Integrated Drilling Equipment Patent Portfolio Report & Sealed-Bid Auction

In 2015 Houston-based Integrated Drilling Equipment exited the Drilling Rig Building business. This will be a Sealed-Bid Auction of the firm's remaining Patent Portfolio, and will represent an excellent opportunity to purchase the patents as the Seller is committed to making the sale.

The "Bid Submission Deadline" will be noon, July 28, 2017 PDT. Bidders should submit their "Best and Final" bid by that date and should understand there will be no further subsequent rounds of bidding after the deadline has passed. The sale will be "Subject to Seller Confirmation", with the Receiver having final authority to accept the high bid price.

All bidder Due Diligence must be conducted in advance and all bids must be in full conformance with the Auction Terms & Conditions. Further information is available on the Heritage Global website at www.hgpauction.com

Please direct questions to:

Doug Berman, Director
Heritage Global Patents & Trademarks
707-245-4417
dberman@hginc.com

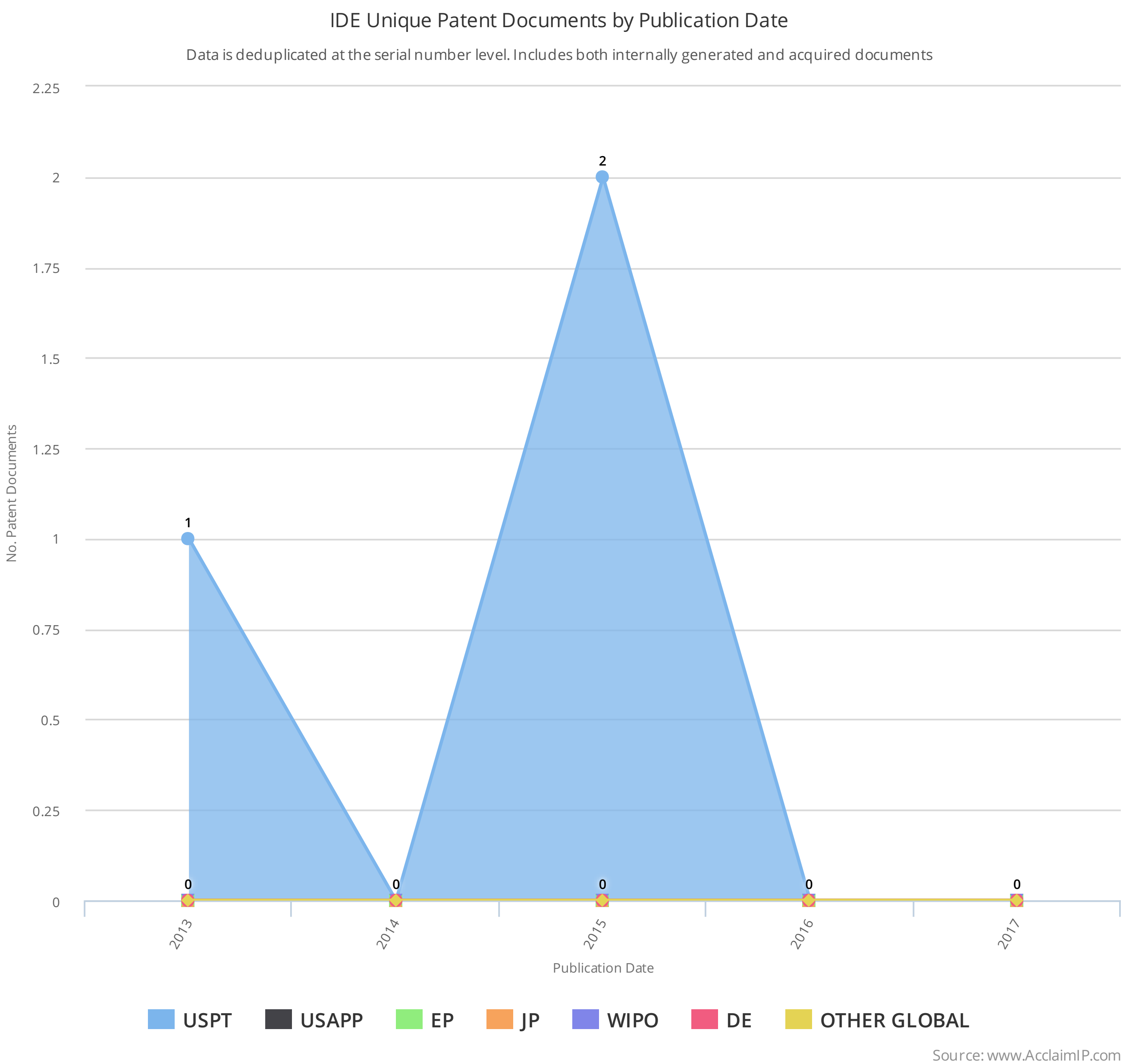
Key Patenting Statistics for IDE		
Total US Grants		3
Utility		3
Design		0
Pending US Applications (Within 5 years)		0
Average Pendency		2.89 Years
Total Non-US Documents		0
Top Inventors	WASTERVAL, PHILIP	3
Top Agents	OSHA LIANG LLP	3

IDE's Global Patenting Activity by Year

Analysis includes data from all 30 jurisdictions in which IDE owns patents

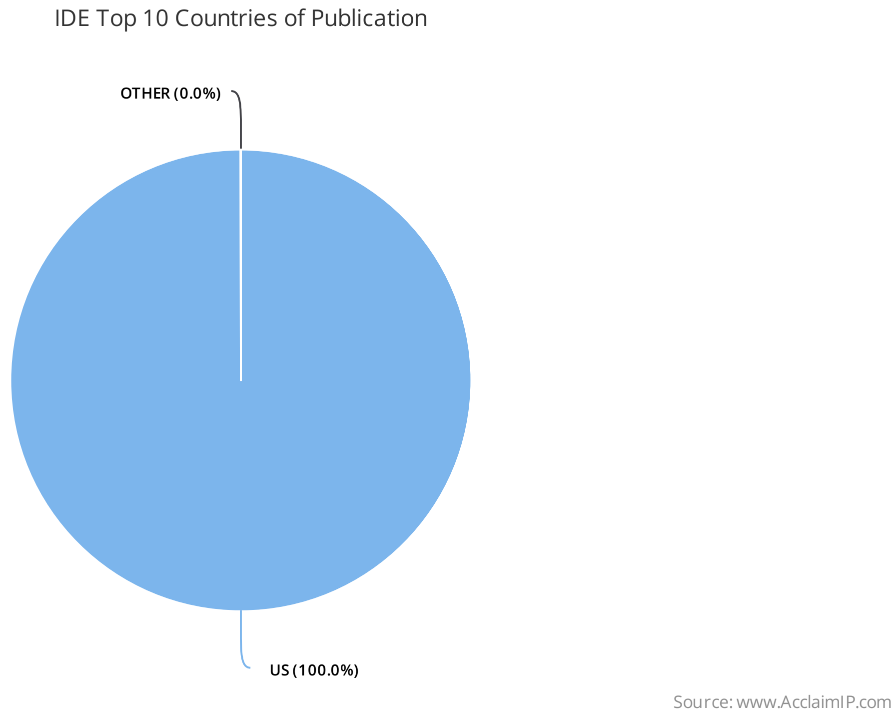
IDE's published patents and applications are displayed by their publication date. The data in the analysis is deduplicated at the serial number level, which means that only one document is counted per invention per country analyzed. The "Other Global" set contains all patenting authorities not specifically broken out in the other data collections. Furthermore, the analysis includes both internally developed patents, and those that may have been acquired from other patentees.

IDE is currently assigned to 3 patent documents published in the last 20 years. They have enjoyed a growth rate of 25.0% over the past 5 years, and peaked in 2015 with 2 global patent documents published.



Breakout of IDE's Global Patents By Authority

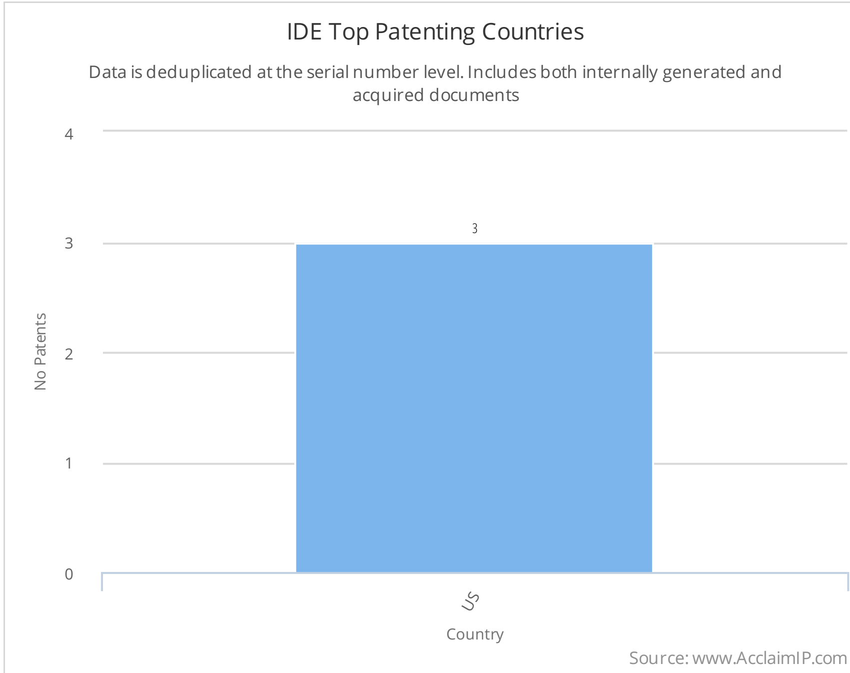
Analysis Includes Deduplicated Global Patent Documents



IDE owns patents and patent applications from 1 different countries and jurisdictions. The top 10 are displayed in the pie chart above.

100.0% of the portfolio is made up of US patents and applications.

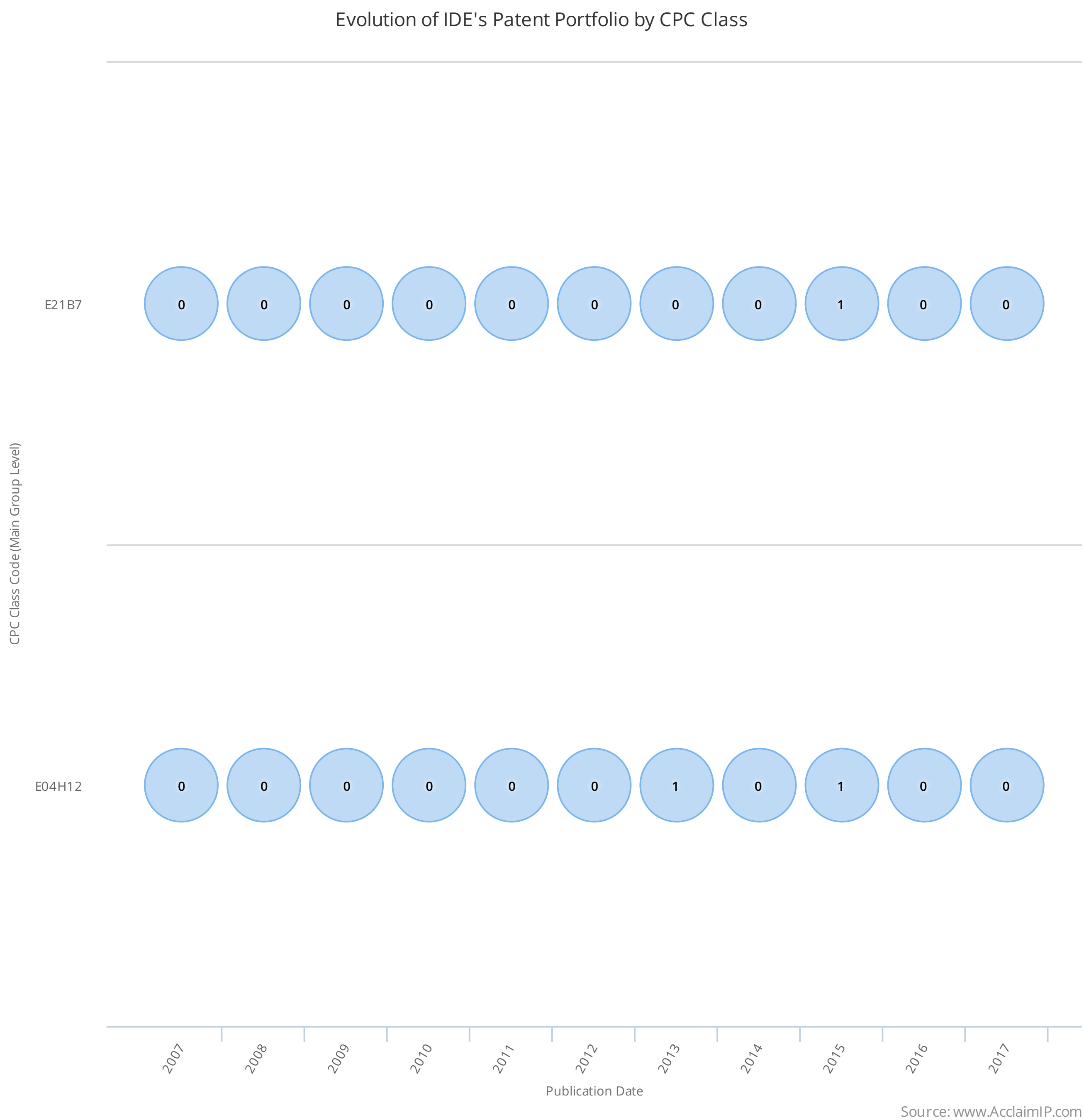
The chart on the right displays the raw counts of the number of global patent documents owned by IDE in the top 10 patenting jurisdictions.



Evolution of Technology Covered by IDE's US Portfolio

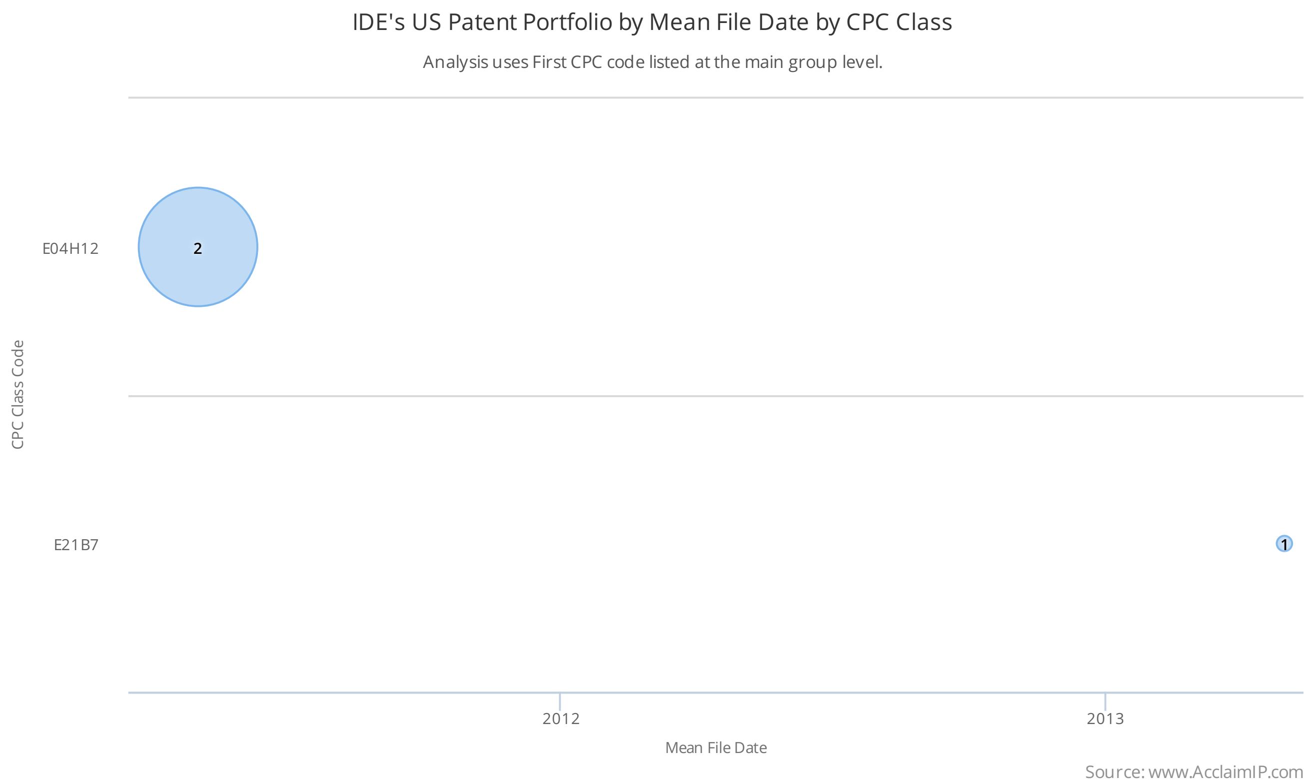
Analysis Includes Deduplicated US Patent Documents

The chart below shows IDE's patent portfolio by class and by publication date, representing a 10-year window. The chart signals where IDE is currently active in patenting, and where they are no longer patenting new technology, but may have a significant number of patents. The top 20 CPC classes are represented here at the Main Group level. A supporting table of class titles is presented at the end of the section.



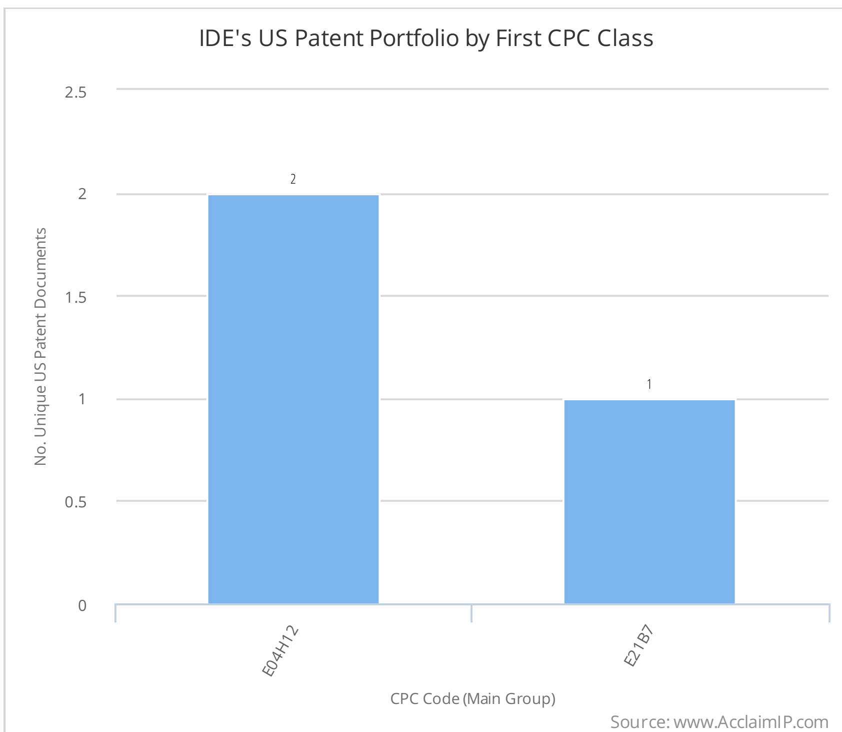
Top 20 Patent Classifications in IDE's US Portfolio

Analysis Includes Deduplicated Patent Families by Mean File Date



50% of IDE's US patent portfolio is represented by their top 20 CPC patent classifications. In this analysis, we first performed a serial deduplication on the patents, then analyzed them using the CPC classification listed first on the patent or application. In this way the portfolio is represented simply and accurately.

The chart to the right shows the same analysis as the bubble chart for easier comparison of relative quantity.



Top 20 Patent Classifications in IDE's US Portfolio

Analysis Includes Deduplicated US Patent Documents

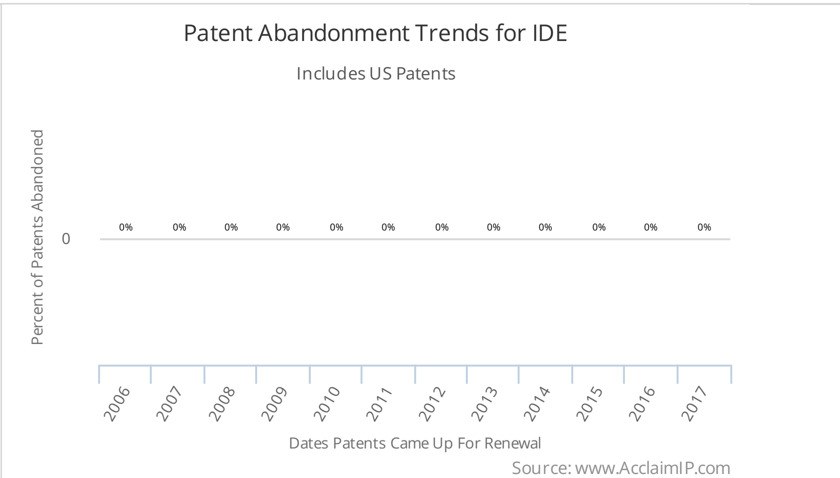
The table below displays the top 20 CPC classifications at the Main Group level, including class title. The No. Patent Docs is reiterated from the previous page.

CPC Class Code	CPC Class Title	No. Patent Docs
E04H12	Towers; Masts or poles; Chimney stacks; Water-towers; Methods of erecting such structures	2
E21B7	Special methods or apparatus for drilling	1

Maintenance Trends for IDE

Patent maintenance trends are an important measure of how a patent portfolio is managed over time, and speaks volumes about a company's patent strategy. Some companies abandon as much as 50 percent of their portfolio at each renewal tranche, while others pay maintenance fees on the entire portfolio regardless of the current benefit the portfolio conveys to the patent owner. A well-managed healthy portfolio will typically show abandonment rates of 10 to 20 percent at each renewal tranche.

Annual Maintenance Behavior

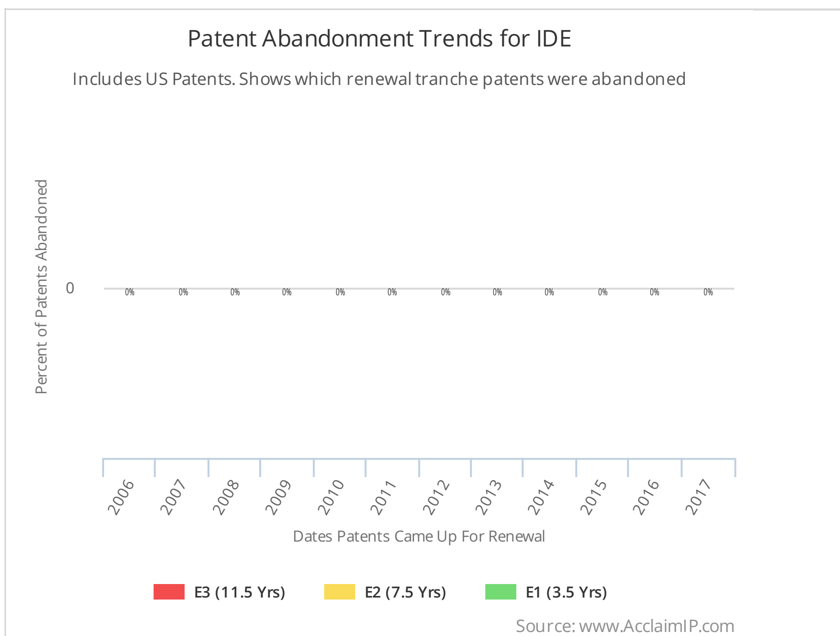


The chart to the left shows year-over-year maintenance activity. It accounts for previously abandoned patents, and shows the percentage of the patents that came up for renewal in any renewal tranche, and were subsequently abandoned.

