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(71) Applicant (for all designated States except US):
FRANK'S INTERNATIONAL, INC. [US/US]; 10260
Westheimer, Suite 700, Houston, TX 77042 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KAMPMAN, Rolf, N.** [NL/NL]; Vogelzand 2620, NL-1788 GR Den Helder (NL). **SCHMIDT, Hans, A.** [DE/DE]; Rohrsers Breite 25, 31789 Hameln (DE).

(74) Agent: **THE MATTHEWS FIRM**; 2000 Bering Drive,
Suite 700, Houston, TX 77057 (US).

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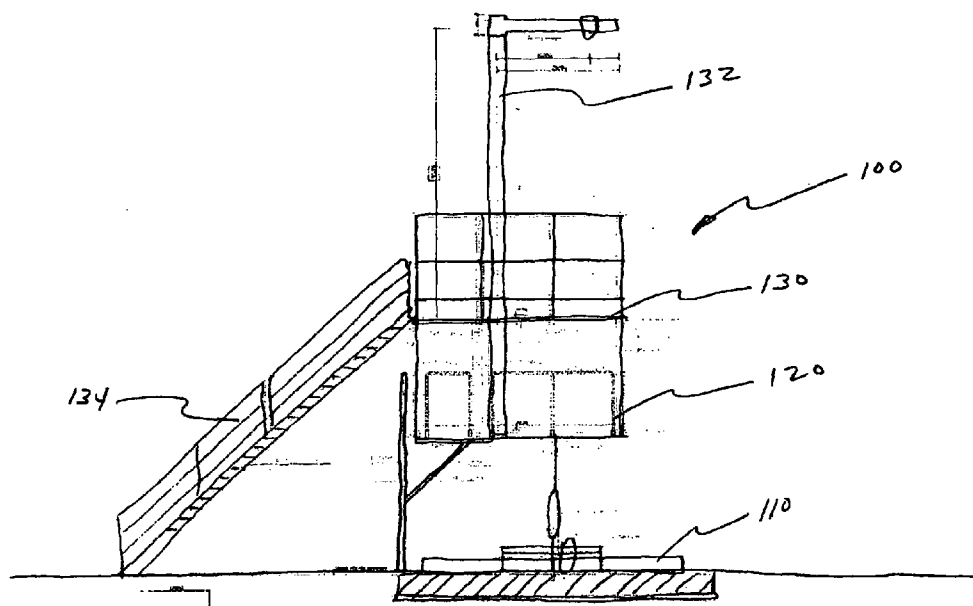
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(54) Title: RIGLESS WELL INTERVENTION APPARATUS AND METHOD



(57) Abstract: The present invention relates generally to a rigless well intervention apparatus and method for well completion, recompletion, servicing, workover and intervention. Specifically, the present invention relates to a rigless well intervention apparatus and method for performing various well completion, recompletion, servicing, workover and intervention operations that pertains to a range of products, services and techniques whether designed to be run through, or conducted within, the production tubing of an oil or gas well, or not, ranging from the ability to operate within a restricted diameter tubular with live-well intervention when the tubing is in place to the ability to drill the well.

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RIGLESS WELL INTERVENTION APPARATUS AND METHOD

FIELD OF THE INVENTION

The present invention relates generally to a rigless well intervention apparatus and method. Specifically, the present invention relates to a rigless well intervention apparatus and method for performing various well workover and intervention operations that pertains to a range of products, services and techniques designed to be run through, or conducted within, the production tubing of an oil or gas well ranging from the ability to operate within a restricted diameter tubular with live-well intervention particularly, for running or pulling pipe on salt leaching, geothermal or suspended wells.

BACKGROUND OF THE INVENTION

Oil well completion is a generic term used to describe the assembly of downhole tubulars and equipment required to enable the safe and efficient production from an oil or gas well. The point at which the completion process begins may depend on the type and design of the well. However, there are many options applied or actions performed during the construction phase of a well that have significant impact on the productivity of the well.

The drilling completion hardware is used to optimize the production of hydrocarbons from the well. This may range from nothing but a packer on tubing above an openhole completion, sometimes referred to as barefoot completion, to a system of mechanical filtering elements outside of the perforated pipe, to a fully automated measurement and control system that optimizes reservoir economics without human intervention, sometimes referred to as an intelligent completion.

The drilling completion hardware, typically, requires a drilling rig. A drilling rig is the machine used to drill a wellbore. In onshore operations, the rig includes virtually everything except living quarters. Major components of the rig include the mud tanks, the mud pumps, the derrick or mast, the drawworks, the rotary table or topdrive, the drillstring, the power generation equipment and auxiliary equipment. Offshore, the rig includes the same components as onshore, but not those of the vessel or drilling platform itself. The rig is sometimes referred to as the drilling package, particularly offshore.

The rigless operation of a well completion process is defined as the well-intervention operation conducted with equipment and support facilities that precludes the requirement for a rig over the wellbore. By way of example, and without limitation, examples of rigless well completion operations are coiled tubing, slickline and snubbing activities. However, it can be appreciated by those skilled in the art that the use of the present invention provides for the use of a rigless operation that can encompass essentially all well completion processes.

With respect to drilling a well, snubbing is the act of putting drillpipe into the wellbore when the blowout preventers (BOPs) are closed and pressure is contained in the well. Snubbing is necessary when a kick is taken, since well kill operations should always be conducted with the drillstring on bottom, and not somewhere up the wellbore. If only the annular blowout preventer has been closed, the drillpipe may be slowly and carefully lowered into the wellbore, and the blowout preventer itself will open slightly to permit the larger diameter tool joints to pass through. If the well has been closed with the use of ram blowout preventers, the tool joints

will not pass by the closed ram element. Hence, while keeping the well closed with either another ram blowout preventer or the annular blowout preventer, the ram must be opened manually, then the pipe lowered until the tool joint is just below the ram, and then closing the ram again. This
5 procedure is repeated whenever a tool joint must pass by a ram blowout preventer. In snubbing operations, the pressure in the wellbore acting on the cross-sectional area of the tubular can exert sufficient force to overcome the weight of the drillstring, so the string must be pushed or “snubbed” back into the wellbore. In ordinary stripping operations, the pipe falls into the
10 wellbore under its own weight, and no additional downward force or pushing is required.

Through-tubing well completion operations pertain to any reservoir or wellbore treatment performed through the tubing string. Through-tubing treatments are generally associated with live-well operations, thereby
15 causing minimal interruption to production and eliminating the need to kill the well.

Well workover and intervention operations pertain to a range of products, services and techniques designed to be run through, or conducted within, the production tubing of an oil or gas well. The term implies an
20 ability to operate within a restricted diameter tubular and is often associated with live-well intervention since the tubing is in place.

Typically, the well site is required to be rigged-up prior to production beginning. The rigging-up process includes setting up the substructure of the rig, setting up rig floor, setting up the mast or derrick,
25 installing handrails, guardrails, stairs, walkways, and ladders, installing the power systems, rigging up the circulating system, installing the auxiliary

equipment, and inspecting the rig. After the procedure is complete that required the rig, the rigging-down procedure is begun. The rigging down procedure is, typically, the opposite procedure from the rigging-up procedure.

5 In setting up the substructure of the rig, the equipment is unloaded and positioned at or near the exact location that it will occupy during operations. The substructure is assembled, pinned together, leveled, and made ready for other rig components on the floor. Equipping the cellar begins but can be done throughout the rigging up process. Equipping the
10 cellar includes welding on a drilling nipple to the conductor pipe and attaching a flow line. The cellar is a pit in the ground to provide additional height between the rig floor and the well head to accommodate the installation of blowout preventers, ratholes, mouseholes, and so forth. The cellar also collects drainage water and other fluids for disposal.

15 Once the substructure is set in place, the process of setting up the rig floor begins. Setting up the rig floor begins by installing stairways and guardrails to allow access to the rig floor. Then, the drawworks is set in place and secured to the substructure. On mechanical rigs, the engines are set in place and the compound and associated equipment connected to the
20 drawworks. On electric rigs, the electric cables or lines are strung to the drawworks.

 The bottom of the mast is raised to the rig floor and pinned in place. The crown section is then raised into place on the derrick stand. The "A-legs" are raised and pinned into place. The monkey board is pinned in place
25 on the mast and all lines and cables are laid out to prevent tangling when the mast is raised. The mast is now ready to be raised. The engines are

started, and the drilling line is spooled onto the drawworks drum. Once the mast has been raised and pinned, the remaining floor equipment can be set into place. If the rig has safety guylines, they must be attached to the anchors and properly tensioned prior to continuing the rigging up process.