Split by Renewal Tranche

In the US, patents must be maintained three times during their lifecycle. Maintenance payments are due at years 3.5, 7.5, and 11.5 after the patent's grant date. If no payments are received, patents expire after the six month grace period at years 4, 8 and 12 respectively.

By way of comparison, approximately 20% of all renewable US patents are abandoned each year.

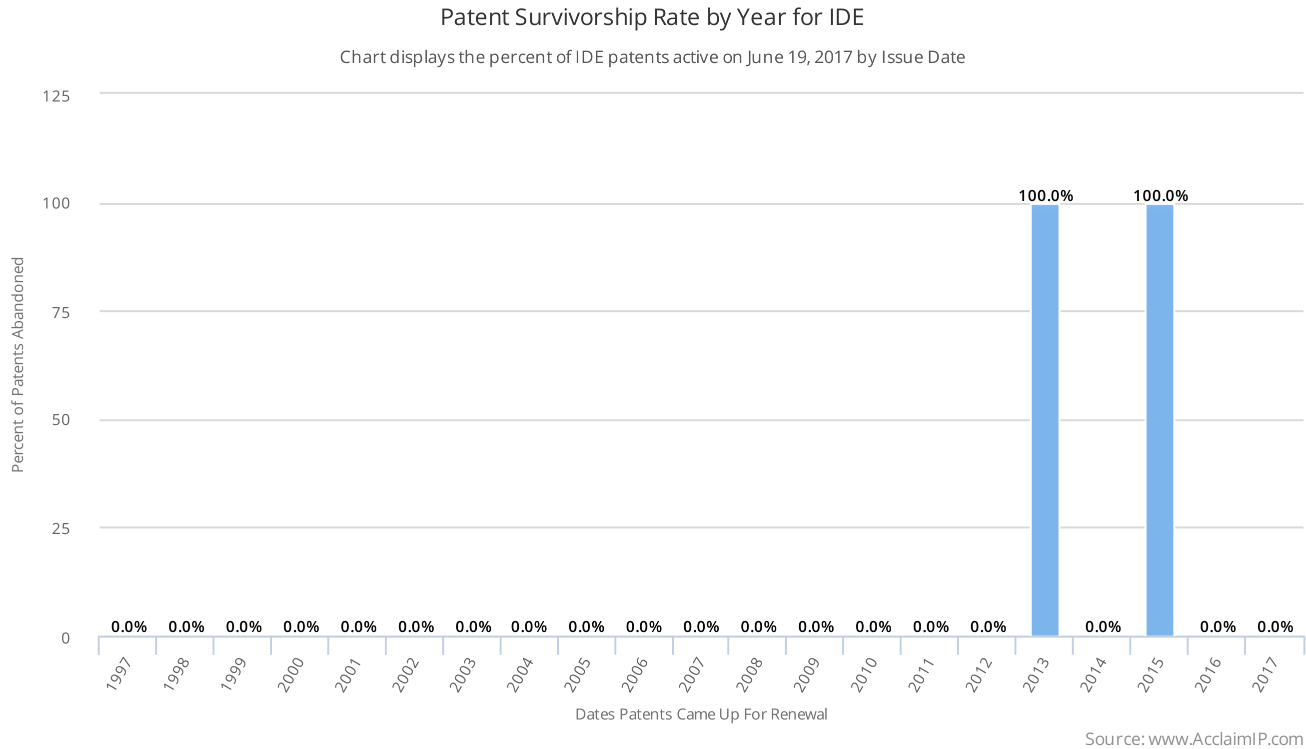


Powered by ANAQUA

Survivorship Trends for IDE

A patent survivorship rate analysis uses the same data from the maintenance analysis to show the number of patents that were issued on a date that still survive today.

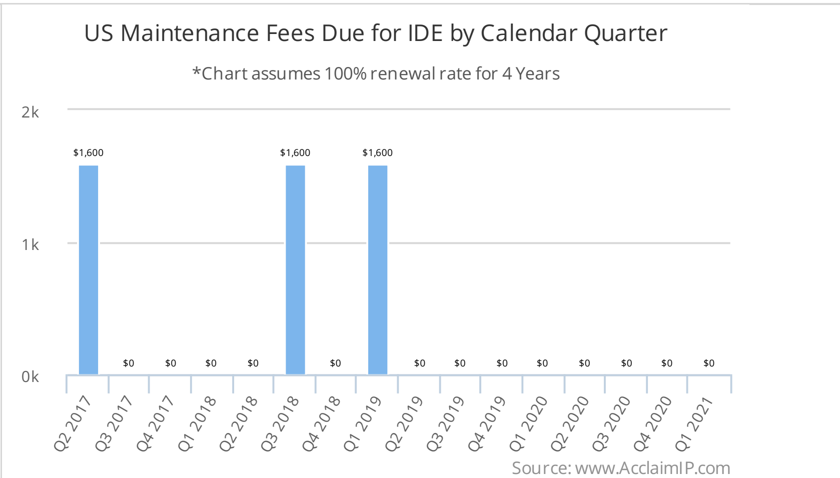
Many portfolios show a typical stair-step look, where survivorship drops at 4-year intervals at years 4, 8 and 12 when maintenance payments can no longer be made, and the patent expires for failure to pay maintenance fees.



Maintenance Fees Due in Future Quarters

The charts below aid in planning portfolio maintenance. They show the total dollars due for the subsequent 4 years, by quarter, if one were to fully maintain a portfolio. In the US, maintenance fees rise at each renewal tranche from $1800 to $3600 to $7400 for large entities. The estimates account for these differences, as well as the lower fees allowed for small and micro entities.

Total Future Fees



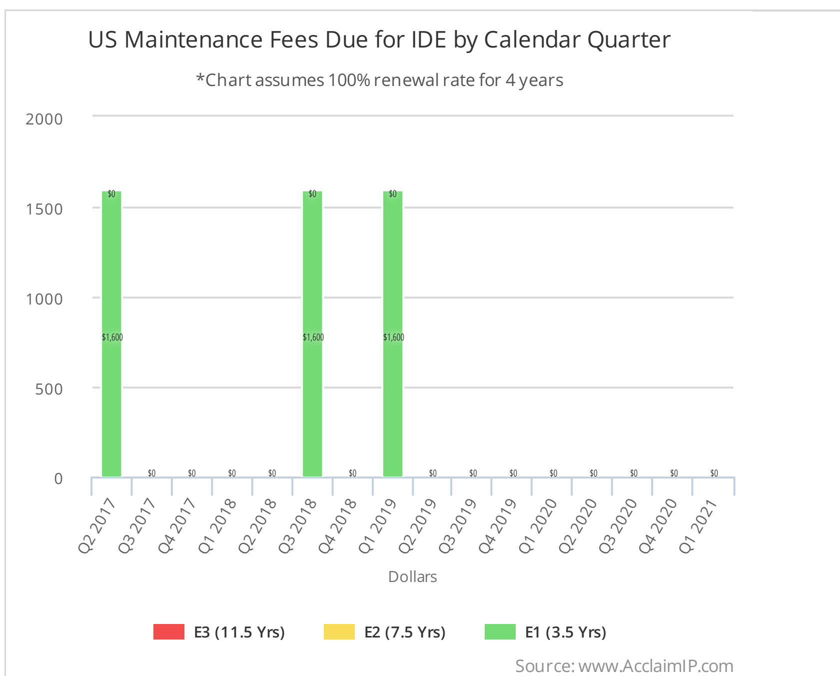
Over the next four quarters, IDE will pay a total of USD0 to maintain their US portfolio which highlights the need for a sound portfolio management and maintenance strategy.

In this view, in contrast to the view below, is easier to read the total fees due to fully maintain the US portfolio.

Fees Due by Renewal Tranche

Maintenance fees effectively double at each maintenance tranche.

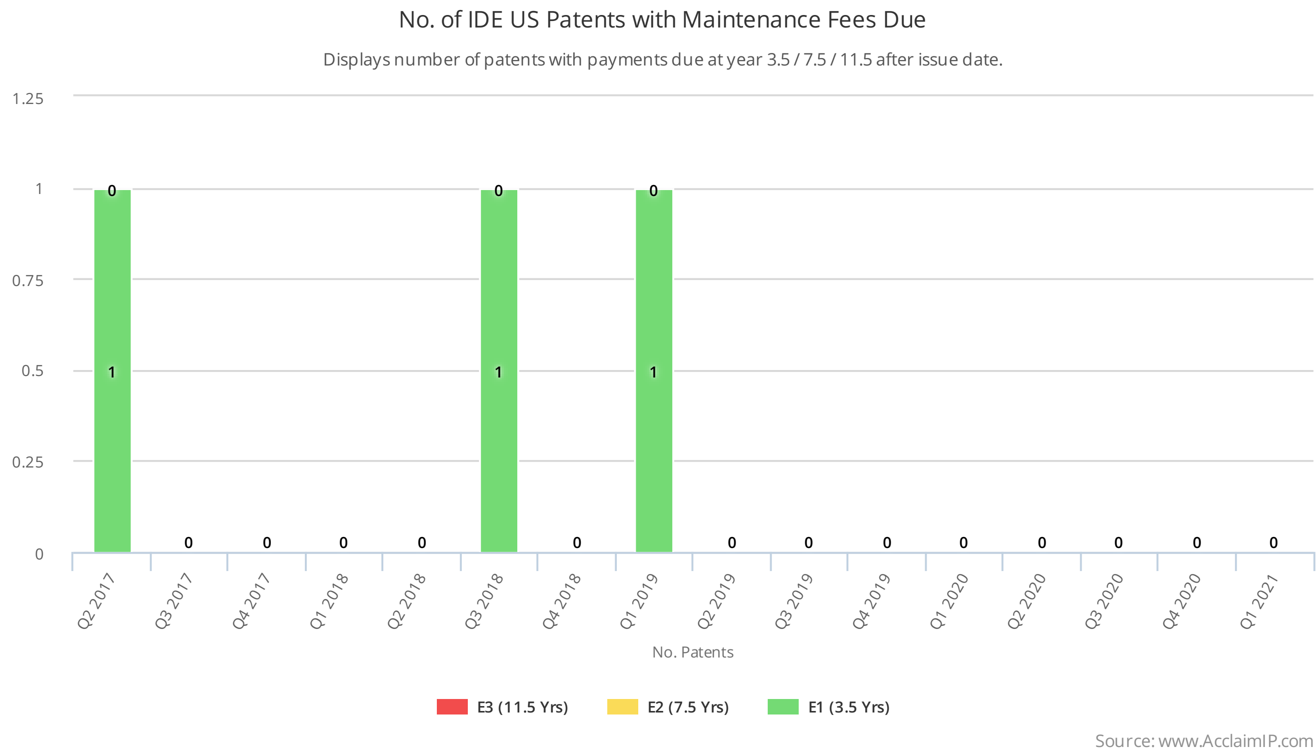
The same chart above is split into renewal tranches. Special attention should be paid to patents in the E2 and E3 renewal tranches. They have had enough time to prove their worth to the company and impact on the market, and their fees are relatively high.



Maintence Fees Due by Number of Patents

It is valuable to know precisely how many patents require maintenance decisions in each of the subsequent future quarters. Special attention should be paid to the patents in their E3 renewal period shown in red. These patents cost USD7,400 to maintain to the end of their term. Due to terminal disclaimers, some patents may have only a few months or years left in their full term. Other E3 patents may not have proved valuable, and will likely not do so in their remaining term.

Unlike the expiration charts which use the 4, 8 and 12 year expiration dates, the chart below shows you when the payments are due which is year 3.5, 7.5 and 11.5 respectively. Using maintenance due date helps you avoid unnecessary late fee penalties for renewing a patent in the six month grace period.



Fees Due by Renewal Tranche

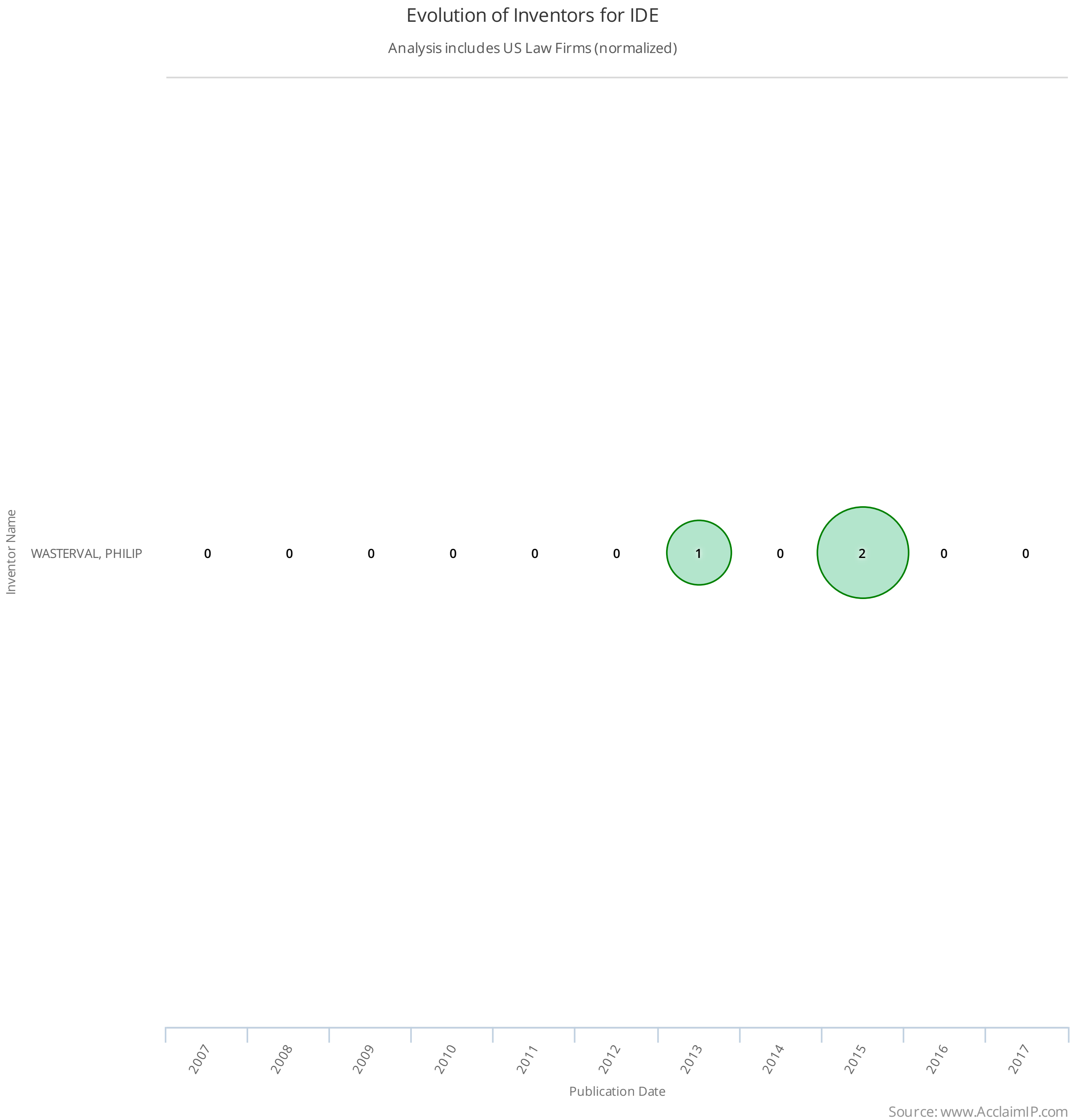
In the next three years patent maintenance fees are due to the USPTO totaling USD4,800. The table below presents the fees due in each calendar year for the next three years. The current year (2017) shows what is currently remaining assuming 100% maintenance of the portfolio and removes patents that have either had their maintenance paid or have already been abandoned.

Tranche	2017	2018	2019
E1 (3.5 Years)	USD1,600	USD1,600	USD1,600
E2 (7.5 Years)	USD0	USD0	USD0
E3 (11.5 Years)	USD0	USD0	USD0
Total	**USD1,600**	**USD1,600**	**USD1,600**

Evolution of Key Inventors in IDE's US Portfolio

Analysis Includes Deduplicated US Patent Documents

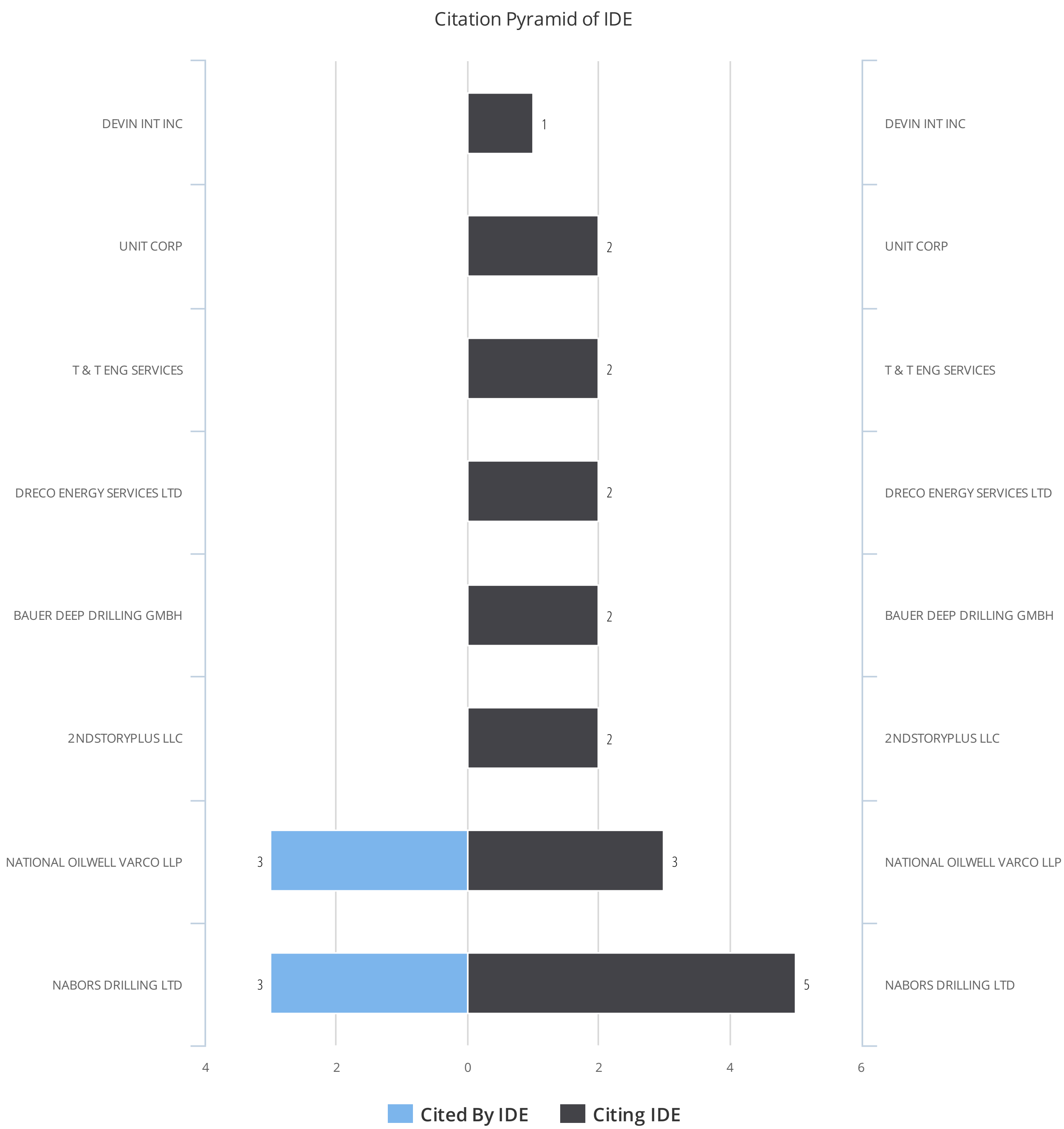
The chart below shows IDE's patent portfolio by inventor and by publication date, representing a 10-year window. The chart identifies the top 20 most prolific inventors of their organic portfolio(i.e. acquired patents are excluded from the analysis). The chart is most useful to identify key innovators and their level of current patenting activity at IDE.



Citation Pyramid Analysis of IDE's US Portfolio

Relative Strength by Citing and Cited Patents

The citation pyramid shows the number of patents that cite IDE's portfolio and the number of patents that are cited by IDE to a particular patent owner. The top 20 citing assignees are analyzed, then the number of cited (by IDE) patent documents is mapped for each assignee.



Source: www.AcclaimIP.com

IDE's Interesting Patents

The following is a short list of interesting patents owned by IDE. The patents described below are standouts when ranked by various statistical value indicators. A complete ranked list by any of these measures - and up to 30 more - may be provided on request.

11 Forward Citations

Patent US8555564 (*Drilling rig assembly method and apparatus*) has earned 11 forward citations since it was filed on 2009-06-26 making it IDE's most cited patent. Top citers include DRECO ENERGY SERVICES LTD (2) , NABORS DRILLING LTD (2) , and DEVIN INT INC (1).

4.31 Years Pendency

Patent US8555564 (*Drilling rig assembly method and apparatus*) has the longest pendency of any of IDE's US patent holdings. Patents with exceptionally long pendencies tend to be top patents.

14 Claims

Patent US9133643 (*Drilling rig assembly method and apparatus*) boasts 14 claims, putting it in first place among all IDE patents. Patents with a higher number of claims require a larger investment in prosecution and tend to be better patents.

4 Family Members

Patent US9133643 (*Drilling rig assembly method and apparatus*) contains 4 members in its simple patent family making it the priority US document in IDE's largest patent family. Patents from large families containing divisionals, continuations and a large ecosystem of non-US counterparts represent a large investment in patenting and are often high value patents.

147 Words in Claim 1

Patent US8959874's 147-word claim...

A method to assemble a portable drilling rig, the method comprising: providing a pedestal structure on a rig floor; the pedestal structure comprising a lower pivot point, a lower attachment point, and an upper pivot point; aligning a mast structure and the pedestal structure; pinning a mast pivot point located at a lower end of the mast structure to the upper pivot point of the pedestal structure; pivoting the pedestal structure from a substantially horizontal position to a vertical position; moving the mast structure in a horizontal direction toward a center of the rig floor; securing the lower attachment point of the pedestal structure to a corresponding attachment point on the rig floor; erecting the mast structure from a substantially horizontal position to a vertical position about a pivot point between the mast structure and the pedestal structure; and securing the mast structure in a vertical position.

... is the shortest among all IDE's US utility patents granted. Short claims tend to be very broad.

90 Strength Score

Patent US8959874 (*Portable drilling rig apparatus and assembly method*) has earned the highest statistical strength ranking of all IDE patents. A patent's statistical strength is calculated using an assortment of weighted value metrics and has been shown to have a positive correlation with a patent's true value.

US008555564B2

(12) United States Patent
Wasterval

(10) **Patent No.: US 8,555,564 B2**
(45) **Date of Patent: Oct. 15, 2013**

(54) **DRILLING RIG ASSEMBLY METHOD AND APPARATUS**

(75) Inventor: **Philip Wasterval**, Edwards, CO (US)

(73) Assignee: **Integrated Drilling Equipment Company LLC**, Spring, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 931 days.

(21) Appl. No.: **12/492,980**

(22) Filed: **Jun. 26, 2009**

(65) **Prior Publication Data**

US 2010/0326734 A1 Dec. 30, 2010

(51) **Int. Cl.**

E04H 12/34 (2006.01)
B66C 23/34 (2006.01)
E04B 1/00 (2006.01)
E04G 21/00 (2006.01)

(52) **U.S. Cl.**

USPC **52/123.1**; 52/111; 52/169.13; 52/745.03

(58) **Field of Classification Search**

USPC 52/111, 112, 114, 115, 123.1, 169.13, 52/745.03, 745.17, 745.18; 405/196, 202, 405/221, 220

See application file for complete search history.