- 5 A derrick emergency escape device is installed on the mast. Handrails, guardrails, stairways, walkways, and ladders are installed where they are needed for safety and access.

The power system is usually installed simultaneously with setting up the rig floor, because power is needed to operate the equipment. Today
10 there are generally two types of rigs being used on land. A mechanical rig is powered by engines and compound. An electric rig is powered by engines and generators. This type supplies power to electric motors, which drive the machinery. All power cords, belts, and chains are connected to the machinery from their associated power source. Also, the fuel lines and tanks
15 are hooked up, and the engines are started.

Then, the circulating system is rigged up. Rigging up the circulating system requires that the mud tanks and mud pumps are set into the predetermined location. The mud lines are then connected and electric cords are strung.

- 20 Thereafter, all remaining drilling and auxiliary equipment must be set into place and installed where needed. The catwalk and pipe racks are positioned and the pipe and drill collars are set on the racks.

After production casing is run and cemented, the rig is taken down and moved to another site. The rigging down process is similar to, but the
25 opposite of, the rigging up process.

Wells eventually need maintenance or service on the surface or down-hole equipment. Working on an existing well to restore or increase oil and gas production is an important part of the petroleum industry. A well that is not producing to its full potential may require service or workover.

5 Workover activities include one or more of a variety of remedial operations on a producing well to try to increase production. For example, sand cleanout operations are performed to remove buildup of sand in the wellbore. Repair is required for the liners and casing. The liners and casing are essentially the same and repair procedures are the same for both. Casing
10 can be damaged by corrosion, abrasion, pressure, or other forces that create holes or splits. A packer is run down the well to locate the hole in the casing. Fluid is pumped into the casing above the packer. A loss of pressure indicates a hole in the casing. Examples of just some of the principal methods for repairing casing is squeeze cementing, patching a liner,
15 replacing casing, adding a liner, and opening collapsed casing.

 Sidetracking is the workover term for drilling a directional hole to bypass an obstruction in the well that cannot be removed or causes damage to the well, such as a collapsed casing that cannot be repaired. Sidetracking is also done to deepen a well or to relocate the bottom of the well in a more
20 productive zone, which is horizontally removed from the original well. To sidetrack, a hole called a window is made in the casing above the obstruction. The well is then plugged with cement below the window. Special drill tools, such as a whipstock, bent housing, or bent sub are used to drill off at an angle from the main well. This new hole is completed in
25 the same manner as any well after a liner is set.

Plug-back places a cement plug at one or more locations in a well to shut off flow from below the plug. Plug-back is also used before abandoning a well or before sidetracking is done.

Generally, a pulling unit or production rig is a well-servicing outfit
5 used in pulling rods and tubing from the well. The production rig is a portable servicing or workover unit, usually mounted on wheels and self-propelled. A well servicing unit consists of a hoist and engine mounted on a wheeled chassis with a self-erecting mast. A workover rig is basically the same, with the addition of a substructure with rotary, pump, pits, and
10 auxiliaries to permit handling and working a drill string.

Among the reasons for pulling tubing includes replacing a packer, locating a tubing leak, or plugged tubing. To service, repair, or replace the rods or pump, the sucker rod string must be pulled out of the hole. Pulling rods refers to the process of removing rods from the well. Running rods
15 refers to the process of replacing rods in the well.

To begin the process of pulling or running rods, the wellhead must be removed from the casing flange. The wellhead or casing head is a heavy, flanged steel fitting connected to the first string of casing. The casing head provides a housing for slips and packing assemblies, allows suspension of
20 intermediate and production strings of casing, and supplies the means for the annulus to be sealed off. It may also be called a spool.

The above background discussion provides examples where the rigless well intervention apparatus and method of the present invention can be used. The above discussion is not intended to be limiting, but rather, is
25 meant to be exemplar. Thus, one skilled in the art will appreciate that the rigless well intervention apparatus and method can be adapted for use in

many and varied applications, including applications not discussed above, but appreciated by those skilled in the art as being applicable applications of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The accompanying drawings which are incorporated in and constitute a part of the specification, illustrate a preferred embodiment of the invention and together with the general description of the invention given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

10 FIG. 1 is an elevation view of a preferred embodiment of the rigless well intervention apparatus encompassed by the present invention.