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* cited by examiner

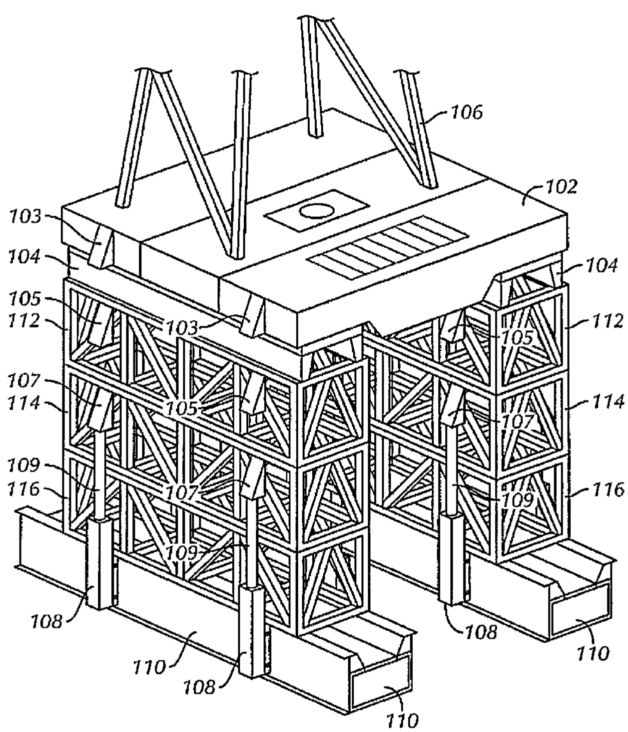
Primary Examiner — Ryan Kwiecinski

(74) *Attorney, Agent, or Firm* — Osha Liang LLP

(57) **ABSTRACT**

A method to assemble a drilling rig includes providing a base structure of the drilling rig, stacking a rig floor including a derrick on the base structure, actuating lifting cylinders to lift the rig floor above the base structure, inserting at least one first upper box between the base structure and the rig floor, and retracting the lifting cylinders to set the rig floor atop the at least one first upper box.

3 Claims, 7 Drawing Sheets



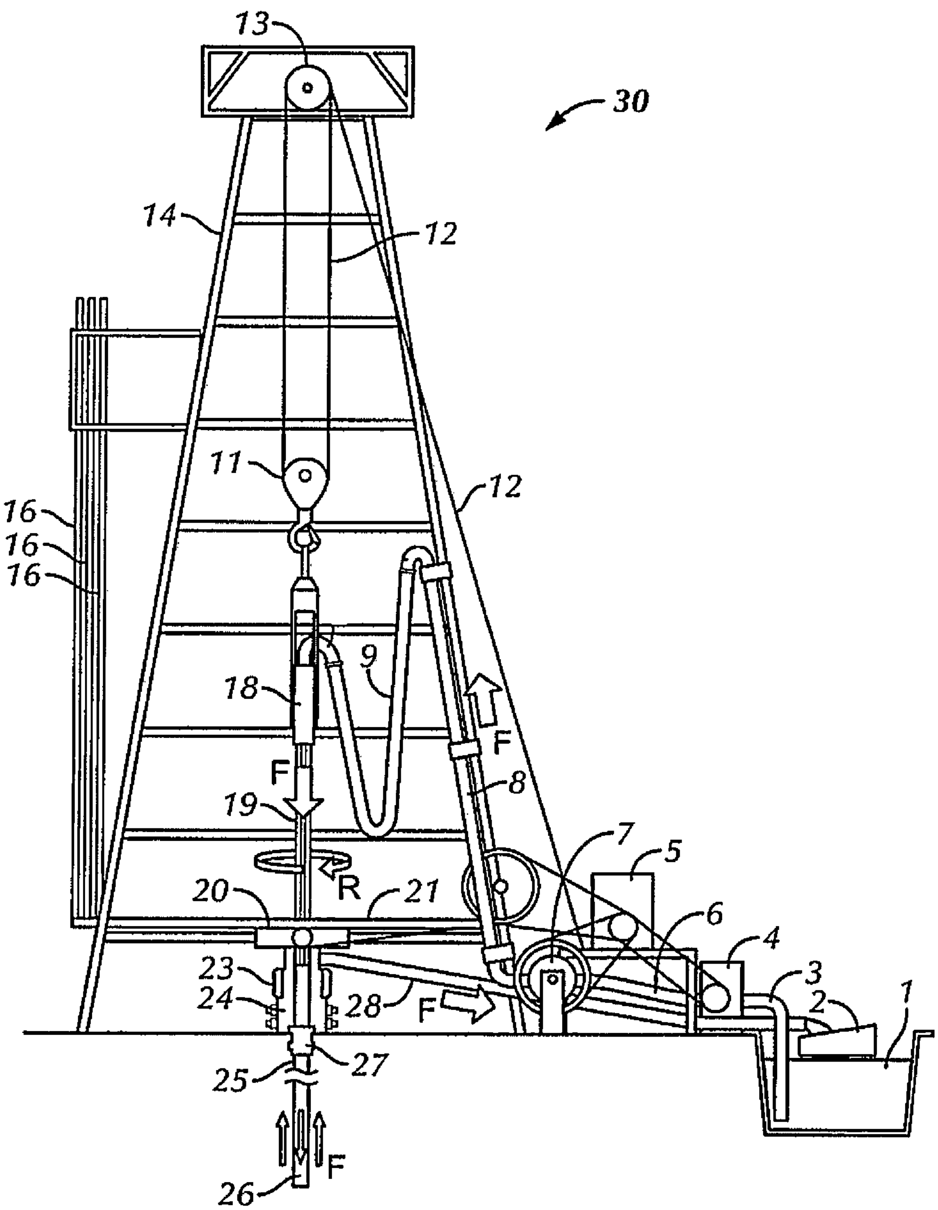


FIG. 1
(Prior Art)

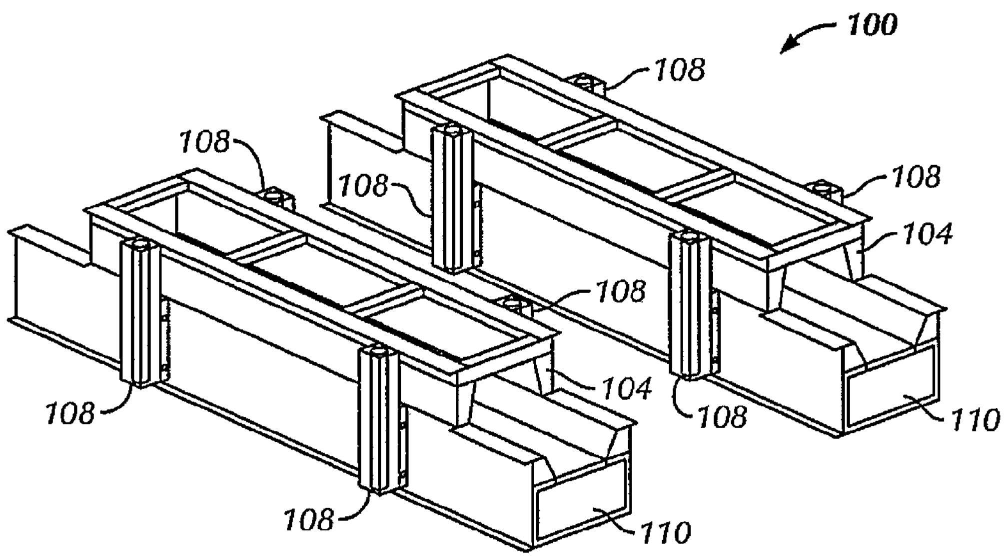

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FIG. 2

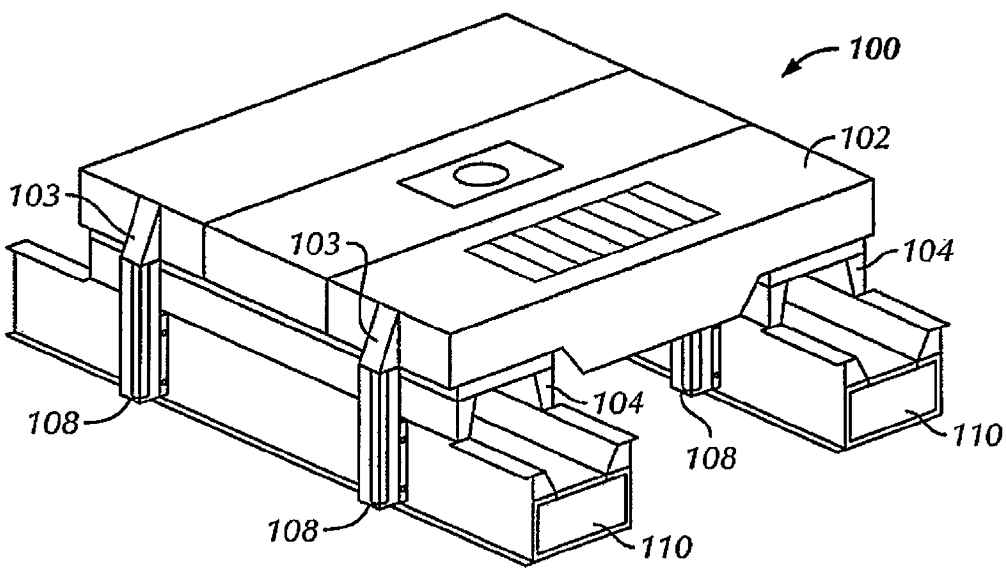
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FIG. 3A

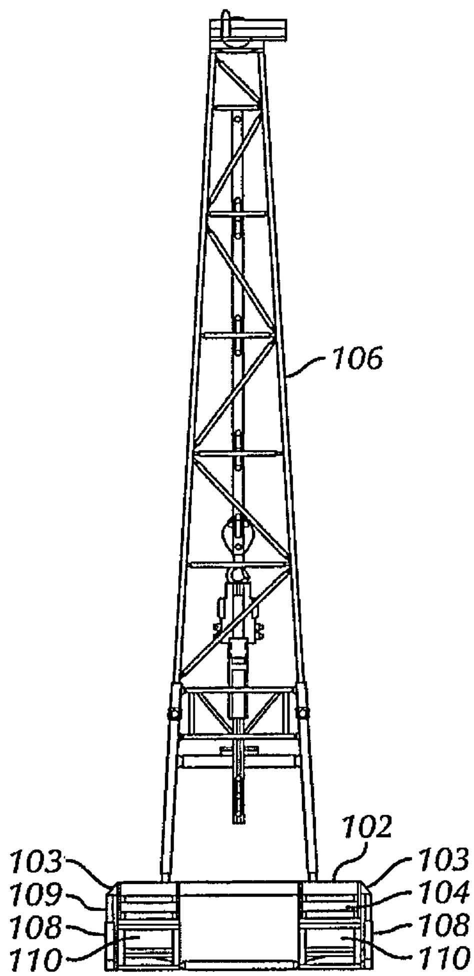

FIG. 3B

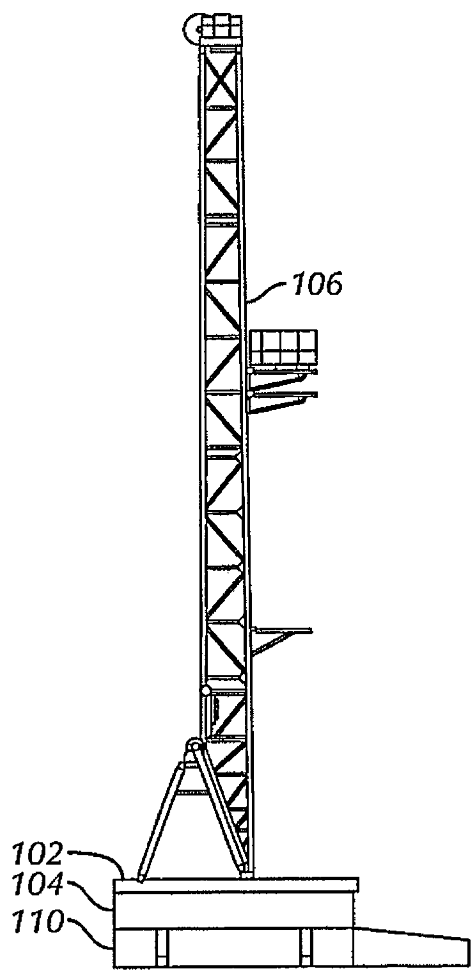

FIG. 3C

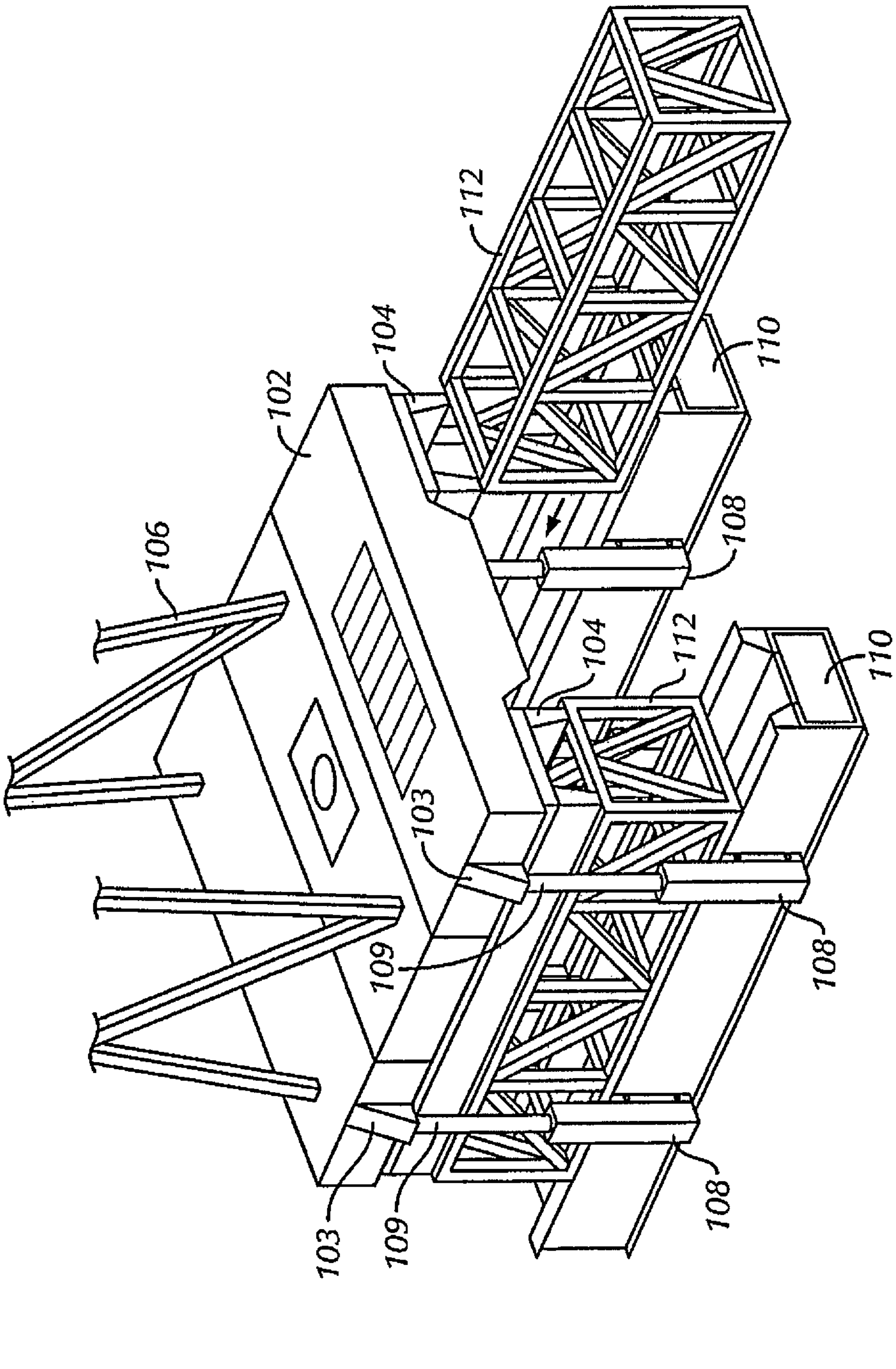

FIG. 4A

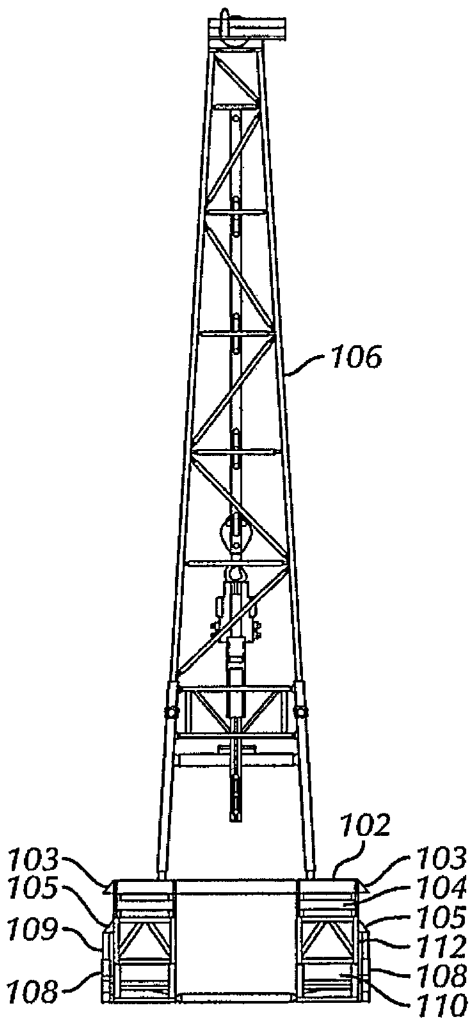
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FIG. 4B

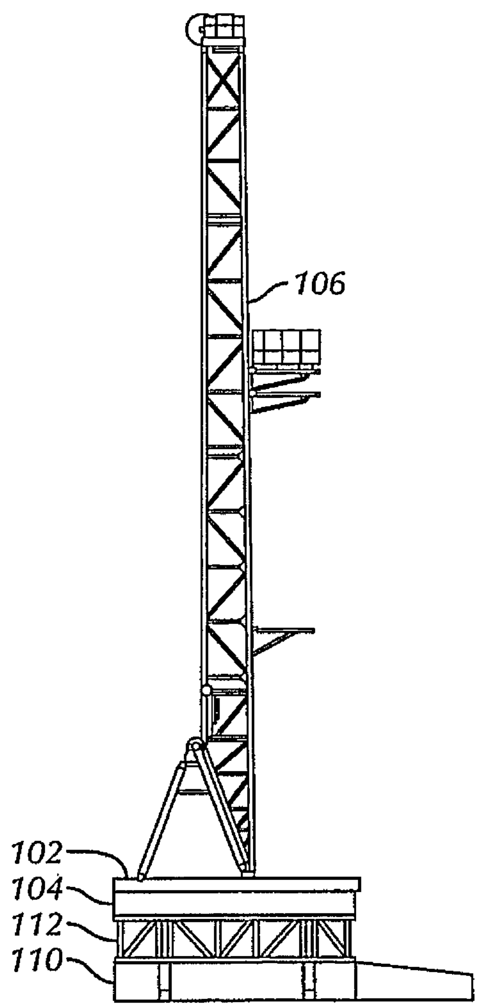
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FIG. 4C

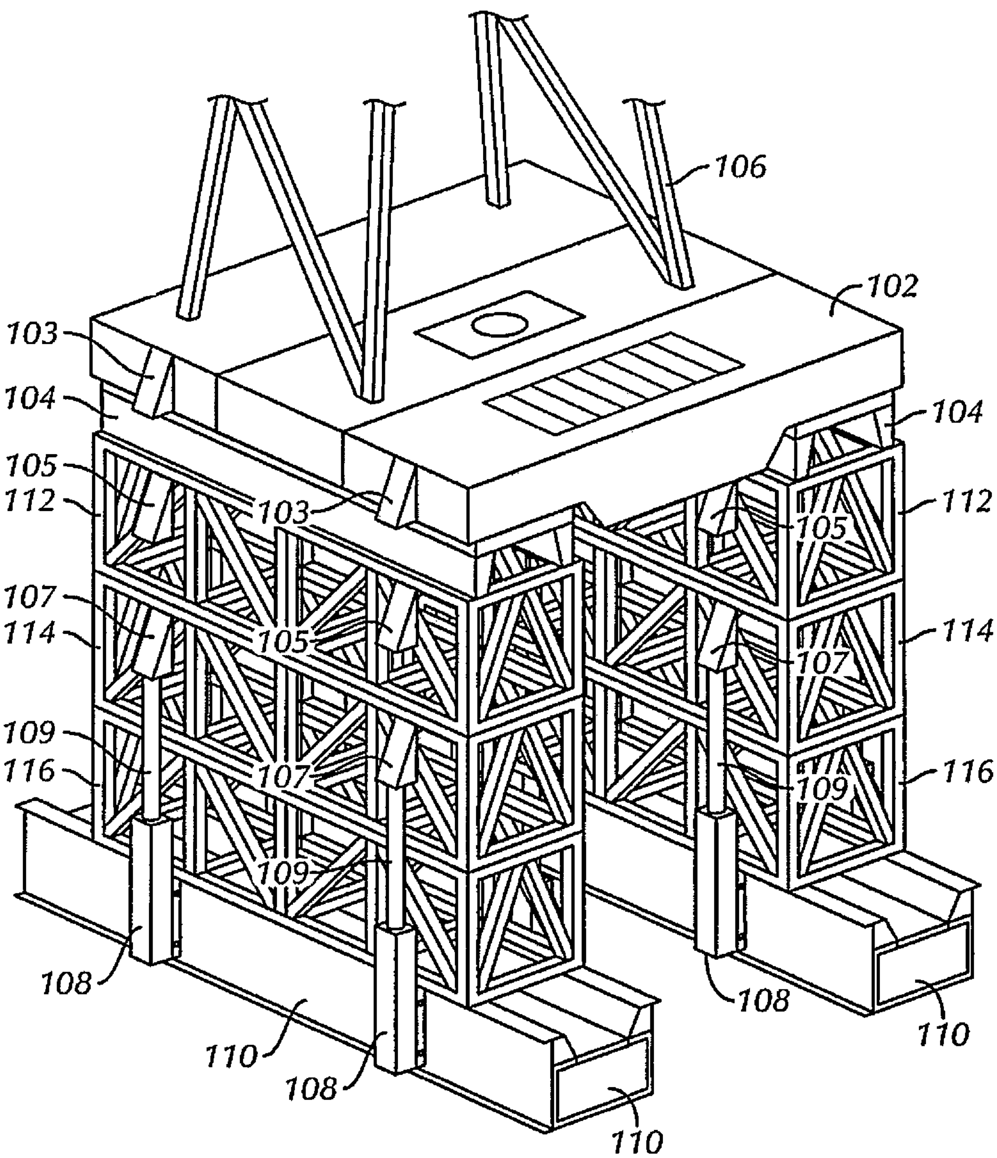
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FIG. 5A

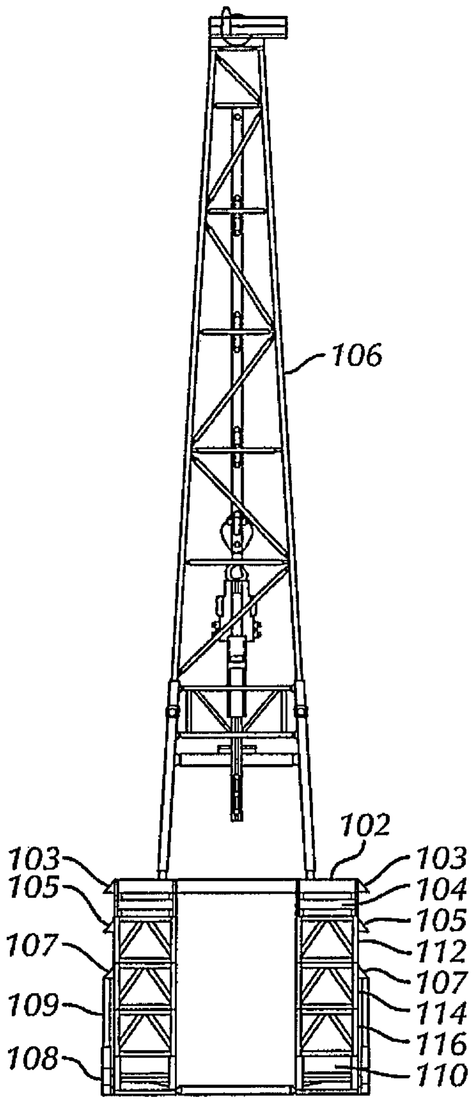
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FIG. 5B

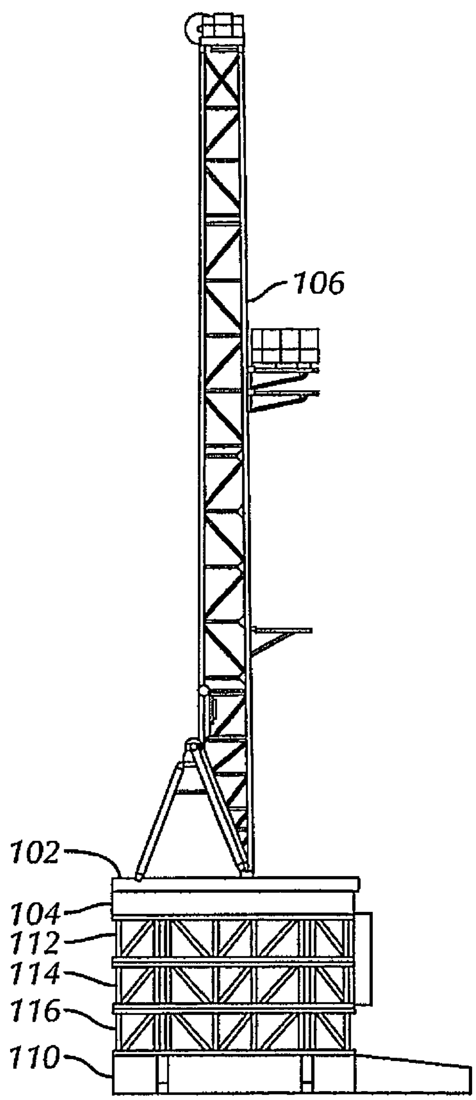
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FIG. 5C

DRILLING RIG ASSEMBLY METHOD AND APPARATUS

BACKGROUND

1. Field of the Disclosure

Embodiments disclosed herein relate generally to drilling rigs. In particular, embodiments disclosed herein relate to drilling rig assembly methods and apparatus.

2. Background Art

A drilling rig is used to drill a wellbore in a formation. Drilling rigs may be large structures that house equipment used to drill water wells, oil wells, or natural gas extraction wells. Drilling rigs sample sub-surface mineral deposits, test rock, soil and groundwater physical properties, and may also be used to install sub-surface fabrications, such as underground utilities, instrumentation, tunnels or wells. Drilling rigs may be mobile equipment mounted on trucks, tracks, or trailers, or more permanent land or marine-based structures (such as oil platforms). The term "rig," therefore, generally refers to a complex of equipment that is used to penetrate the surface of the earth's crust.

Referring to FIG. **1**, a conventional drilling rig **30** is shown. Drilling rig **30** includes a derrick **14**, which provides a support structure for a majority of the equipment used to raise and lower a drillstring **25** into and out of a wellbore. The drillstring **25** may be an assembled collection of drillpipe, drill collars, or any other assortment of tools, connected together and run into the wellbore to facilitate the drilling of a well (drillpipe **16** is shown in joints prior to being connected together). The drillstring **25** may be raised and lower into and out of the wellbore by the draw-works **7**, which includes a spool powered by a motor or other power source **5**. A drill line **12**, which may be a thick, stranded metal cable, is run from the draw-works **7** over a crown block **13** and down through a travelling block **11**. Typically, the crown block **13** remains stationary while the travelling block **11** moves vertically with the drillstring **25**. The combination of the crown block **13** and the travelling block **11** provides a significant mechanical advantage for lifting the drillstring **25**. Further, a swivel **18** may be attached to the travelling block **11** to allow rotation of the drillstring **25** without twisting the travelling block **11**.

The drilling rig **30** further includes a rotary table **20** mounted in a rig floor **21**, which is used to rotate the drillstring **25** along with a kelly drive **19**. Kelly drive **19**, attached at an upper end to the swivel **18** and at a lower end to the drillstring **25**, is inserted through the rotary table **20** to rotate the drillstring **25** (drillstring rotation shown by arrow "R"). Kelly drive **19** may be square, hexagonal, or any other polygonal-shaped tubing and is able to move freely vertically while the rotary table **20** rotates it. Alternatively, drilling rig **30** may include a top drive (not shown) in place of kelly drive **19** and rotary table **20**. Additionally, blowout preventers ("BOPs") may be located below the rig floor **21** and installed atop a wellhead **27** to prevent fluids and gases from escaping from the wellbore. An annular BOP **23** and one or more ram BOPs **24** are shown and are commonly understood in the art.

During drilling operations, drilling fluid may be circulated through the system to carry cuttings away from the bottom of the wellbore as drilling progresses. Drilling fluid may be stored in mud tanks **1** before being drawn through suction line **3** by mud pumps **4**. Drilling fluid (drilling fluid route is indicated by arrows "F") is then pumped from mud pumps **4** through a hose **6**, up a stand pipe **8**, through a flexible hose **9**, and down into the wellbore. Drilling fluid returning from the wellbore is routed through a flow line **28** to shakers **2**, which are used to separate drill cuttings from the drilling fluid before it is pumped back down the wellbore.

When designing a drilling rig, numerous factors may be taken into account. For instance, referring still to FIG. **1**, the crown block **13** must be located high enough to pull the drillstring **25** from the wellbore for assembly or disassembly. This may require that the derrick structure **14** be built having a substantial height to have the crown block **13** high enough above the wellbore. Additionally, the rig floor **21** must be high enough off the ground to allow the blowout prevention equipment, namely BOPs **23**, **24**, to fit beneath the rig floor **21** when mounted on the wellhead **27**. Due to these design factors, among others, the size of drilling rigs is often very large. Due to the large size, assembly of the drilling rigs may often be difficult.

Different methods have been employed to assemble drilling rigs and attempt to overcome the difficulty associated with assembling very large structures having on them a substantial amount of drilling equipment. One method used is known as "box on box," which basically uses a crane to stack large box structures on top of one another up to a certain height. The crane is then used to lift the rig floor onto the stacked boxes. After the rig floor is installed, the remaining equipment, including the derrick and blocks, must be assembled. One drawback to this assembly method is that a substantial crane is required to lift the equipment during assembly, which due to often rough terrain in remote drilling locations becomes extremely costly or even unfeasible in certain conditions. Also, assembly of a majority of the drilling equipment occurs after the rig floor is installed, and thus, must take place at the rig floor height, which may be 25-40 feet (8-12 m) off the ground.

Other methods used to assemble drilling rigs are known as "swing up," "slingshot," or some other form of parallelogram method. Using any of these methods, the drilling rig is, in a sense, collapsed because the rig floor sits on a base near the ground with the legs laid out horizontal. A hydraulic or wireline system then pulls the structure up (the rig floor is lifted off the ground and the legs are raised to a vertical position). However, these assembly methods typically incur unusually high loads, which may increase chances of mechanical failure. Additionally, active participation of rig personnel is required during assembly. Accordingly, there exists a need for a method and apparatus for a drilling rig capable of being assembled with minimal extra equipment (e.g., cranes) and minimal rig personnel participation during assembly.

SUMMARY OF THE DISCLOSURE

In one aspect, embodiments disclosed herein relate to a method to assemble a drilling rig, the method including providing a base structure of the drilling rig, stacking a rig floor including a derrick on the base structure, actuating lifting cylinders to lift the rig floor above the base structure, inserting at least one first upper box between the base structure and the rig floor, and retracting the lifting cylinders to set the rig floor atop the at least one first upper box.

In other aspects, embodiments disclosed herein relate to a drilling rig including a base structure, lifting cylinders, and a rig floor including a derrick and drilling equipment disposed thereon, wherein the lifting cylinders are configured to extend and retract to lift the rig floor and insert at least one upper box.

Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-sectional schematic view of a conventional drilling rig.

FIG. **2** is a perspective view of a base structure of a drilling rig in accordance with embodiments of the present disclosure.

FIG. **3**A is a perspective view of a rig floor installed onto the base structure of FIG. **2** in accordance with embodiments of the present disclosure.

FIG. **3**B is a front view of an entire drilling rig installed onto the base structure as in FIG. **3**A in accordance with embodiments of the present disclosure.

FIG. **3**C is a side view of the drilling rig shown in FIG. **3**B in accordance with embodiments of the present disclosure.

FIG. **4**A is a perspective view of a first upper box inserted between the rig floor and base structure in accordance with embodiments of the present disclosure.

FIG. **4**B is a front view of an entire drilling rig with a first upper box inserted between the drilling rig and the base structure in accordance with embodiments of the present disclosure.

FIG. **4**C is a side view of the drilling rig shown in FIG. **4**B in accordance with embodiments of the present disclosure.

FIG. **5**A is a perspective view of multiple upper boxes inserted between the rig floor and base structure in accordance with embodiments of the present disclosure.

FIG. **5**B is a front view of an entire drilling rig with multiple upper boxes inserted between the drilling rig and the base structure in accordance with embodiments of the present disclosure.

FIG. **5**C is a side view of the drilling rig shown in FIG. **5**B in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

In one aspect, embodiments disclosed herein relate to drilling rig assembly methods and apparatus that use multiple box structures stacked on top of one another to elevate the drilling rig to a certain height. Referring initially to FIG. **5**A, a perspective view of a bottom portion of a fully assembled drilling rig **100** is shown in accordance with embodiments of the present disclosure. Drilling rig **100** includes a base structure **110**, multiple upper boxes **112**, **114**, and **116** stacked thereon, and a rig floor **102** located atop upper boxes **112**, **114**, **116**. Drilling rig **100** also includes lifting cylinders **108** attached to base structure **110**. Drilling rig **100** is assembled according to the following sequence.

Referring to FIG. **2**, a perspective view of a base structure **110** of a drilling rig **100** is shown in accordance with embodiments of the present disclosure. Base structure **110** may be configured as a land based structure or as an offshore platform. Base structure **110** includes at least two bottom box structures that are positioned at ground level to form a base structure from which to assemble drilling rig **100**. The bottom box structures may be configured as parallelogram truss structures or solid beams. Initially, strongback beams **104**, which are beams or girders that act as secondary support members, may rest on top of the bottom box structures of base structure **110**. The combination of the stacked bottom box structures of base structure **110** and strongback beams **104** may be about 8-10 feet in height. Additionally, base structure **110** may include lifting cylinders, or hydraulic cylinders **108**, attached thereto. Hydraulic cylinders **108** may be welded or fastened using mechanical fasteners to base structure **110**. Those skilled in the art will understand that other types of lifting cylinders may also be used, including but not limited to, pneumatic cylinders, electric cylinders, and mechanical screws.

Now referring to FIG. **3**A, a perspective view of a rig floor **102** including one or more pieces installed onto the base structure **110** of the drilling rig **100** is shown in accordance with embodiments of the present disclosure. Rig floor **102** is shown installed onto base structure **110** and strongback beams **104**. Strongback beams **104** may be attached to rig floor **102**, e.g., welded or fastened with mechanical fasteners. Rig floor **102** may be positioned on base structure **110** squarely so that load points **103** of the rig floor **102** are aligned with cylinders **108** of base structure **110**. As shown in FIGS. **3**B and **3**C, the rig floor **102** may include a derrick **106** (shown in FIGS. **3**A and **3**B) and all required drilling equipment installed thereon prior to being assembled onto base structure **110** (derrick and drilling equipment installed at ground level rather than at a final rig floor height). Thus, the rig floor **102** may be considered a completed rig floor with all required drilling equipment installed thereon prior to stacking the rig floor on the base structure and no further assembly may be required after the rig floor is elevated to a final height.

As shown in FIGS. **4**A-**4**C, after the rig floor **102** is installed onto the base structure **110**, the cylinders **108** may be actuated and arms **109** of the cylinders **108** extended to contact load points **103** of rig floor **102** and elevate the rig floor **102**. After the arms **107** of cylinders **108** are fully extended, a gap may exist between the base structure **110** and the rig floor **102**. Full extension of arms **107** may be about 8 feet (about 2.5 m), thus, the gap between the base structure **110** and rig floor **102** is about 8 feet (about 2.5 m). A first upper box **112** may then be inserted into the gap created between the base structure **110** and rig floor **102**. First upper boxes **112** may also be approximately 8 feet (about 2.5 m) in height, and thus, when arms **109** of cylinders **108** are retracted, rig floor **102** immediately rests on top of first upper boxes **112**.

Referring now to FIGS. **5**A-**5**C, a drilling rig **100** having multiple upper boxes **112**, **114**, and **116** is shown in accordance with embodiments of the present disclosure. Additional upper boxes may be added in the same manner as the first upper box (previously described) to elevate the rig floor **102** to a desired height. To insert additional upper boxes, arms **109** (shown in FIG. **4**A) of the cylinders **108** may be extended to contact load points **105** of first upper box **112**. Arms **109** may be completely extended, which as before, leaves a gap between the first upper box **112** and base structure **110** into which a second upper box **114** may be inserted. Subsequently, arms **109** of cylinders **108** may be retracted. Load points **105** and **107** may be hinged or slid so that they may collapse into the upper box on which they are mounted (upper box **112** and **114**, respectively) and no longer protrude outside the upper box. The load points may collapse or otherwise moved out of position so that they do not interfere with extension of arms **109** of cylinders **108**. In alternative embodiments, an additional upper box may be inserted between an elevated rig floor and the first upper box, which is stacked atop the base structure.

To insert a third upper box, load points **107** of second upper box **114** may be hinged open to align with cylinders **108**. Arms **109** are completely extended, which elevates second upper box **114** and leaves a gap between the second upper box **114** and the base structure **110** into which a third upper box **116** may be inserted. Subsequently, arms **109** of cylinders **108** may be retracted. In alternative embodiments, an additional upper box may be inserted between an elevated rig floor and the second upper box, which is stacked atop the first upper box.

As previously mentioned, the desired height of the drilling rig **100** may be determined by the room needed below the rig floor **102** to install blowout preventer equipment. Also, the crown block at the top of the derrick must be far enough above the ground to be able to pull the drillpipe. Those skilled in the art will understand the height requirements to meet these criteria. In certain embodiments disclosed herein, a drilling rig having a rig floor stacked on three upper boxes and a base structure (bottom boxes) may have its rig floor at a height of about 38-40 feet (8-12 m).

Advantageously, embodiments of the present disclosure provide a method of assembling a drilling rig, which requires substantially less intervention from rig personnel as well as heavy lifting equipment, including larger cranes. The assembly method allows a drilling rig to be assembled in more remote locations where heavy equipment would be unable to travel. Remote drill sites may be more accessible using a drilling rig assembled using methods in accordance with embodiments disclosed herein. Therefore, rig assembly costs may be reduced and productivity costs may be increased.

While the present disclosure has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from the scope of the disclosure as described herein. Accordingly, the scope of the disclosure should be limited only by the attached claims.

What is claimed is:

1. A method of incrementally raising a rig floor, the method comprising:

contacting one or more lifting cylinders, the one or more lifting cylinders attached to a base structure, with one or more rig floor load points on the rig floor positioned above the base structure;

extending one or more arms of the one or more lifting cylinders against the one or more rig floor load points and raising the rig floor above the base structure a specified increment;

inserting a first box between the base structure and the rig floor, wherein the rig floor is raised to a specified height;

contacting one or more first box load points on the first box with the one or more lifting cylinders;

extending the one or more arms of the one or more lifting cylinders and raising the rig floor above the base structure by a specified increment; and

inserting one or more additional boxes between the base structure and the rig floor, wherein the rig floor is raised to a specified height.

2. The method of claim **1**, wherein the one or more first box load points on the first box comprise one or more collapsible load points.

3. The method of claim **1**, further comprising installing a derrick structure on the rig floor prior to raising the rig floor.

* * * * *

US008959874B2

(12) **United States Patent**
Wasterval

(10) **Patent No.: US 8,959,874 B2**
(45) **Date of Patent: Feb. 24, 2015**

(54) **PORTABLE DRILLING RIG APPARATUS AND ASSEMBLY METHOD**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/899,293**

(22) Filed: **May 21, 2013**

(65) **Prior Publication Data**

US 2013/0318909 A1 Dec. 5, 2013

Related U.S. Application Data

(62) Division of application No. 12/568,489, filed on Sep. 28, 2009.

(51) **Int. Cl.**
E21B 7/02 (2006.01)

(52) **U.S. Cl.**
CPC ***E21B 7/023*** (2013.01); ***E21B 7/021*** (2013.01)
USPC **52/745.18**; 52/117; 52/118; 52/119; 52/146; 52/651.05

(58) **Field of Classification Search**
USPC 52/116–119, 146, 632, 651.01, 651.05, 52/651.07, 745.19, 745.2, 745.17, 745.18; 173/28, 42, 44, 190, 193; 166/379; 175/162, 203
See application file for complete search history.

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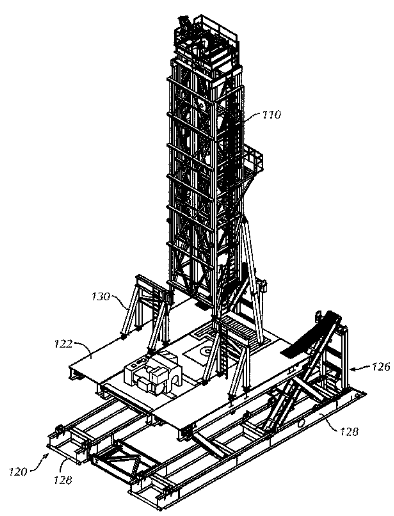
Primary Examiner — Robert Canfield
Assistant Examiner — Charissa Ahmad
(74) *Attorney, Agent, or Firm* — Osha Liang LLP

(57) **ABSTRACT**

A portable drilling rig apparatus includes a rig floor having a pedestal structure thereon, the pedestal structure comprising a lower pivot point and a lower attachment point and wherein the pedestal structure is configured to be rotated to a vertical position about the lower pivot point. The drilling rig further includes a mast structure having a mast pivot point at a lower end of the mast structure wherein the mast pivot point is configured to be pinned to an upper pivot point of the pedestal structure.

10 Claims, 11 Drawing Sheets



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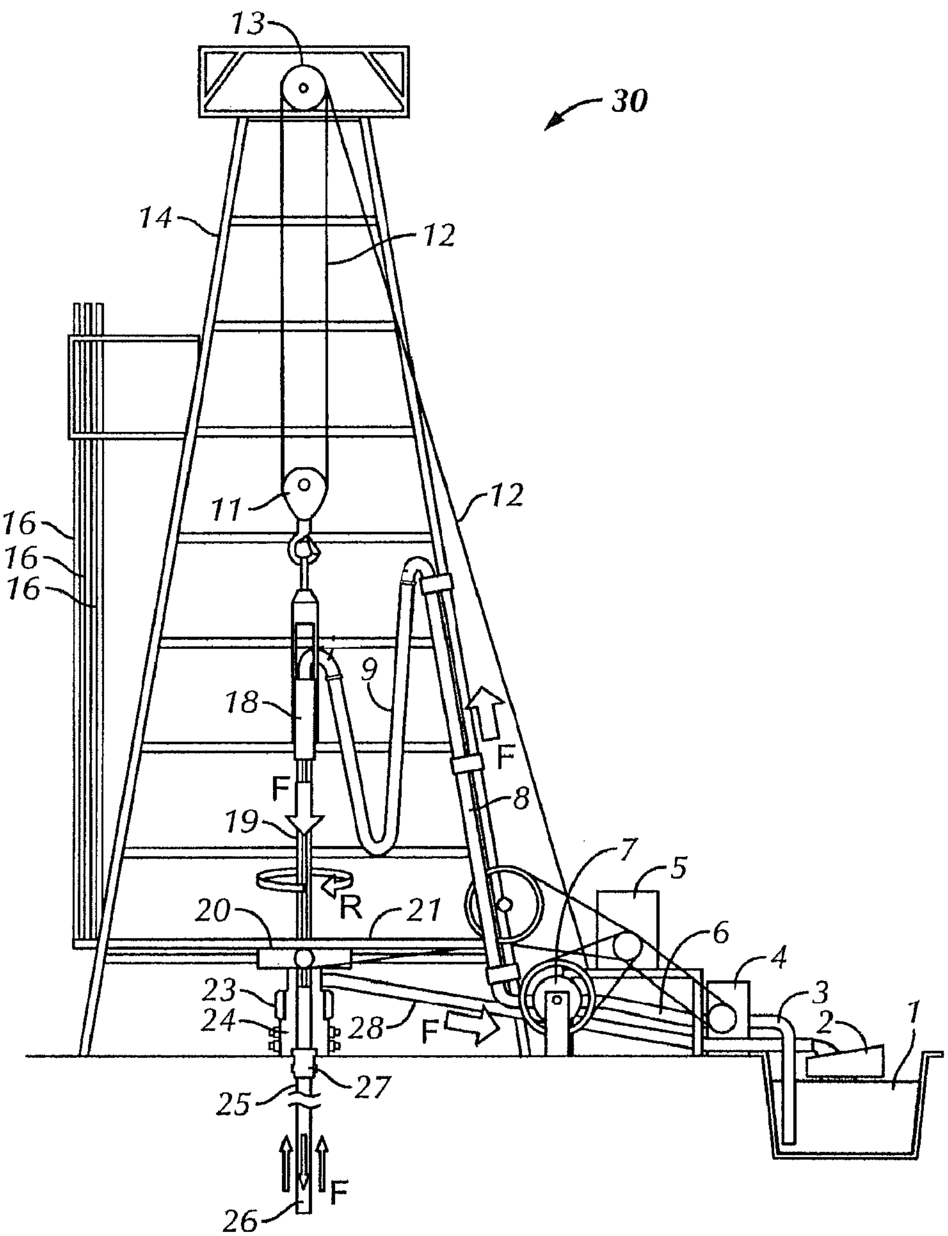

FIG. 1
(Prior Art)