FIG. 2 is an elevation view of the preferred embodiment of the rigless well intervention apparatus encompassed by the present invention at a 90 degree angle from the view in FIG. 1.

15 FIG. 3 is an plan view of the preferred embodiment of the rigless well intervention apparatus encompassed by the present invention as illustrated in FIGS. 1 and 2.

FIG. 4 is an plan view of the upper level of the preferred embodiment of the rigless well intervention apparatus encompassed by the present invention as illustrated in FIGS. 1, 2 and 3.

20 FIG. 5 is an illustration of a preferred embodiment of the rigless well intervention apparatus encompassed by the present invention showing a landing joint about to engage a hanger.

FIG. 6 is an illustration of the preferred embodiment of the rigless well intervention apparatus in FIG. 5 showing the hanger being removed.

25

FIG. 7 is an illustration of the preferred embodiment of the rigless well intervention apparatus in FIGS. 5 and 6 showing the hanger being removed and the cylinders and gauges.

FIG. 8 is an illustration of the preferred embodiment of the rigless well intervention apparatus in FIGS. 5, 6 and 7 showing the hanger removed.

FIG. 9 is an illustration of a preferred embodiment of the rigless well intervention apparatus encompassed by the present invention showing a spider on the second level with the spider in an open position.

FIG. 10 is an illustration of a preferred embodiment of the rigless well intervention apparatus encompassed by the present invention showing the spider on the second level as shown in FIG. 9 with the spider in an engaged position.

FIG. 11 is an illustration of a preferred embodiment of the rigless well intervention apparatus encompassed by the present invention showing the rigless well intervention apparatus being lifted and placed on a well.

FIG. 12 is flow chart of a preferred embodiment of the rigless well intervention method encompassed by the present invention.

FIG. 13 is flow chart of another preferred embodiment of the rigless well intervention method encompassed by the present invention.

FIG. 14 is flow chart of another preferred embodiment of the rigless well intervention method encompassed by the present invention.

The above general description and the following detailed description are merely illustrative of the generic invention, and additional modes, advantages, and particulars of this invention will be readily suggested to

those skilled in the art without departing from the spirit and scope of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The rigless intervention apparatus of the present invention is a
5 substructure frame created to handle pipe and perform many and varied
well workover and intervention operations. Such operations can pertain to
a range of products, services and techniques associated with running or
pulling pipe, or alternately, associated with the servicing or repair of the
production tubing or other aspects of an oil or gas well. The rigless
10 intervention apparatus of the present invention is especially adapted for
running or pulling pipe on salt leaching, geothermal, or suspended wells.

The substructure frame of the rigless intervention apparatus and
method of the present invention includes hydraulic jacks and strain gauges
for accurately controlling the positioning and movement of the pipe or
15 other well components.

The rigless intervention apparatus of the present invention provides a
moveable framework adapted for movement mechanically, hydraulically,
using any type of fluid pressure, or any other way to move the parts of the
frame to enable lifting or moving tubulars, pipe, and other components. In
20 one embodiment, the framework of the rigless intervention apparatus of the
present invention has three levels: a upper level, a mid level and a base
level. The top level has a gallows-type device for lifting. The mid level has
a spider elevator. And, the base level is configured to any height required to
accommodate the ground covered. The rigless intervention apparatus of the
25 present invention has a lifting capacity of several hundred tons. Strain
gauges are incorporated into the rigless intervention apparatus of the present

invention to determine and to monitor the exact weight to be lifted or being lifted. The strain gauges are preferably in operative association with or located in the lifting mechanism. However, it is appreciated by one skilled in the art that the strain gauges can be adapted for use with respect to any
5 part of the rigless intervention apparatus of the present invention. Thus, the rigless intervention apparatus of the present invention can determine, for example, the weight of the pipe of the old string hanging on the hook, or, what the weight is before initiating the pull to make sure that the weight of the string will not exceed the pulling weight. The rigless intervention
10 method and apparatus of the present invention replaces the conventional rig and incorporates the ability to monitor the lifting process.

Activities for which the rigless intervention apparatus of the present invention is adapted particularly includes, without limitation, running completions, running and pulling casing for measuring the cavern cavities,
15 pulling damaged pipe, jacking of the hanger prior to pulling, drilling salt with a mud motor, repair cavity leakage by pumping synthetic resin, drilling a synthetic plug, testing with an inflatable plug system, change over of the P-Seals on the well head without pulling the casing, pull testing on the packer down hole, setting completion in tension, cavern acceptance
20 testing, changing seals on the wellhead. Examples of the varied and different activities for which the rigless intervention apparatus of the present invention is adapted are jacking the hanger free, running pipe and running a control line.

The rigless intervention apparatus of the present invention can be
25 built, transported and lifted into place on the well head.

The advantages of the rigless intervention apparatus of the present invention are varied and numerous. By way of example, and without limitation, the rigless intervention apparatus and method of the present invention is designed for leached activities, it is safe to operate, has low transportation cost, has low rig movement cost, has low cost during the rig-up and rig-down process, the capacity can be above a conventional workover rig, it has minimum equipment requirements, no highly qualified personnel are required, it has minimum certification requirements, and all operations are PC monitored. Additional features and advantages of the invention will be set forth in part in this description, and in part will become apparent from the description, or may be learned by practice of the invention. The features and advantages of the invention may be realized by means of the combinations and steps particularly pointed out in the appended claims.

Reference will now be made in detail to the present preferred embodiments of the invention as described in the accompanying drawings.

FIG. 1 is an elevation view of a preferred embodiment of the rigless well intervention apparatus 100 encompassed by the present invention. The rigless well intervention apparatus 100 comprises a base level 110, an intermediate level 120 and an upper level 130. The upper level 130 has a gallows structure 132 for lifting components. Also, the upper level 130 has a ladder 134 for accessing the upper level 130.

FIG. 2 is an elevation view of the preferred embodiment of the rigless well intervention apparatus 200 encompassed by the present invention. The rigless well intervention apparatus 200 in FIG. 2 is shown at a 90 degree angle from the view in FIG. 1. The rigless well intervention

apparatus 200 comprises a base level 210, an intermediate level 220 and an upper level 230.

FIG. 3 is an elevation view of an embodiment of the cylinder 316A, 316B and strain gauge 318A, 318B arrangement of a preferred embodiment of the rigless well intervention apparatus 300 encompassed by the present invention. The rigless well intervention apparatus 300 is shown with a base level 310 and an intermediate level 320. Intermediate between the base level 310 and the intermediate level 320 are a rotating member 311A, 311B, an exterior cylinder 312A, 312B, a cylinder mechanism 316A, 316B, a strain gauge 318A, 318B, a shaft 314A, 314B and a second rotating member 314A, 314B.

FIG. 4 is an plan view of an upper level 402 of the preferred embodiment of the rigless well intervention apparatus 400 encompassed by the present invention.

FIG. 5 is an illustration of a preferred embodiment of the rigless well intervention apparatus 500 encompassed by the present invention showing a landing joint 12 about to engage a hanger 14. The landing joint 12 and the hanger 14 are disposed between the base level 510 and the intermediate level 520.

FIG. 6 is an illustration of the preferred embodiment of the rigless well intervention apparatus 600 in FIG. 5 showing the hanger 12 being removed from the well head 16. FIG. 6 also illustrates the base level 610, the intermediate level 620 and the upper level 630. Between the base level 610 and the intermediate level 620, the rotating member 611, the exterior cylinder 312, and the shaft 314 are shown.

FIG. 7 is an illustration of the preferred embodiment of the rigless well intervention apparatus 700 in FIGS. 5 and 6 showing the hanger 12 being removed from the well head 16 via the landing joint 14. The intermediate level 720 is supported by the combination of the exterior cylinder 712, the rod 714 and the rotating member 713. Also illustrated is the connection 718C in the cylinder 712 for the strain gauge. The rod 714 is shown extended from the cylinder 712.

FIG. 8 is an illustration of the preferred embodiment of the rigless well intervention apparatus 800 in FIGS. 5, 6 and 7 showing the hanger 12 removed. Between the base level 810 and the intermediate level 820, the rotating member 811, the exterior cylinder 812, and the shaft 814 are shown. The rod 814 is shown withdrawn into the cylinder 812.

FIG. 9 is an illustration of a preferred embodiment of the rigless well intervention apparatus encompassed by the present invention showing the spider 932 on the second level 920 and below the upper level 930. The spider 932 is in a disengaged, open position.