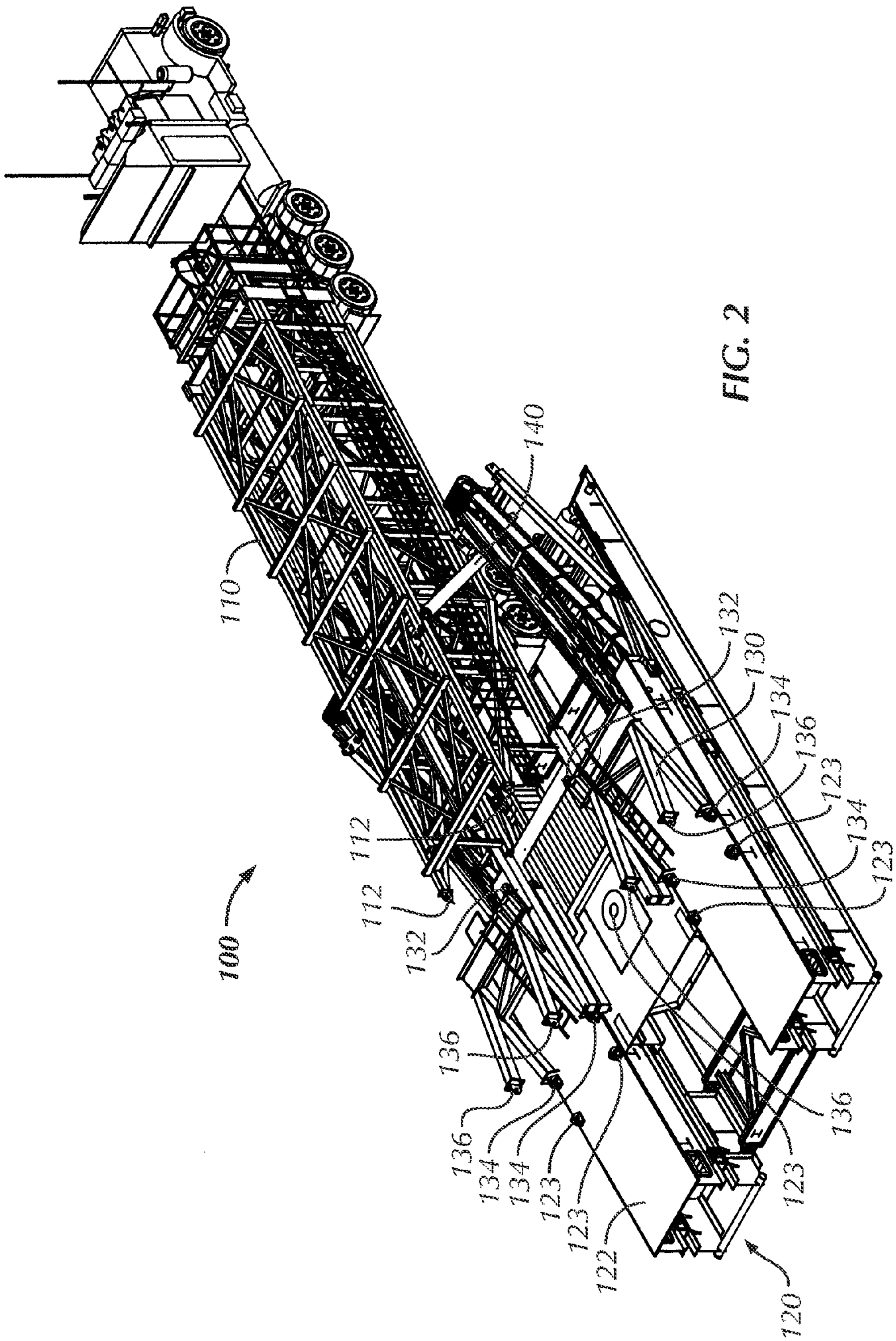
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FIG. 2

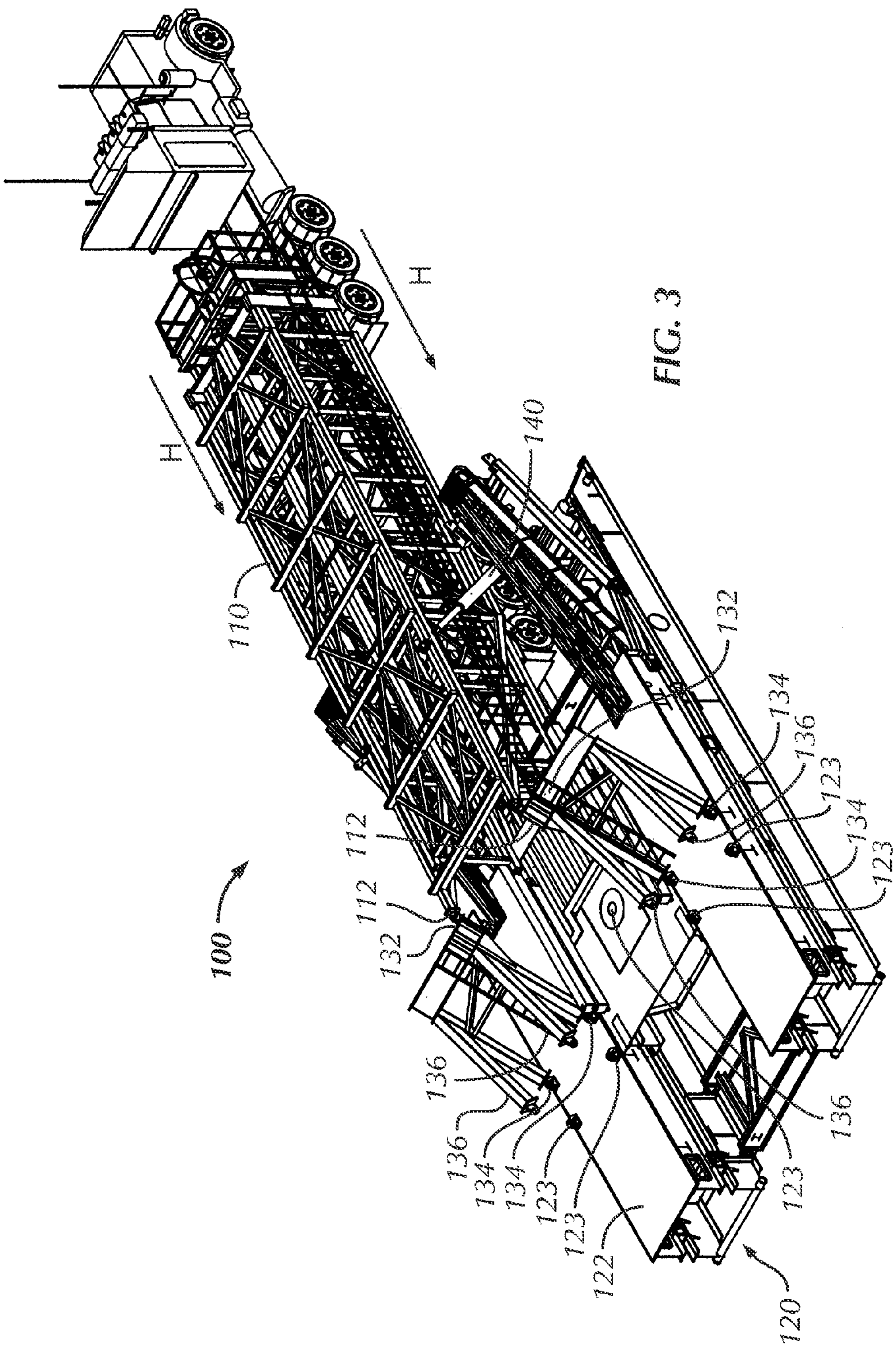

FIG. 3

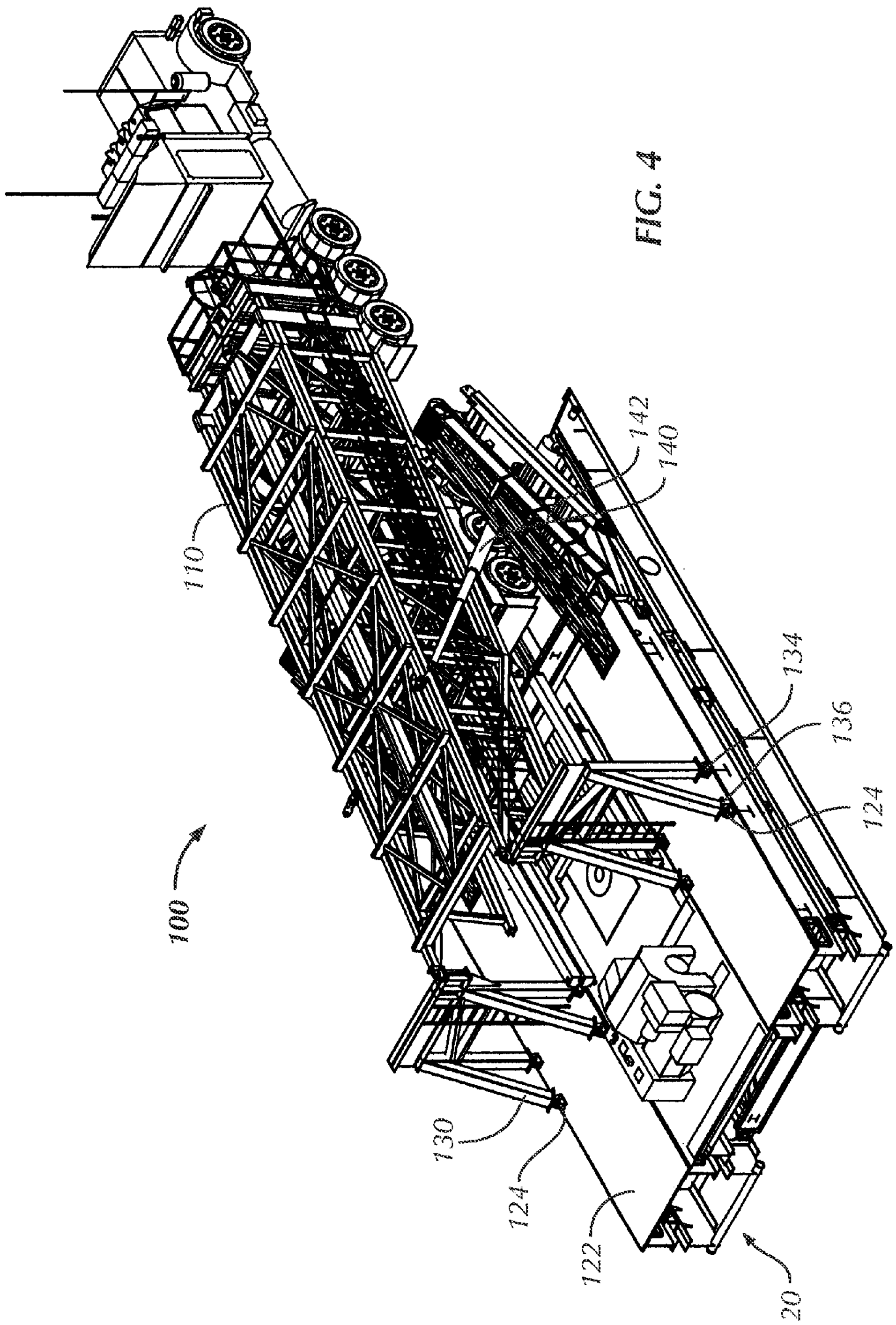

FIG. 4

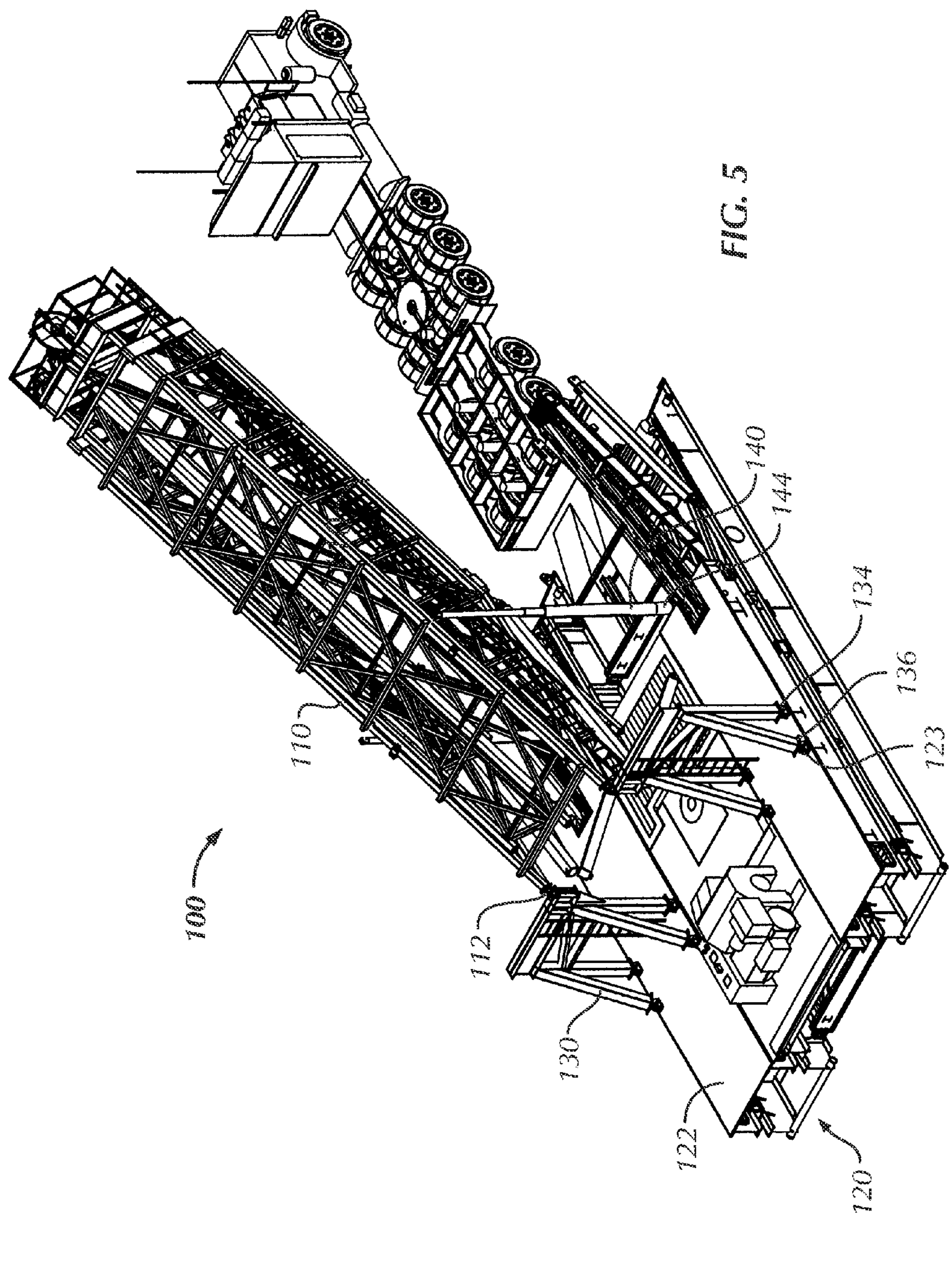

FIG. 5

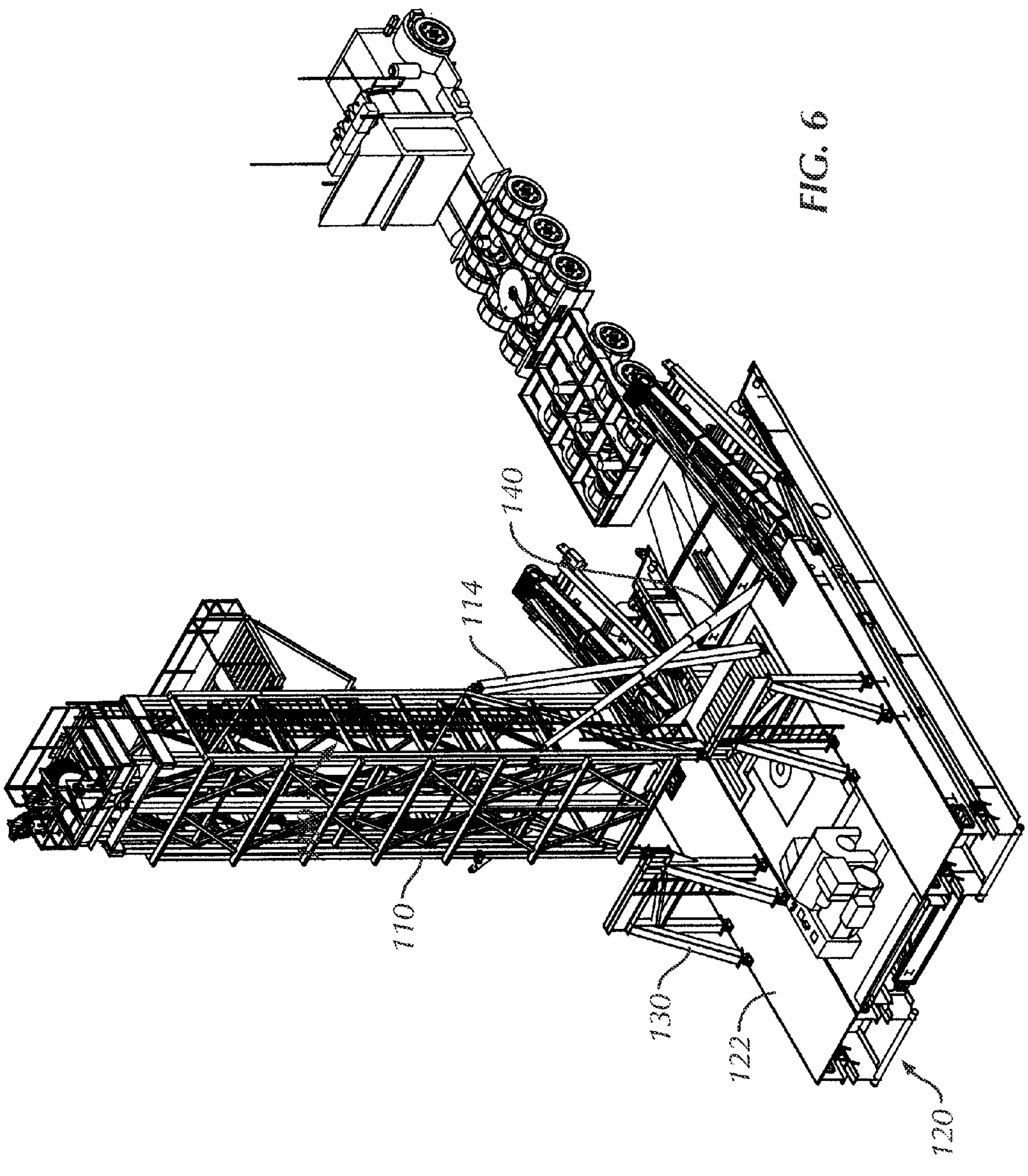

FIG. 6

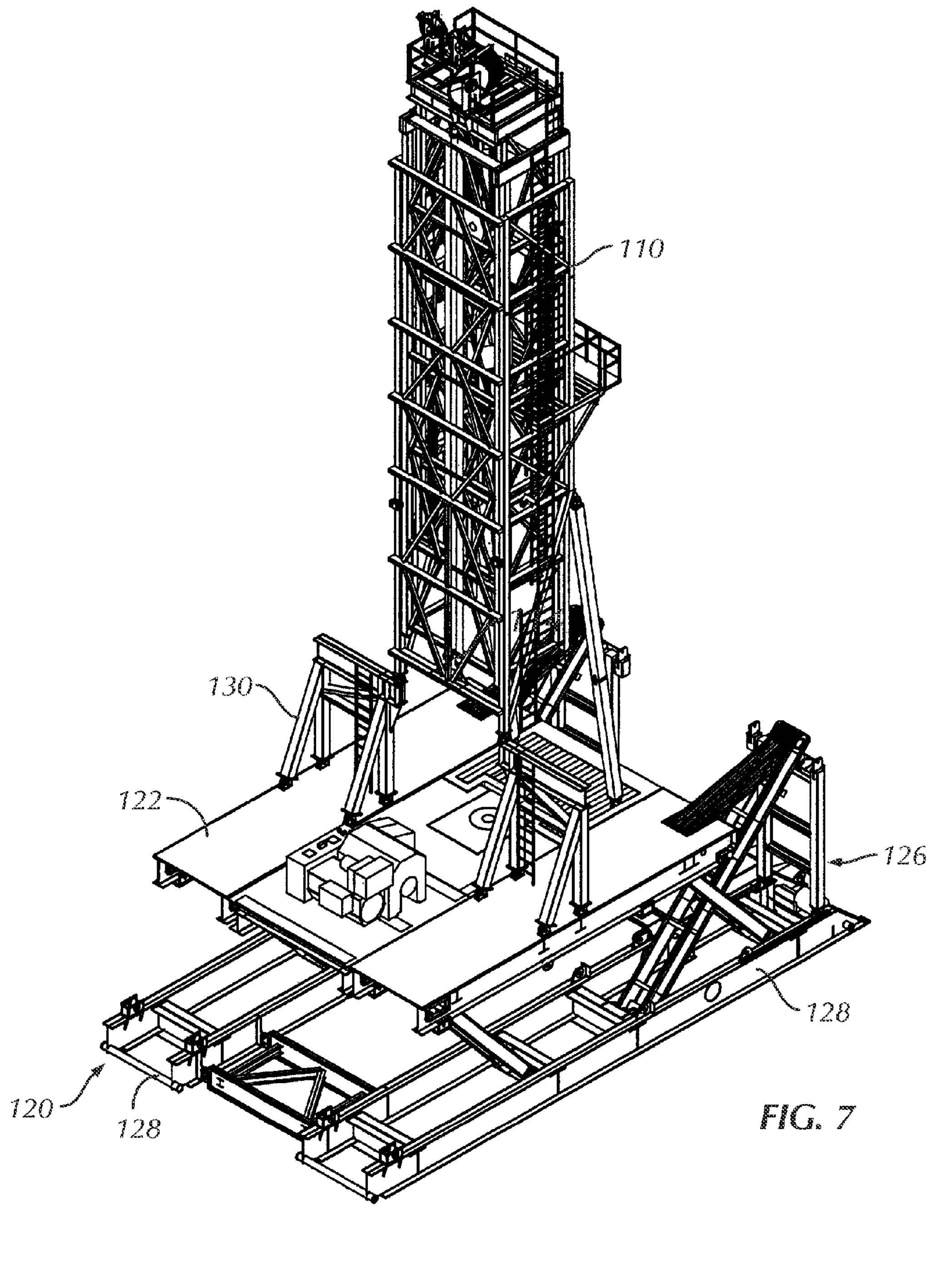

FIG. 7

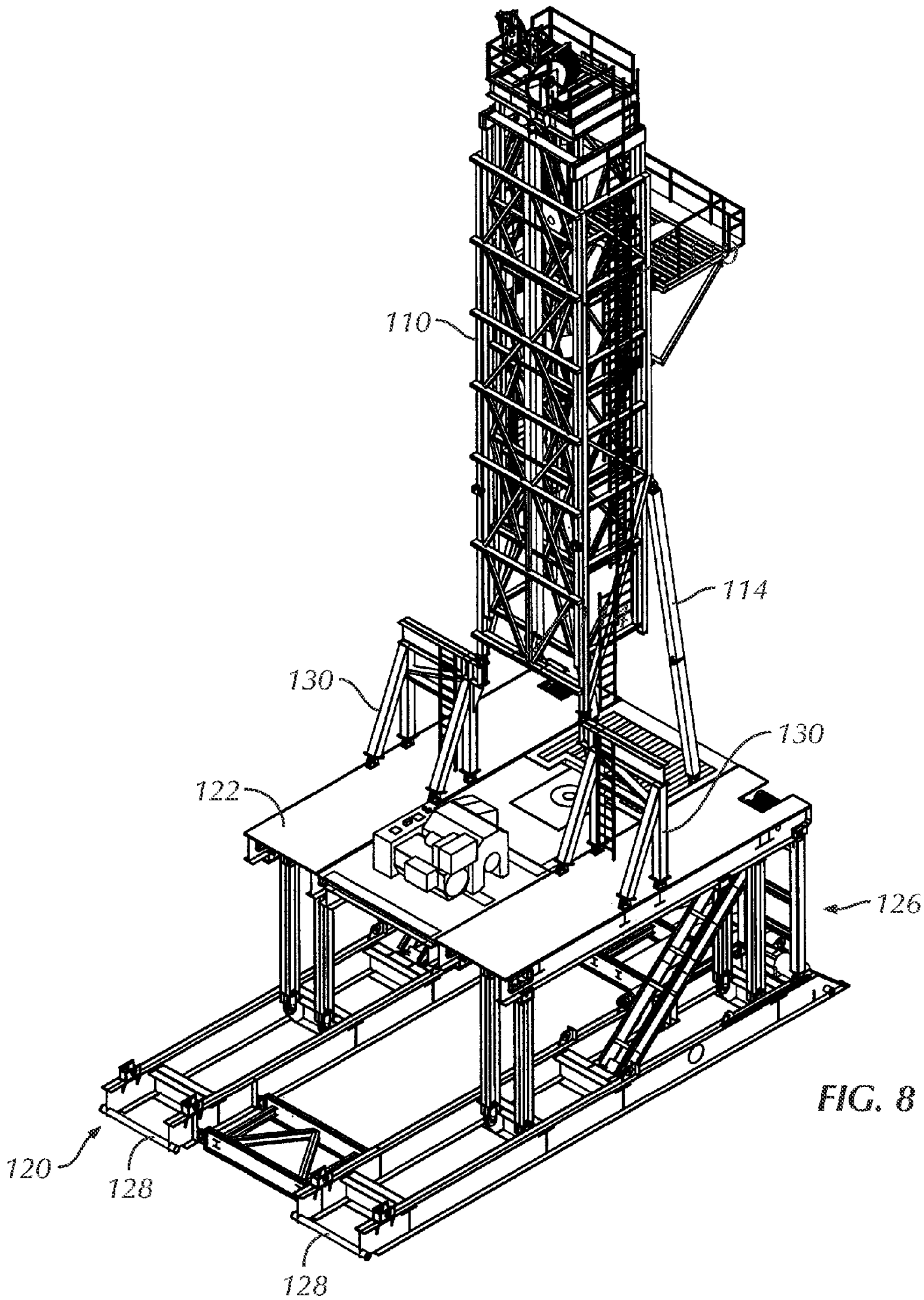

FIG. 8

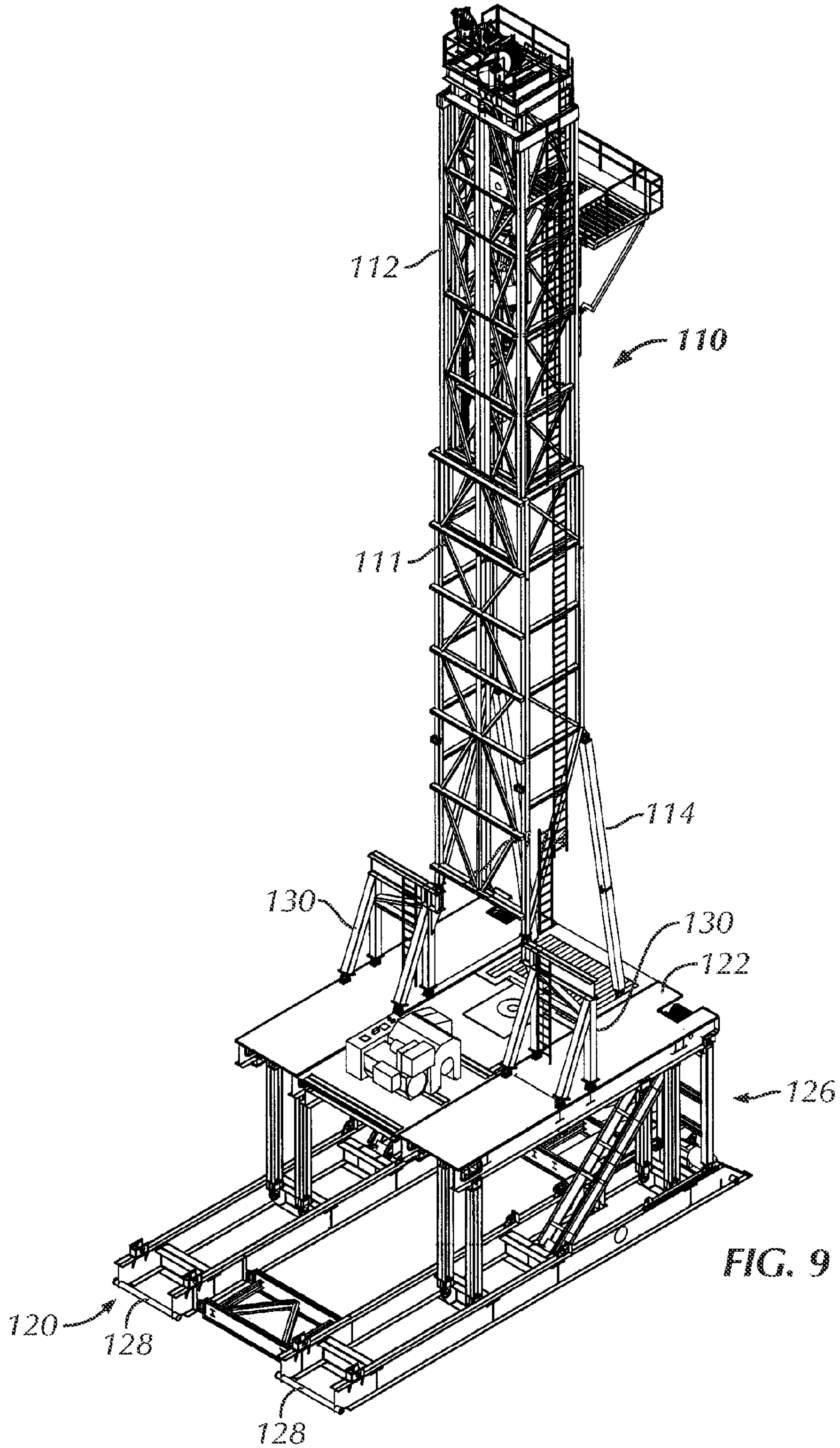

FIG. 9

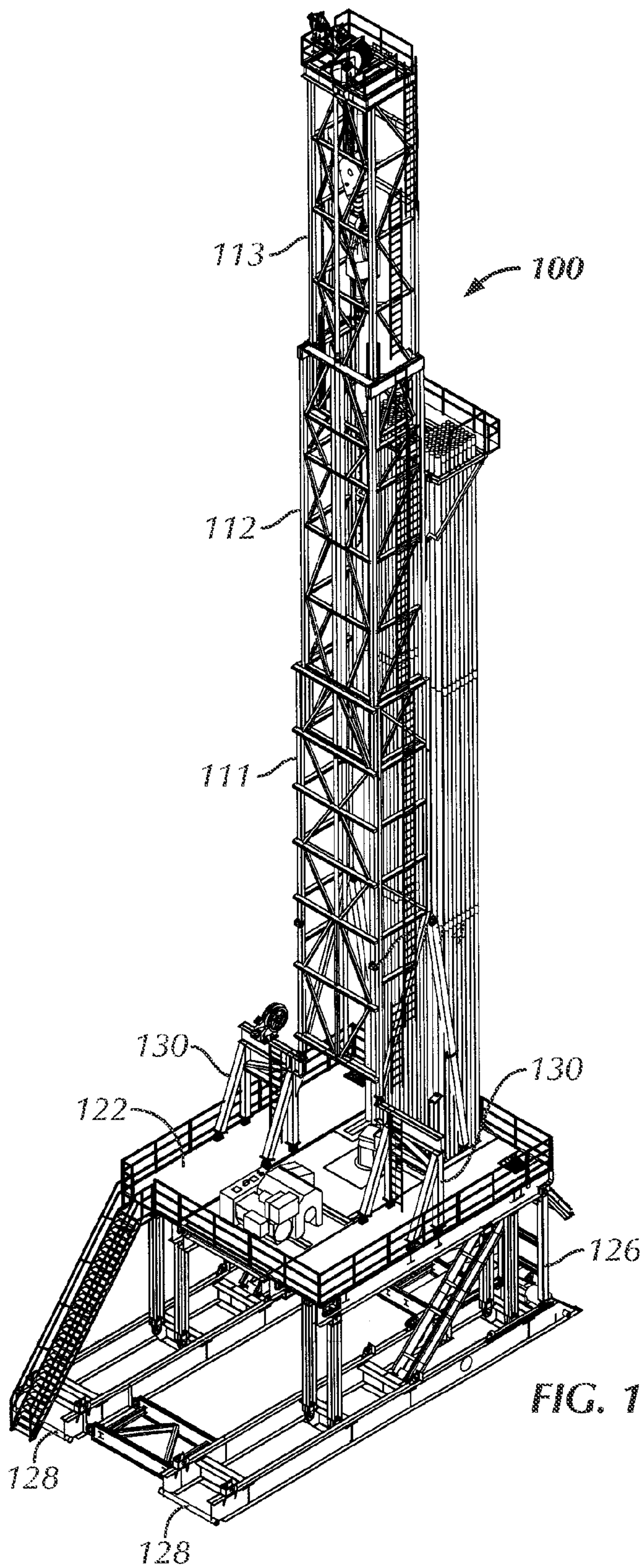

FIG. 10

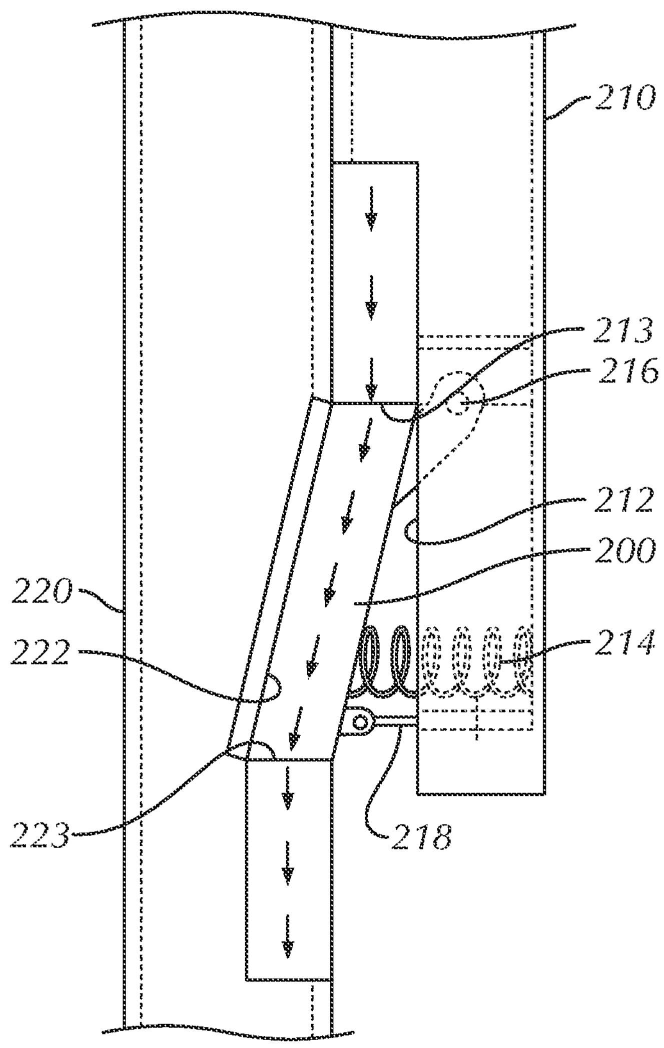

FIG. 11

PORTABLE DRILLING RIG APPARATUS AND ASSEMBLY METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a divisional application of and, thereby, claims benefit under 35 U.S.C. §120 to U.S. patent application Ser. No. 12/568,489 filed on Sep. 28, 2009, titled, "PORTABLE DRILLING RIG APPARATUS AND ASSEMBLY METHOD." The contents of the priority application are incorporated by reference in its entirety.

BACKGROUND

1. Field of the Disclosure

Embodiments disclosed herein relate generally to drilling rigs. In particular, embodiments disclosed herein relate to portable drilling rig apparatuses and related methods of assembly.

2. Background Art

A drilling rig is used to drill a wellbore in a formation. Drilling rigs may be large structures that house equipment used to drill water wells, oil wells, or natural gas extraction wells. Drilling rigs sample sub-surface mineral deposits, test rock, soil and groundwater physical properties, and may also be used to install sub-surface fabrications, such as underground utilities, instrumentation, tunnels or wells. Drilling rigs may be mobile equipment mounted on trucks, tracks, or trailers, or more permanent land or marine-based structures (such as oil platforms). The term "rig," therefore, generally refers to a complex of equipment that is used to penetrate the surface of the earth's crust.

Referring to FIG. **1**, a conventional drilling rig **30** is shown. Drilling rig **30** includes a derrick **14**, which provides a support structure for a majority of the equipment used to raise and lower a drillstring **25** into and out of a wellbore. The drillstring **25** may be an assembled collection of drillpipe, drill collars, or any other assortment of tools, connected together and run into the wellbore to facilitate the drilling of a well (drillpipe **16** is shown in joints prior to being connected together). The drillstring **25** may be raised and lower into and out of the wellbore by the draw-works **7**, which includes a spool powered by a motor or other power source **5**. A drill line **12**, which may be a thick, stranded metal cable, is run from the draw-works **7** over a crown block **13** and down through a travelling block **11**. Typically, the crown block **13** remains stationary while the travelling block **11** moves vertically with the drillstring **25**. The combination of the crown block **13** and the travelling block **11** provides a significant mechanical advantage for lifting the drillstring **25**. Further, a swivel **18** may be attached to the travelling block **11** to allow rotation of the drillstring **25** without twisting the travelling block **11**.

The drilling rig **30** further includes a rotary table **20** mounted in a rig floor **21**, which is used to rotate the drillstring **25** along with a kelly drive **19**. Kelly drive **19**, attached at an upper end to the swivel **18** and at a lower end to the drillstring **25**, is inserted through the rotary table **20** to rotate the drillstring **25** (drillstring rotation shown by arrow "R"). Kelly drive **19** may be square, hexagonal, or any other polygonal-shaped tubing and is able to move freely vertically while the rotary table **20** rotates it. Alternatively, drilling rig **30** may include a top drive (not shown) in place of kelly drive **19** and rotary table **20**. Additionally, blowout preventers ("BOPs") may be located below the rig floor **21** and installed atop a wellhead **27** to prevent fluids and gases from escaping from the wellbore. An annular BOP **23** and one or more ram BOPs **24** are shown and are commonly understood in the art.

During drilling operations, drilling fluid may be circulated through the system to carry cuttings away from the bottom of the wellbore as drilling progresses. Drilling fluid may be stored in mud tanks **1** before being drawn through suction line **3** by mud pumps **4**. Drilling fluid (drilling fluid route is indicated by arrows "F") is then pumped from mud pumps **4** through a hose **6**, up a stand pipe **8**, through a flexible hose **9**, and down into the wellbore. Drilling fluid returning from the wellbore is routed through a flow line **28** to shakers **2**, which are used to separate drill cuttings from the drilling fluid before it is pumped back down the wellbore.

Drilling rigs may add considerable cost to the overall costs of extracting oil or natural gas from underground reservoirs. This may be due to large equipment needed to erect certain drilling rigs or the difficulty of erecting certain drilling rigs in remote locations where it may be more costly to transport the drilling rig. Also, certain oil and natural gas wells may have a relatively limited well life, i.e., the well has only a limited amount of gas or oil capable of being extracted. Because of the reduced production, to maintain profitable margins from drilling and producing such a well, a less expensive drilling rig would be desirable. Thus, there exists a need for an economical drilling rig capable of being transported to remote and difficult to reach locations.

SUMMARY OF THE DISCLOSURE

In one aspect, embodiments disclosed herein relate to a portable drilling rig apparatus including a rig floor having a pedestal structure thereon, the pedestal structure comprising a lower pivot point and a lower attachment point and wherein the pedestal structure is configured to be rotated to a vertical position about the lower pivot point. The drilling rig further includes a mast structure having a mast pivot point at a lower end of the mast structure wherein the mast pivot point is configured to be pinned to an upper pivot point of the pedestal structure.

In other aspects, embodiments disclosed herein relate to a method to assemble a portable drilling rig, the method including providing a pedestal structure on a rig floor, the pedestal structure comprising a lower pivot point, a lower attachment point, and an upper pivot point. The method further includes aligning a mast structure and the pedestal structure, pinning a mast pivot point located at a lower end of the mast structure to the upper pivot point of the pedestal structure, and pivoting the pedestal structure from a substantially horizontal position to a vertical position. Further, the method includes moving the mast structure in a horizontal direction toward a center of the rig floor, securing the lower attachment point of the pedestal structure to a corresponding attachment point on the rig floor, erecting the mast structure from a substantially horizontal position to a vertical position about a pivot point between the mast structure and the pedestal structure, and securing the mast structure in a vertical position.

In other aspects, embodiments disclosed herein relate to a method to assemble a portable drilling rig, the method including attaching a mast structure to a pedestal structure on a rig floor and pivoting the pedestal structure from a horizontal position to a vertical position about a lower pivot point and securing the pedestal structure to the rig floor.

In other aspects, embodiments disclosed herein relate to an apparatus to restrict axial movement between an inner mast section and an outer mast section, the apparatus including a latch mechanism pivotably connected to the inner mast section wherein the latch mechanism is configured to move between a collapsed position and an extended position. The apparatus further includes a first cutout formed in an outer surface of the inner mast section wherein the latch mechanism sits flush with the outer surface of the inner mast section when the latch mechanism is in the collapsed position, and a second cutout formed in an inner surface of the outer mast section, wherein the latch mechanism is configured to be extended radially and engage the second cutout in the inner surface of the outer mast section.

Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-sectional schematic view of a conventional drilling rig.

FIG. **2** is a perspective view of a portable drilling rig prior to assembly in accordance with embodiments of the present disclosure.

FIG. **3** is a perspective view of the portable drilling rig at a first intermediate assembly stage in accordance with embodiments of the present disclosure.

FIG. **4** is a perspective view of the portable drilling rig at a second intermediate assembly stage in accordance with embodiments of the present disclosure.

FIGS. **5-6** are perspective views of the portable drilling rig at third and fourth intermediate assembly stages in accordance with embodiments of the present disclosure.

FIGS. **7-8** are perspective views of the portable drilling rig at fifth and sixth intermediate assembly stages in accordance with embodiments of the present disclosure.

FIG. **9-10** are perspective views of the portable drilling rig at seventh or eighth intermediate assembly stages in accordance with embodiments of the present disclosure.

FIG. **11** is a cross-sectional view of a latch to secure telescoping mast sections of the portable drilling rig in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

In one aspect, embodiments disclosed herein relate to portable drilling rig apparatuses and related methods of assembling the portable drilling rig.

Referring to FIG. **2**, a perspective view of a portable drilling rig **100** prior to assembly is shown in accordance with embodiments of the present disclosure. The drilling rig **100** includes a base assembly **120** and a mast structure **110** configured to be installed on the base assembly **120**. The base assembly **120** includes a collapsible rig floor **122**, which will be described later.

Drilling rig **100** may further include a pedestal structure **130** that may be mounted on rig floor **122** and configured to link mast structure **110** and rig floor **122**, as well as aid with assembly of the drilling rig **100**. Pedestal structure **130** may include an upper attachment point **132** configured to be pinned to a mast pivot point **112** during assembly. Pedestal structure **130** may also include a lower pivot point **134**, which is pinned to rig floor **122**, about which pedestal structure **130** may pivot and a lower attachment point **136** where pedestal structure is pinned to rig floor **112** after being positioned in a vertical position, as explained later. Initially, as shown in FIG. **2**, pedestal structure **130** may be laid over in a substantially horizontal position, in which lower attachment point **136** is unpinned, thereby allowing pedestal structure **130** to freely pivot about lower pivot point **134**.

Referring now to FIG. **3**, a perspective view of portable drilling rig **100** at a first intermediate assembly stage is shown in accordance with embodiments of the present disclosure. To begin assembly, mast pivot point **112** of mast structure is aligned with upper pivot points **132** of pedestal structure and pinned together. Hydraulic cylinders **140**, attached to mast structure **110** and a first attachment point **142** on base assembly **120**, may be used to properly align mast pivot point **112** and upper pivot point **132** prior to pinning them together. Once mast pivot point **112** and upper pivot point **132** are pinned together, mast structure **110** is moved horizontally in direction "H" toward a center **123** of rig floor **112**. Again, hydraulic cylinders **140** may be used to move mast structure **110** horizontally. Because mast structure **110** is pinned at mast pivot point **112** to upper pivot point **132** of pedestal structure, movement of mast structure **110** in direction H may pivot pedestal structure upward about lower pivot point **134**.

Now referring to FIG. **4**, a perspective view of portable drilling rig **100** at a second intermediate assembly stage is shown in accordance with embodiments of the present disclosure. Hydraulic cylinders **140** continue to move mast structure **110** horizontally, and pedestal structure **130** continues to rotate about lower pivot point **134** until lower attachment points **136** of pedestal structure **130** are aligned with corresponding rig floor attachment points **124** of rig floor **122**. Once aligned, lower attachment points **136** and rig floor attachment points **124** may be pinned, thereby securing pedestal structure **130** to rig floor **112** and preventing pedestal structure **130** from pivoting about lower pivot points **134** any further.

Referring now to FIGS. **5** and **6**, perspective views of portable drilling rig **100** at third and fourth intermediate assembly stages are shown in accordance with embodiments of the present disclosure. Hydraulic cylinders **140** previously used to move mast structure **110** horizontally may be moved from first attachment point **142** (FIG. **4**) and reattached to a second attachment point **144**, which provides the hydraulic cylinders **140** with a new range of motion used to erect mast structure **110**. As shown, hydraulic cylinders **140** may be extended to erect mast structure **110** as mast structure **110** pivots about the attachment between upper pivot point **132** and mast pivot point **112**.

FIG. **6** illustrates mast structure **110** after it has been raised to a final vertical position. As shown, hydraulic cylinders **140** may be fully extended to erect mast structure **110**. To secure mast structure to rig floor **122**, a mast leg **114**, which connects to a point on mast structure **110** and rig floor **112**, may be fully extended and fastened. Once installed, hydraulic cylinders **140** may be retracted, as they are no longer needed.

Referring now to FIGS. **7** and **8**, perspective views of portable drilling rig **100** at fifth and sixth intermediate assembly stages are shown in accordance with embodiments of the present disclosure. After mast structure **110** is fully erected and secured, rig floor **122** may be elevated to a specified height. As previously described, this specified height is often driven by requirements for the height of a crown block (**13** in FIG. **1**) or blowout prevention equipment (**23**, **24** in FIG. **1**) installed below rig floor **122**, which will be understood by those skilled in the art. In certain embodiments, a hydraulic system **126**, mounted at a lower end to skids **128** and an upper end to rig floor **112**, may be used to elevate rig floor **122**. Those skilled in the art will understand that pneumatic and mechanical systems may also be used.

FIGS. **9** and **10** are perspective views of portable drilling rig **100** during seventh and eighth intermediate assembly stages in accordance with embodiments of the present disclosure, at which point mast structure **110** is extended to a final (drilling) height. As shown, mast structure **110** may be configured as a telescoping structure including multiple mast sections **111**, **112**, and **113**, with each mast section having a slightly smaller cross-sectional area than the mast section below it. In this way, multiple mast sections are able to fit within the mast section below it, thus allowing the mast structure **110** to be collapsed to a shorter length for easier transportation and handling during assembly. The mast sections may be raised using hydraulics, pneumatics, mechanical devices, or other methods known to those skilled in the art.

Referring now to FIG. **11**, a cross-sectional view of a latch **200** used to lock and restrict movement between the extended mast sections of mast structure is shown in accordance with embodiments of the present disclosure. Latch **200** may be installed on a smaller inner mast section **210**, or a mast section that fits inside a slightly larger outer mast section **220**. Inner mast section **210** has a cavity or cutout **212** formed in an outer surface of inner mast section **210** in which latch **200** may be positioned to sit flush with an outer profile of inner mast section **210** (so that inner mast section **210** is free to slide up and down within outer mast section **220** when latch **200** is collapsed). Similarly, outer mast section **220** has a corresponding cutout **222** formed in an inner surface of outer mast section **220**, into which latch **200** may extend to secure the two mast sections relative to each other. Latch **200** is attached to inner mast section **210** at an attachment point **216** about which latch **200** is able to pivot and move from a collapsed position to an extended position (shown). Further, a spring **214** may be provided to bias latch **200** into an extended position and a cable **218** (or other device) may be provided to operate latch **200**.