FIG. 10 is an illustration of a preferred embodiment of the rigless well intervention apparatus encompassed by the present invention showing the spider 1032 on the second level 1020 and below the upper level 1030. The spider 1032 is in an engaged, closed position.

FIG. 11 is an illustration of a preferred embodiment of the rigless well intervention apparatus 1100 encompassed by the present invention showing the rigless well intervention apparatus 1100 being lifted and placed on a well by a crane 18.

FIG. 12 is flow chart of a preferred embodiment of the rigless well intervention method 1200 encompassed by the present invention. The

method is for performing various well completion, recompletion, servicing, workover and intervention operations that pertain to a range of products, services and techniques applied to a well having a wellbore, and particularly, associated with a pipe string. The method comprises the steps

5 of maintaining a structure in association with the wellbore such that the structure has a maximum string pulling capacity 1202, measuring the weight of the pipe string in the wellbore 1204, determining whether the weight of the pipe string in the wellbore exceeds the maximum string pulling capacity of the structure 1206, if the weight of the pipe string in

10 the wellbore exceeds the maximum string pulling capacity of the structure then, terminating the pull of the pipe string in the wellbore 1208, and, if the weight of the pipe string in the wellbore does not exceed the maximum string pulling capacity of the structure then, commencing the pull of the pipe string in the wellbore 1210.

15 FIG. 13 is flow chart of another preferred embodiment of the rigless well intervention method 1300 encompassed by the present invention for performing various well completion, recompletion, servicing, workover and intervention operations that pertains to a range of products, services and techniques applied to a well having a wellbore and a component associated

20 with the well. The method comprising the steps of maintaining a structure in association with the wellbore such that the structure has a maximum lifting capacity 1302, measuring the weight of the component associated with the well 1304, determining whether the weight of the component associated with the well exceeds the maximum lifting capacity of the

25 structure 1306, if the weight of the component associated with the well exceeds the maximum lifting capacity of the structure then, terminating the

lift of the component associated with the well 1308, and if the weight of the component associated with the well does not exceed the maximum lifting capacity of the structure then, commencing the lift of the component associated with the well 1310.

5 FIG. 14 is flow chart of another preferred embodiment of the rigless well intervention method 1400 encompassed by the present invention for performing various well completion, recompletion, servicing, workover and intervention operations that pertains to a range of products, services and techniques applied to a well having a wellbore and a component associated
10 with the well. The method comprising the steps of maintaining a structure in association with the wellbore such that the structure has a maximum lifting capacity 1402, measuring the weight of the component associated with the well 1404, determining whether the weight of the component associated with the well exceeds the maximum lifting capacity of the
15 structure 1406, if the weight of the component associated with the well exceeds the maximum lifting capacity of the structure then, terminating the lift of the component associated with the well 1408, if the weight of the component associated with the well does not exceed the maximum lifting capacity of the structure then, commencing the lift of the component
20 associated with the well 1410, monitoring the weight of the component during the lift 1412, if the weight of the component exceeds the maximum lifting capacity of the structure during the lifting process then, terminating the lift of the component and secure the component 1414, and if the weight of the component does not exceed the maximum lifting capacity of the
25 structure during the lifting process then, continuing the lift of the component to completion 1416.

Additional advantages and modification will readily occur to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus, and the illustrative examples shown and described herein. Accordingly, departures may be
5 made from the details without departing from the spirit or scope of the disclosed general inventive concept.

WHAT IS CLAIMED IS:

1 1. A method for performing various well completion,
2 recompletion, servicing, workover and intervention operations that pertains
3 to a range of products, services and techniques applied to a well having a
4 wellbore comprising a pipe string, the method comprising the steps of:

5 (a) maintaining a structure in association with the wellbore
6 such that the structure has a maximum string pulling
7 capacity,

8 (b) measuring the weight of the pipe string in the wellbore,

9 (c) determining whether the weight of the pipe string in the
10 wellbore exceeds the maximum string pulling capacity of
11 the structure,

12 (d) if the weight of the pipe string in the wellbore exceeds
13 the maximum string pulling capacity of the structure
14 then, terminating the pull of the pipe string in the
15 wellbore, and

16 (e) if the weight of the pipe string in the wellbore does not
17 exceed the maximum string pulling capacity of the
18 structure then, commencing the pull of the pipe string in
19 the wellbore.