As such, when mast sections are extended (e.g., as shown in FIGS. **9** and **10**), latch **200** may be aligned with cavity **222** formed in an inner surface of outer mast section **220**, at which point latch **200** may be extended radially outward to engage cavity **222**. When engaged, latch **200** contacts a ledge **213** of inner section **210** and ledge **223** of outer section **220**, so that load forces (represented by "F") may be transmitted from inner section **210**, through latch **200**, and into outer section **220**.

Advantageously, embodiments of the present disclosure for a highly mobile and economical drilling rig capable of reaching remote well locations. The unique pedestal structure eliminates a need for large cranes or other lifting equipment typically required to erect a mast structure, making the drilling rig easily portable to various locations. Additionally, because less equipment is required for assembly, initial assembly costs for setting up the drilling rig may be reduced, which in turn may increase profit margins from smaller or limited production wells.

While the present disclosure has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from the scope of the disclosure as described herein. Accordingly, the scope of the disclosure should be limited only by the attached claims.

What is claimed is:

1. A method to assemble a portable drilling rig, the method comprising:

providing a pedestal structure on a rig floor;

the pedestal structure comprising a lower pivot point, a lower attachment point, and an upper pivot point;

aligning a mast structure and the pedestal structure;

pinning a mast pivot point located at a lower end of the mast structure to the upper pivot point of the pedestal structure;

pivoting the pedestal structure from a substantially horizontal position to a vertical position;

moving the mast structure in a horizontal direction toward a center of the rig floor;

securing the lower attachment point of the pedestal structure to a corresponding attachment point on the rig floor;

erecting the mast structure from a substantially horizontal position to a vertical position about a pivot point between the mast structure and the pedestal structure; and

securing the mast structure in a vertical position.

2. The method of claim **1**, further comprising elevating the rig floor to a specified height.

3. The method of claim **1**, further comprising extending a mast leg from the mast structure to the rig floor to secure the mast structure in a vertical position.

4. The method of claim **1**, wherein erecting the mast structure comprises extending at least one hydraulic cylinder attached to the mast structure and the rig floor.

5. The method of claim **4**, further comprising extending multiple telescoping mast sections of the mast structure to a final height.

6. The method of claim **5**, further comprising latching the multiple telescoping mast sections to prevent relative movement.

7. A method to assemble a portable drilling rig, the method comprising:

pinning a mast pivot point located at a lower end of a mast structure to an upper pivot point of a pedestal structure, the mast structure being separable from the pedestal structure, and each of the mast structure and pedestal structure are disposed on a rig floor;

pivoting the pedestal structure from a horizontal position to a vertical position about a lower pivot point and securing the pedestal structure to the rig floor;

erecting the mast structure to a vertical position about the upper pivot point of the pedestal structure; and

extending a mast leg from the mast structure to the rig floor and securing the mast structure in the vertical position.

8. A method of erecting a drilling rig, the method comprising:

pivoting a pedestal structure about a lower pivot point to a substantially vertical position while an upper pivot point is pinned to a mast pivot point of a mast structure and the mast structure and pedestal structure are disposed on a rig floor, the mast structure being separable from the pedestal structure;

fastening the pedestal structure to an attachment point on the rig floor;

erecting the mast structure above the pedestal structure; and

extending a mast kg from the mast structure to the rig floor and securing the mast structure in a vertical position.

9. The method of claim **8**, further comprising latching multiple telescoping mast sections of the mast structure.

10. The method of claim **8**, further comprising extending at least one hydraulic cylinder to pivot the pedestal structure.

* * * * *

US009133643B2

(12) **United States Patent**
Wasterval

(10) **Patent No.: US 9,133,643 B2**
(45) **Date of Patent: Sep. 15, 2015**

(54) **DRILLING RIG ASSEMBLY METHOD AND APPARATUS**

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(72) Inventor: **Philip Wasterval**, Spring, TX (US)

(73) Assignee: **International Drilling Equipment Company LLC**, Spring, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/938,037**

(22) Filed: **Jul. 9, 2013**

(65) **Prior Publication Data**

US 2013/0318890 A1 Dec. 5, 2013

Related U.S. Application Data

(63) Continuation of application No. 12/492,980, filed on Jun. 26, 2009, now Pat. No. 8,555,564.

(51) **Int. Cl.**
E04H 12/34 (2006.01)
E21B 15/00 (2006.01)

(52) **U.S. Cl.**
CPC ***E04H 12/344*** (2013.01); ***E21B 15/00*** (2013.01); *Y10T 29/49826* (2015.01)

(58) **Field of Classification Search**
USPC 52/111, 112, 114, 115, 123.1, 169.13, 52/745.03, 745.17, 745.18, 121; 405/196, 405/202, 221, 220
See application file for complete search history.

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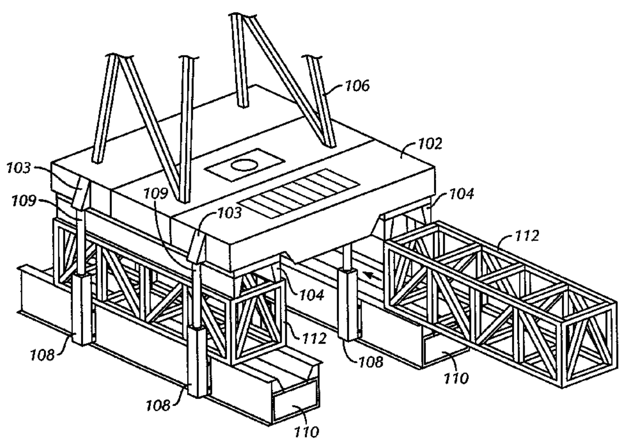
Primary Examiner — Ryan Kwiecinski
(74) *Attorney, Agent, or Firm* — Osha Liang LLP

(57) **ABSTRACT**

A drilling rig including a base structure, a lifting device attached to the base structure, and a rig floor comprising a derrick and drilling equipment disposed thereon, in which the lifting device is configured to lift the rig floor so that at least one box may be inserted between the base structure and the rig floor, the rig floor having load points attached thereto and configured to be aligned with the lifting device.

14 Claims, 7 Drawing Sheets



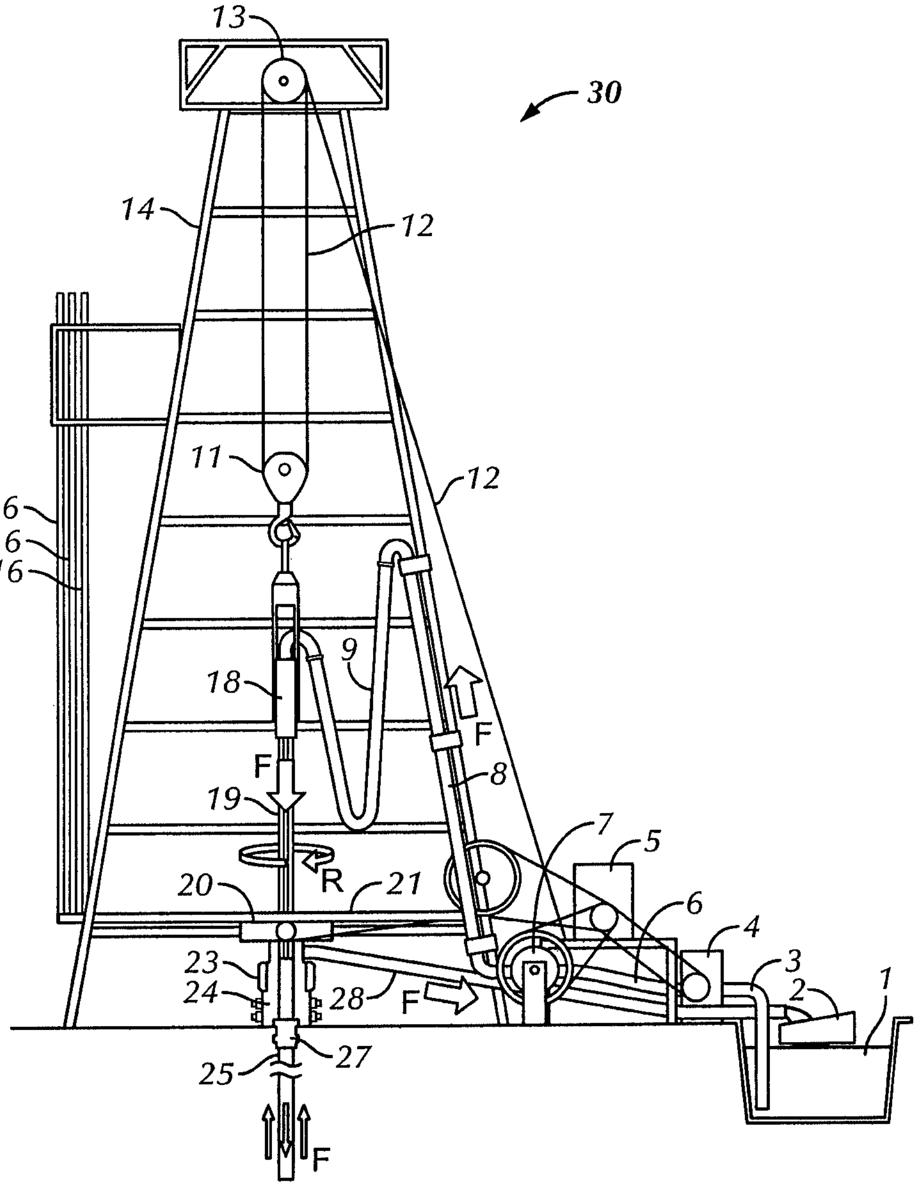


FIG. 1
(Prior Art)

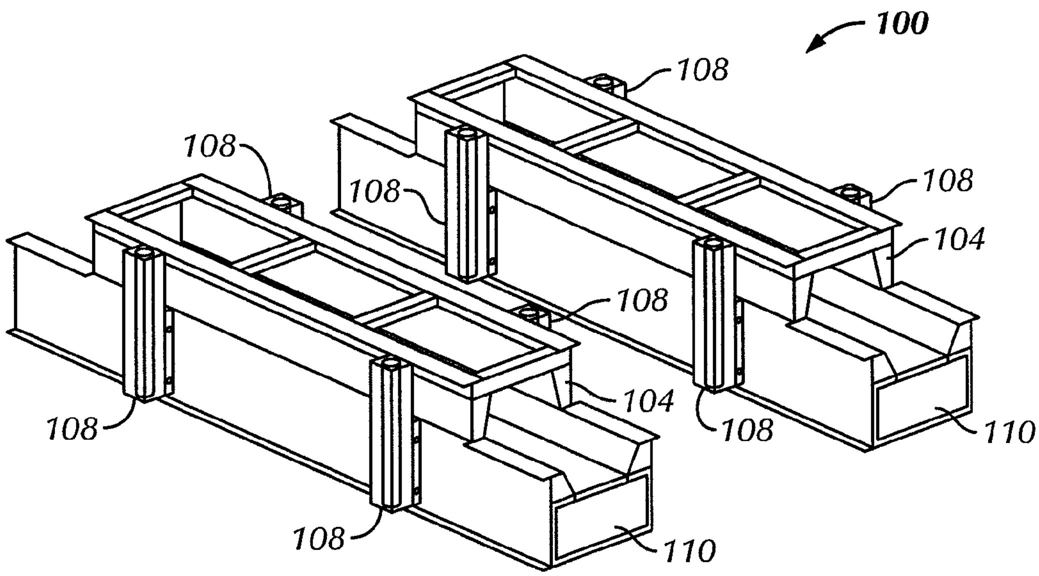

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FIG. 2

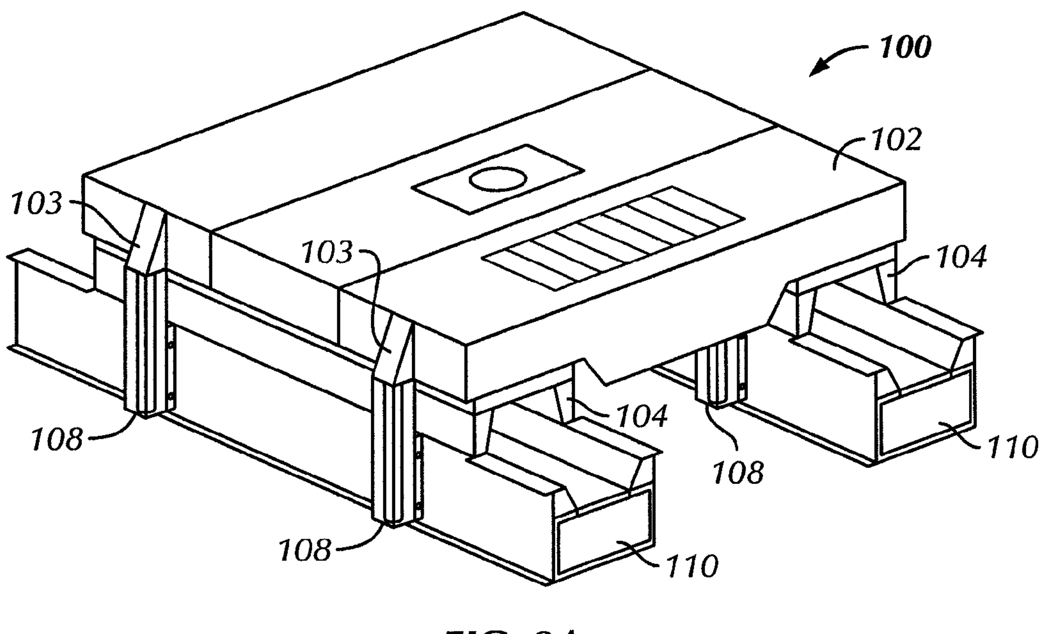
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FIG. 3A

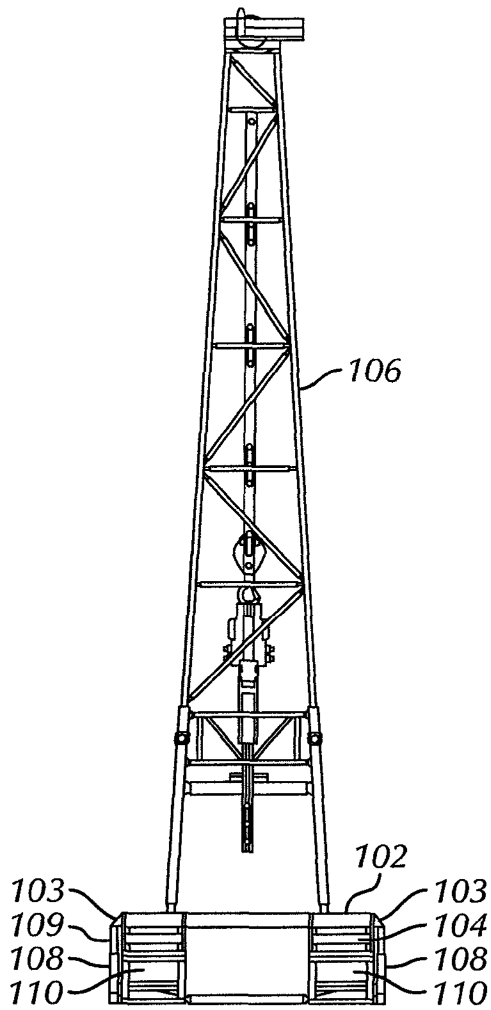

FIG. 3B

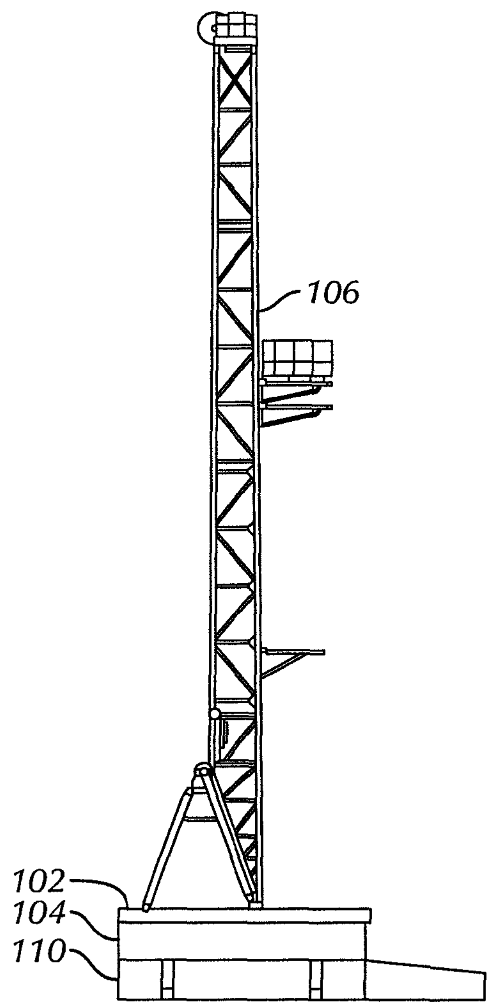

FIG. 3C

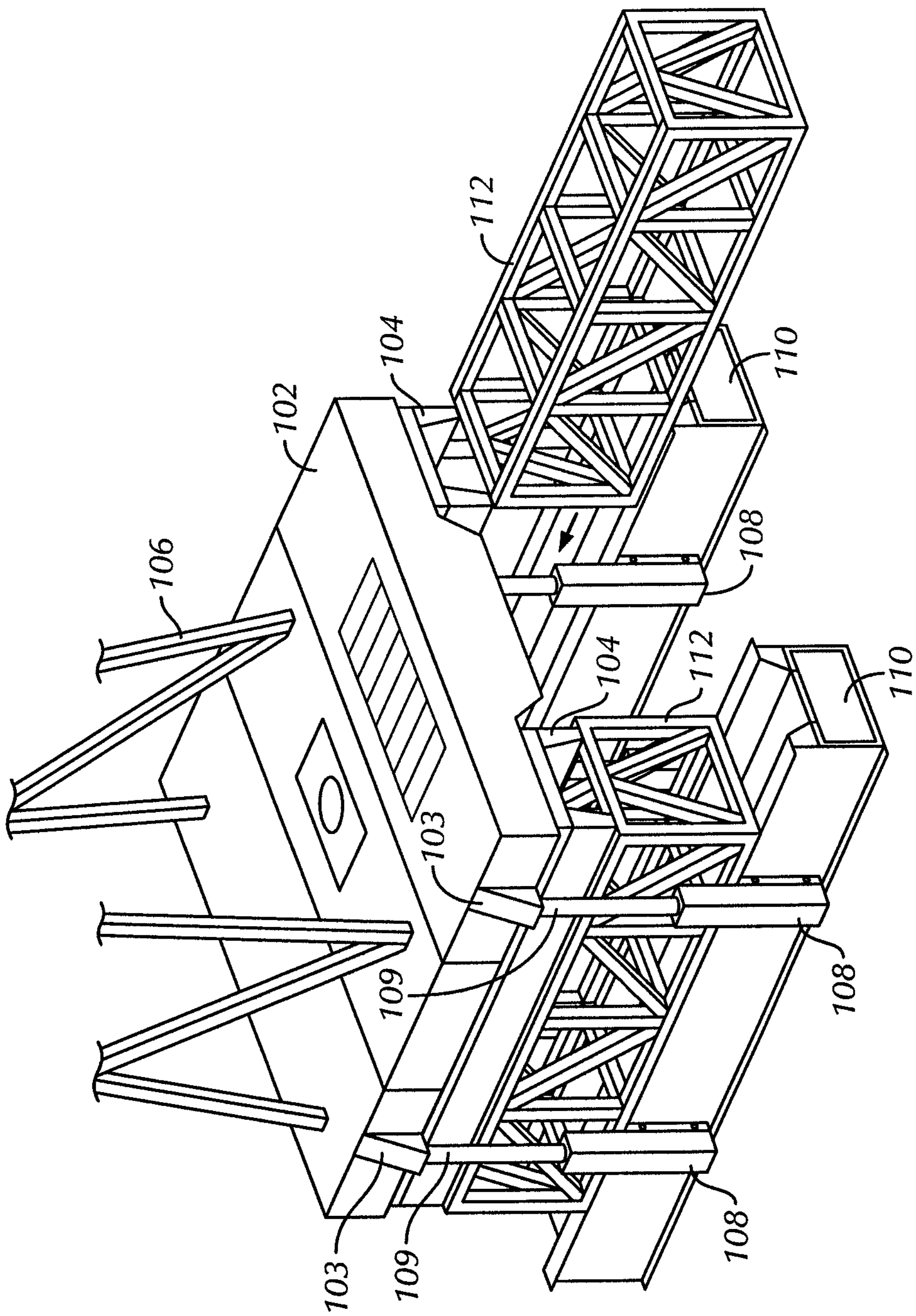

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FIG. 4A

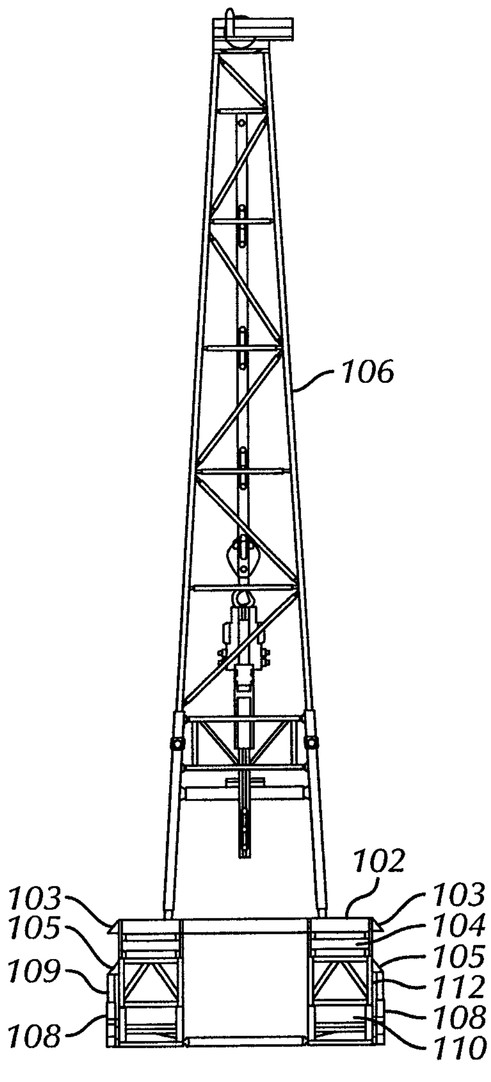
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FIG. 4B

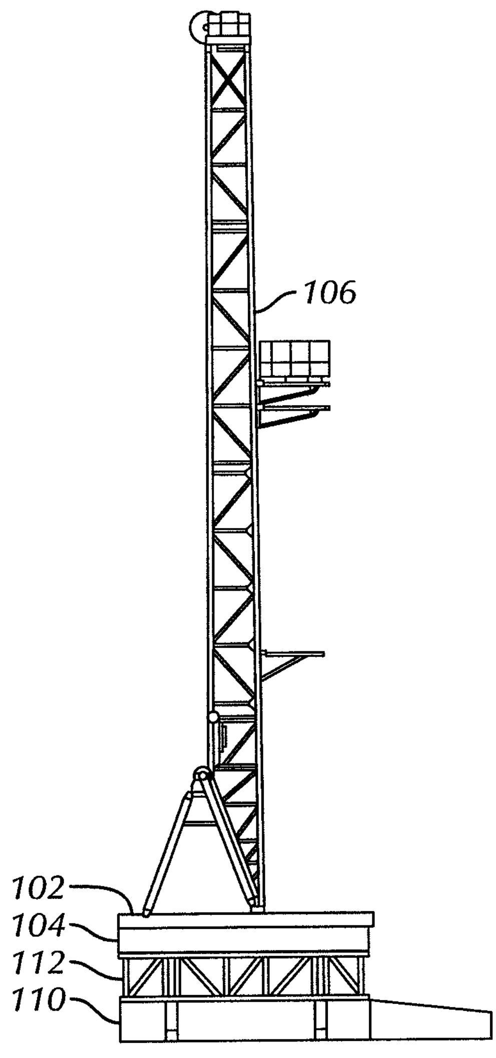
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FIG. 4C

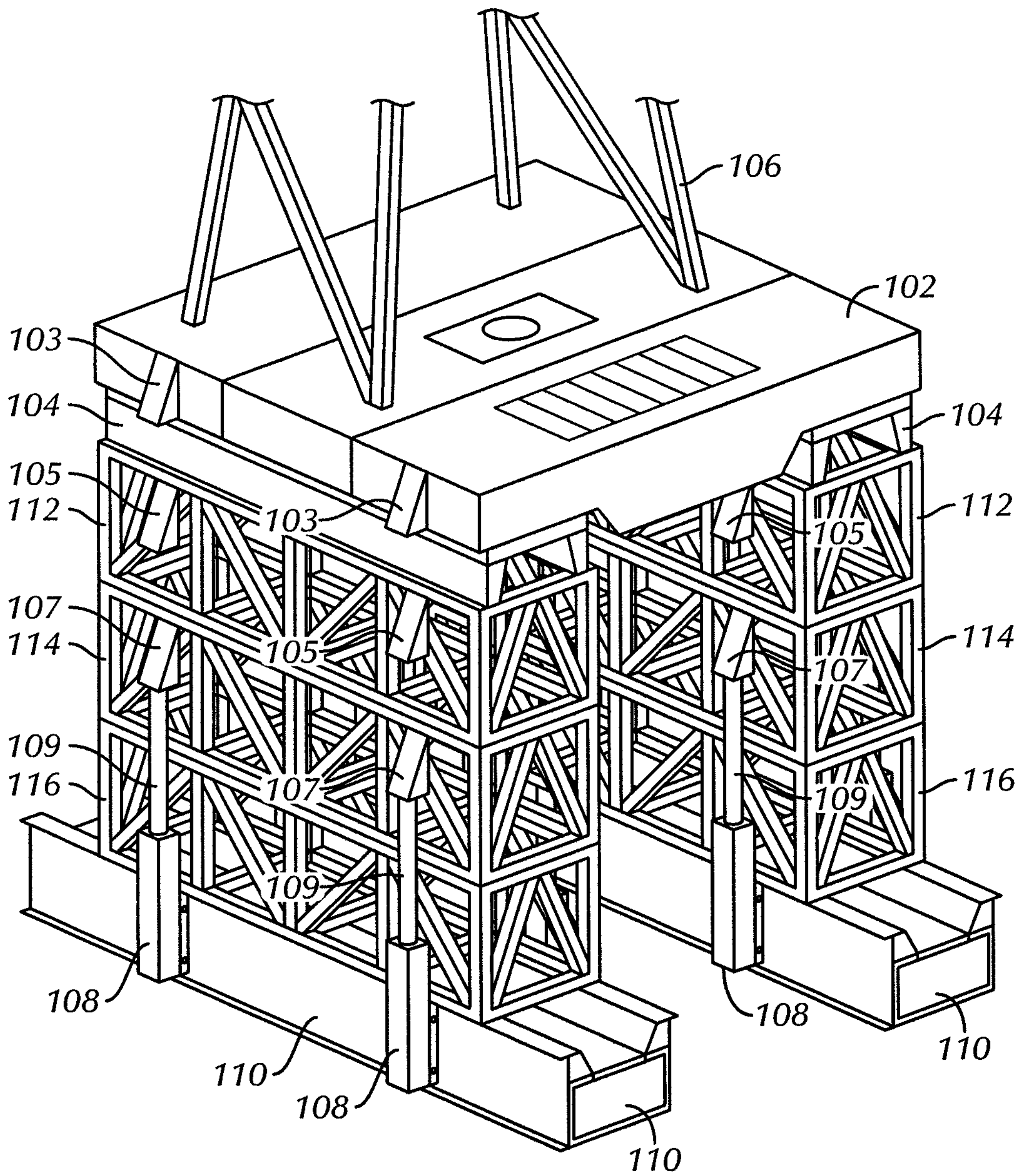
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FIG. 5A

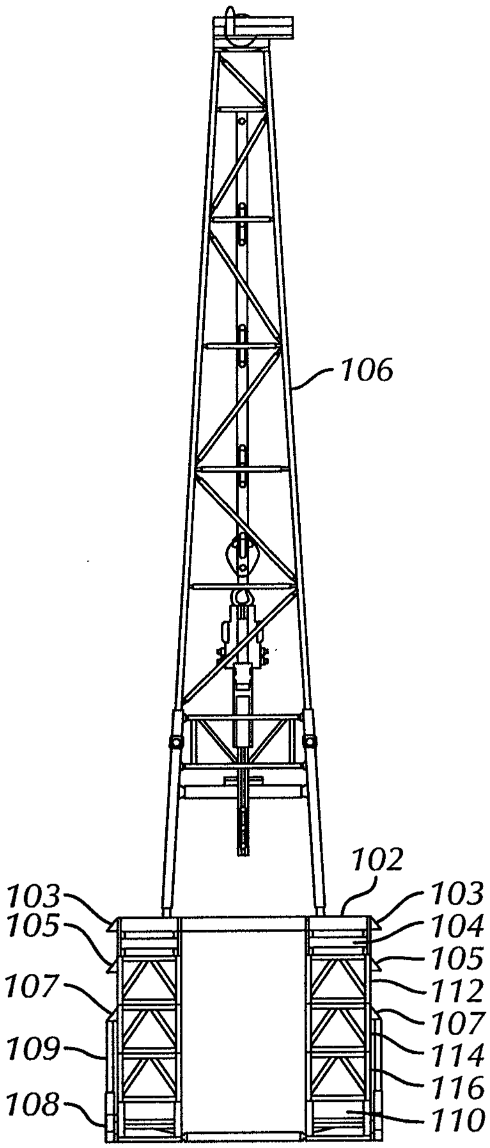
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FIG. 5B

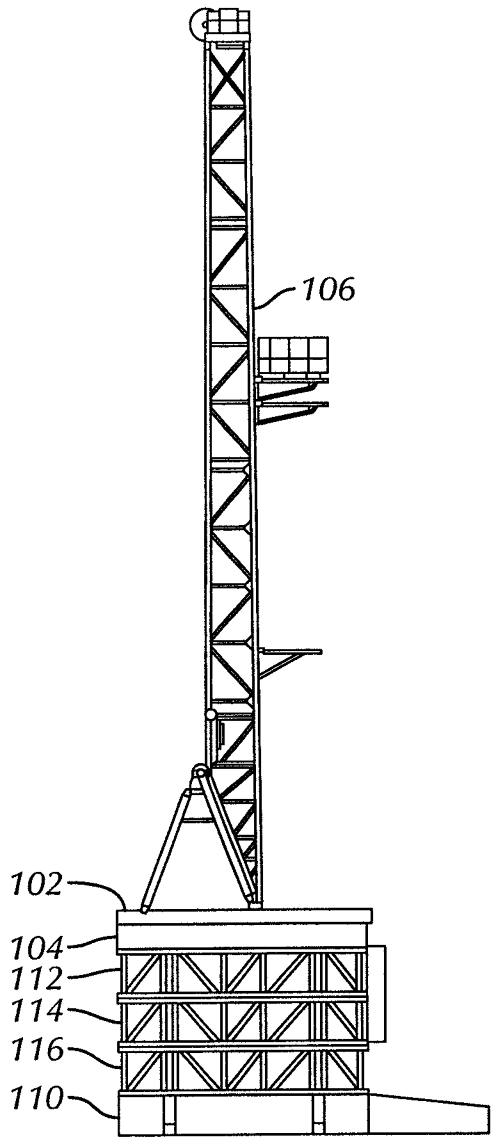
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FIG. 5C

DRILLING RIG ASSEMBLY METHOD AND APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of, and therefore claims priority to, U.S. patent application Ser. No. 12/492,980 filed on Jun. 26, 2009. The priority application is hereby incorporated by reference in its entirety.

BACKGROUND

1. Field of the Disclosure

Embodiments disclosed herein relate generally to drilling rigs. In particular, embodiments disclosed herein relate to drilling rig assembly methods and apparatus.

2. Background Art

A drilling rig is used to drill a wellbore in a formation. Drilling rigs may be large structures that house equipment used to drill water wells, oil wells, or natural gas extraction wells. Drilling rigs sample sub-surface mineral deposits, test rock, soil and groundwater physical properties, and may also be used to install sub-surface fabrications, such as underground utilities, instrumentation, tunnels or wells. Drilling rigs may be mobile equipment mounted on trucks, tracks, or trailers, or more permanent land or marine-based structures (such as oil platforms). The term "rig," therefore, generally refers to a complex of equipment that is used to penetrate the surface of the earth's crust.

Referring to FIG. **1**, a conventional drilling rig **30** is shown. Drilling rig **30** includes a derrick **14**, which provides a support structure for a majority of the equipment used to raise and lower a drillstring **25** into and out of a wellbore. The drillstring **25** may be an assembled collection of drillpipe, drill collars, or any other assortment of tools, connected together and run into the wellbore to facilitate the drilling of a well (drillpipe **16** is shown in joints prior to being connected together). The drillstring **25** may be raised and lower into and out of the wellbore by the draw-works **7**, which includes a spool powered by a motor or other power source **5**. A drill line **12**, which may be a thick, stranded metal cable, is run from the draw-works **7** over a crown block **13** and down through a travelling block **11**. Typically, the crown block **13** remains stationary while the travelling block **11** moves vertically with the drillstring **25**. The combination of the crown block **13** and the travelling block **11** provides a significant mechanical advantage for lifting the drillstring **25**. Further, a swivel **18** may be attached to the travelling block **11** to allow rotation of the drillstring **25** without twisting the travelling block **11**.

The drilling rig **30** further includes a rotary table **20** mounted in a rig floor **21**, which is used to rotate the drillstring **25** along with a kelly drive **19**. Kelly drive **19**, attached at an upper end to the swivel **18** and at a lower end to the drillstring **25**, is inserted through the rotary table **20** to rotate the drillstring **25** (drillstring rotation shown by arrow "R"). Kelly drive **19** may be square, hexagonal, or any other polygonal-shaped tubing and is able to move freely vertically while the rotary table **20** rotates it. Alternatively, drilling rig **30** may include a top drive (not shown) in place of kelly drive **19** and rotary table **20**. Additionally, blowout preventers ("BOPs") may be located below the rig floor **21** and installed atop a wellhead **27** to prevent fluids and gases from escaping from the wellbore. An annular BOP **23** and one or more ram BOPs **24** are shown and are commonly understood in the art.

During drilling operations, drilling fluid may be circulated through the system to carry cuttings away from the bottom of the wellbore as drilling progresses. Drilling fluid may be stored in mud tanks **1** before being drawn through suction line **3** by mud pumps **4**. Drilling fluid (drilling fluid route is indicated by arrows "F") is then pumped from mud pumps **4** through a hose **6**, up a stand pipe **8**, through a flexible hose **9**, and down into the wellbore. Drilling fluid returning from the wellbore is routed through a flow line **28** to shakers **2**, which are used to separate drill cuttings from the drilling fluid before it is pumped back down the wellbore.

When designing a drilling rig, numerous factors may be taken into account. For instance, referring still to FIG. **1**, the crown block **13** must be located high enough to pull the drillstring **25** from the wellbore for assembly or disassembly. This may require that the derrick structure **14** be built having a substantial height to have the crown block **13** high enough above the wellbore. Additionally, the rig floor **21** must be high enough off the ground to allow the blowout prevention equipment, namely BOPs **23**, **24**, to fit beneath the rig floor **21** when mounted on the wellhead **27**. Due to these design factors, among others, the size of drilling rigs is often very large. Due to the large size, assembly of the drilling rigs may often be difficult.

Different methods have been employed to assemble drilling rigs and attempt to overcome the difficulty associated with assembling very large structures having on them a substantial amount of drilling equipment. One method used is known as "box on box," which basically uses a crane to stack large box structures on top of one another up to a certain height. The crane is then used to lift the rig floor onto the stacked boxes. After the rig floor is installed, the remaining equipment, including the derrick and blocks, must be assembled. One drawback to this assembly method is that a substantial crane is required to lift the equipment during assembly, which due to often rough terrain in remote drilling locations becomes extremely costly or even unfeasible in certain conditions. Also, assembly of a majority of the drilling equipment occurs after the rig floor is installed, and thus, must take place at the rig floor height, which may be 25-40 feet (8-12 m) off the ground.

Other methods used to assemble drilling rigs are known as "swing up," "slingshot," or some other form of parallelogram method. Using any of these methods, the drilling rig is, in a sense, collapsed because the rig floor sits on a base near the ground with the legs laid out horizontal. A hydraulic or wireline system then pulls the structure up (the rig floor is lifted off the ground and the legs are raised to a vertical position). However, these assembly methods typically incur unusually high loads, which may increase chances of mechanical failure. Additionally, active participation of rig personnel is required during assembly. Accordingly, there exists a need for a method and apparatus for a drilling rig capable of being assembled with minimal extra equipment (e.g., cranes) and minimal rig personnel participation during assembly.

SUMMARY OF THE DISCLOSURE

In one aspect, embodiments disclosed herein relate to a method to assemble a drilling rig, the method including providing a base structure of the drilling rig, stacking a rig floor including a derrick on the base structure, actuating lifting cylinders to lift the rig floor above the base structure, inserting at least one first upper box between the base structure and the rig floor, and retracting the lifting cylinders to set the rig floor atop the at least one first upper box.

In other aspects, embodiments disclosed herein relate to a drilling rig including a base structure, lifting cylinders, and a rig floor including a derrick and drilling equipment disposed thereon, wherein the lifting cylinders are configured to extend and retract to lift the rig floor and insert at least one upper box.

Other aspects and advantages of the invention will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-sectional schematic view of a conventional drilling rig.

FIG. **2** is a perspective view of a base structure of a drilling rig in accordance with embodiments of the present disclosure.

FIG. **3**A is a perspective view of a rig floor installed onto the base structure of FIG. **2** in accordance with embodiments of the present disclosure.

FIG. **3**B is a front view of an entire drilling rig installed onto the base structure as in FIG. **3**A in accordance with embodiments of the present disclosure.

FIG. **3**C is a side view of the drilling rig shown in FIG. **3**B in accordance with embodiments of the present disclosure.

FIG. **4**A is a perspective view of a first upper box inserted between the rig floor and base structure in accordance with embodiments of the present disclosure.

FIG. **4**B is a front view of an entire drilling rig with a first upper box inserted between the drilling rig and the base structure in accordance with embodiments of the present disclosure.

FIG. **4**C is a side view of the drilling rig shown in FIG. **4**B in accordance with embodiments of the present disclosure.

FIG. **5**A is a perspective view of multiple upper boxes inserted between the rig floor and base structure in accordance with embodiments of the present disclosure.

FIG. **5**B is a front view of an entire drilling rig with multiple upper boxes inserted between the drilling rig and the base structure in accordance with embodiments of the present disclosure.

FIG. **5**C is a side view of the drilling rig shown in FIG. **5**B in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

In one aspect, embodiments disclosed herein relate to drilling rig assembly methods and apparatus that use multiple box structures stacked on top of one another to elevate the drilling rig to a certain height. Referring initially to FIG. **5**A, a perspective view of a bottom portion of a fully assembled drilling rig **100** is shown in accordance with embodiments of the present disclosure. Drilling rig **100** includes a base structure **110**, multiple upper boxes **112**, **114**, and **116** stacked thereon, and a rig floor **102** located atop upper boxes **112**, **114**, **116**. Drilling rig **100** also includes lifting cylinders **108** attached to base structure **110**. Drilling rig **100** is assembled according to the following sequence.

Referring to FIG. **2**, a perspective view of a base structure **110** of a drilling rig **100** is shown in accordance with embodiments of the present disclosure. Base structure **110** may be configured as a land based structure or as an offshore platform. Base structure **110** includes at least two bottom box structures that are positioned at ground level to form a base structure from which to assemble drilling rig **100**. The bottom box structures may be configured as parallelogram truss structures or solid beams. Initially, strongback beams **104**, which are beams or girders that act as secondary support members, may rest on top of the bottom box structures of base structure **110**. The combination of the stacked bottom box structures of base structure **110** and strongback beams **104** may be about 8-10 feet in height. Additionally, base structure **110** may include lifting cylinders, or hydraulic cylinders **108**, attached thereto. Hydraulic cylinders **108** may be welded or fastened using mechanical fasteners to base structure **110**. Those skilled in the art will understand that other types of lifting cylinders may also be used, including but not limited to, pneumatic cylinders, electric cylinders, and mechanical screws.

Now referring to FIG. **3**A, a perspective view of a rig floor **102** including one or more pieces installed onto the base structure **110** of the drilling rig **100** is shown in accordance with embodiments of the present disclosure. Rig floor **102** is shown installed onto base structure **110** and strongback beams **104**. Strongback beams **104** may be attached to rig floor **102**, e.g., welded or fastened with mechanical fasteners. Rig floor **102** may be positioned on base structure **110** squarely so that load points **103** of the rig floor **102** are aligned with cylinders **108** of base structure **110**. As shown in FIGS. **3**B and **3**C, the rig floor **102** may include a derrick **106** (shown in FIGS. **3**A and **3**B) and all required drilling equipment installed thereon prior to being assembled onto base structure **110** (derrick and drilling equipment installed at ground level rather than at a final rig floor height). Thus, the rig floor **102** may be considered a completed rig floor with all required drilling equipment installed thereon prior to stacking the rig floor on the base structure and no further assembly may be required after the rig floor is elevated to a final height.

As shown in FIG. **4**A-**4**C, after the rig floor **102** is installed onto the base structure **110**, the cylinders **108** may be actuated and arms **109** of the cylinders **108** extended to contact load points **103** of rig floor **102** and elevate the rig floor **102**. After the arms **109** of cylinders **108** are fully extended, a gap may exist between the base structure **110** and the rig floor **102**. Full extension of arms **109** may be about 8 feet (about 2.5 m), thus, the gap between the base structure **110** and rig floor **102** is about 8 feet (about 2.5 m). A first upper box **112** may then be inserted into the gap created between the base structure **110** and rig floor **102**. First upper boxes **112** may also be approximately 8 feet (about 2.5 m) in height, and thus, when arms **109** of cylinders **108** are retracted, rig floor **102** immediately rests on top of first upper boxes **112**.

Referring now to FIGS. **5**A-**5**C, a drilling rig **100** having multiple upper boxes **112**, **114**, and **116** is shown in accordance with embodiments of the present disclosure. Additional upper boxes may be added in the same manner as the first upper box (previously described) to elevate the rig floor **102** to a desired height. To insert additional upper boxes, arms **109** (shown in FIG. **4**A) of the cylinders **108** may be extended to contact load points **105** of first upper box **112**. Arms **109** may be completely extended, which as before, leaves a gap between the first upper box **112** and base structure **110** into which a second upper box **114** may be inserted. Subsequently, arms **109** of cylinders **108** may be retracted. Load points **105** and **107** may be hinged or slid so that they may collapse into the upper box on which they are mounted (upper box **112** and **114**, respectively) and no longer protrude outside the upper box. The load points may collapse or otherwise moved out of position so that they do not interfere with extension of arms **109** of cylinders **108**. In alternative embodiments, an additional upper box may be inserted between an elevated rig floor and the first upper box, which is stacked atop the base structure.

To insert a third upper box, load points **107** of second upper box **114** may be hinged open to align with cylinders **108**. Arms **109** are completely extended, which elevates second upper box **114** and leaves a gap between the second upper box **114** and the base structure **110** into which a third upper box **116** may be inserted. Subsequently, arms **109** of cylinders **108** may be retracted. In alternative embodiments, an additional upper box may be inserted between an elevated rig floor and the second upper box, which is stacked atop the first upper box.

As previously mentioned, the desired height of the drilling rig **100** may be determined by the room needed below the rig floor **102** to install blowout preventer equipment. Also, the crown block at the top of the derrick must be far enough above the ground to be able to pull the drillpipe. Those skilled in the art will understand the height requirements to meet these criteria. In certain embodiments disclosed herein, a drilling rig having a rig floor stacked on three upper boxes and a base structure (bottom boxes) may have its rig floor at a height of about 38-40 feet (8-12 m).

Advantageously, embodiments of the present disclosure provide a method of assembling a drilling rig, which requires substantially less intervention from rig personnel as well as heavy lifting equipment, including larger cranes. The assembly method allows a drilling rig to be assembled in more remote locations where heavy equipment would be unable to travel. Remote drill sites may be more accessible using a drilling rig assembled using methods in accordance with embodiments disclosed herein. Therefore, rig assembly costs may be reduced and productivity costs may be increased.

While the present disclosure has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from the scope of the disclosure as described herein. Accordingly, the scope of the disclosure should be limited only by the attached claims.

What is claimed is:

1. A drilling rig comprising:

a base structure;

a lifting device attached to the base structure;

a rig floor comprising a derrick and drilling equipment disposed thereon; and

a first box disposed between the base structure and the rig floor to support the rig floor,

wherein the rig floor comprises a load point, the load point of the rig floor being axially aligned with the lifting device, and

wherein the first box comprises a box load point, the box load point of the first box being moveable between a protruding position, in which the box load point extends from the first box and is axially aligned with the lifting device to enable the lifting device to lift the first box, and a collapsed position, in which the box load point is retracted into a body of the first box and is not axially aligned with the lifting device to enable the lifting device to lift the rig floor or another box.

2. The drilling rig of claim **1**, wherein the lifting device is configured to lift the rig floor and the first box via the box load point such that a second box is capable of being disposed between the base structure and the rig floor.

3. The drilling rig of claim **1**, wherein the lifting device comprises hydraulic cylinders.

4. The drilling rig of claim **1**, wherein the lifting device comprises pneumatic cylinders.

5. The drilling rig of claim **1**, wherein the lifting device comprises mechanical screws.

6. The drilling rig of claim **1**, further comprising strongback beams disposed between the rig floor and the first box.

7. The drilling rig of claim **1**, wherein the base structure comprises at least two bottom box structures located at ground level.

8. The drilling rig of claim **1**, wherein the base structure is configured as a land based structure.

9. The drilling rig of claim **1**, wherein the base structure is configured as an offshore platform.

10. The drilling rig of claim **1**, wherein the first box comprises a plurality of box load points.

11. The drilling rig of claim **10**, wherein, the lifting device is axially aligned with at least one of the plurality of box load points.

12. The drilling rig of claim **10**, further comprising a plurality of lifting devices, each axially aligned with at least one of the plurality of box load points.

13. An oilfield rig, comprising:

a base structure and a rig floor having a derrick and an oilfield equipment disposed thereon; and

a lifting device configured to lift the rig floor to separate the rig floor and the base structure forming a space; at least one box disposed within said space,

wherein the rig floor comprises a load point, the load point of the rig floor being axially aligned the lifting device, and

wherein the at least one box comprises a box load point, the box load point of the at least one box being moveable between a protruding position, which the box load point extends from the at least one box and is axially aligned with the lifting device to enable the lifting device to lift the at least one box, and a collapsed position, in which the box load point is retracted into a body of the at least one box and is not axially aligned with the lifting device to enable the lifting device to lift the rig floor or another box.

14. The oilfield rig of claim **13**, wherein the at least one box supports the rig floor at a given height.

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