1 2. A method for performing various well completion,
2 recompletion, servicing, workover and intervention operations that pertains
3 to a range of products, services and techniques applied to a well having a
4 wellbore and a component associated with the well, the method comprising
5 the steps of:

- 6 (a) maintaining a structure in association with the wellbore
7 such that the structure has a maximum lifting capacity,
- 8 (b) measuring the weight of the component associated with
9 the well,
- 10 (c) determining whether the weight of the component
11 associated with the well exceeds the maximum lifting
12 capacity of the structure,
- 13 (d) if the weight of the component associated with the well
14 exceeds the maximum lifting capacity of the structure
15 then, terminating the lift of the component associated
16 with the well, and
- 17 (e) if the weight of the component associated with the well
18 does not exceed the maximum lifting capacity of the
19 structure then, commencing the lift of the component
20 associated with the well.

1 3. A method for performing various well completion,
2 recompletion, servicing, workover and intervention operations that pertains
3 to a range of products, services and techniques applied to a well having a
4 wellbore and a component associated with the well, the method comprising
5 the steps of:

- 6 (a) maintaining a structure in association with the wellbore
7 such that the structure has a maximum lifting capacity,
- 8 (b) measuring the weight of the component associated with
9 the well,
- 10 (c) determining whether the weight of the component
11 associated with the well exceeds the maximum lifting
12 capacity of the structure,
- 13 (d) if the weight of the component associated with the well
14 exceeds the maximum lifting capacity of the structure
15 then, terminating the lift of the component associated
16 with the well,
- 17 (e) if the weight of the component associated with the well
18 does not exceed the maximum lifting capacity of the
19 structure then, commencing the lift of the component
20 associated with the well,
- 21 (f) monitoring the weight of the component during the lift,
- 22 (g) if the weight of the component exceeds the maximum
23 lifting capacity of the structure during the lifting process
24 then, terminating the lift of the component and secure
25 the component, and

26 (g) if the weight of the component does not exceed the
27 maximum lifting capacity of the structure during the
28 lifting process then, continuing the lift of the component
29 to completion.

1 4. An apparatus for performing various well completion,
2 recompletion, servicing, workover and intervention operations that pertains
3 to a range of products, services and techniques applied to a well having a
4 wellbore and a component associated with the well, the apparatus
5 comprising:

6 (a) a structure having a plurality of levels such that the
7 structure has a maximum lifting capacity, the levels
8 adapted to lift the component associated with the well,
9 and

10 (b) at least one strain gauge associated with the plurality of
11 levels of the structure for monitoring the weight
12 associated with the process of lifting the component such
13 that the maximum lifting capacity of the structure will
14 not be exceeded, and further, the monitoring of the
15 weight associated with the process of lifting the
16 component provides for changing the rate of movement
17 of the process of lifting the component for increasing the
18 rate of movement of the process when the monitored
19 weight is appropriate for an increase and decreasing the
20 rate of movement of the process when the monitored
21 weight is appropriate for a decrease such that the
22 maximum lifting capacity of the structure will not be
23 exceeded and the maximum rate of the process is
24 achieved.

1 5. An apparatus for performing various well completion,
2 recompletion, servicing, workover and intervention operations that pertains
3 to a range of products, services and techniques applied to a well having a
4 wellbore comprising a pipe string, the apparatus comprising:

5 (a) a structure having a plurality of levels such that the
6 structure has a maximum lifting capacity, the levels
7 adapted to accomplish the process of at least one of
8 pulling the pipe string and running a pipe string, and

9 (b) at least one strain gauge associated with the plurality of
10 levels of the structure for monitoring the weight
11 associated with the process of at least one of pulling the
12 pipe string and running the pipe string such that the
13 maximum lifting capacity of the structure will not be
14 exceeded, and further, the monitoring of the weight
15 associated with the process of at least one of pulling the
16 pipe string and running the pipe string provides for
17 adapting the rate of movement of the process for
18 increasing the rate of movement of the process when the
19 monitored weight is appropriate for an increase and
20 decreasing the rate of movement of the process when the
21 monitored weight is appropriated for a decrease such that
22 the maximum lifting capacity of the structure will not be
23 exceeded and the maximum rate of the process is
24 achieved.

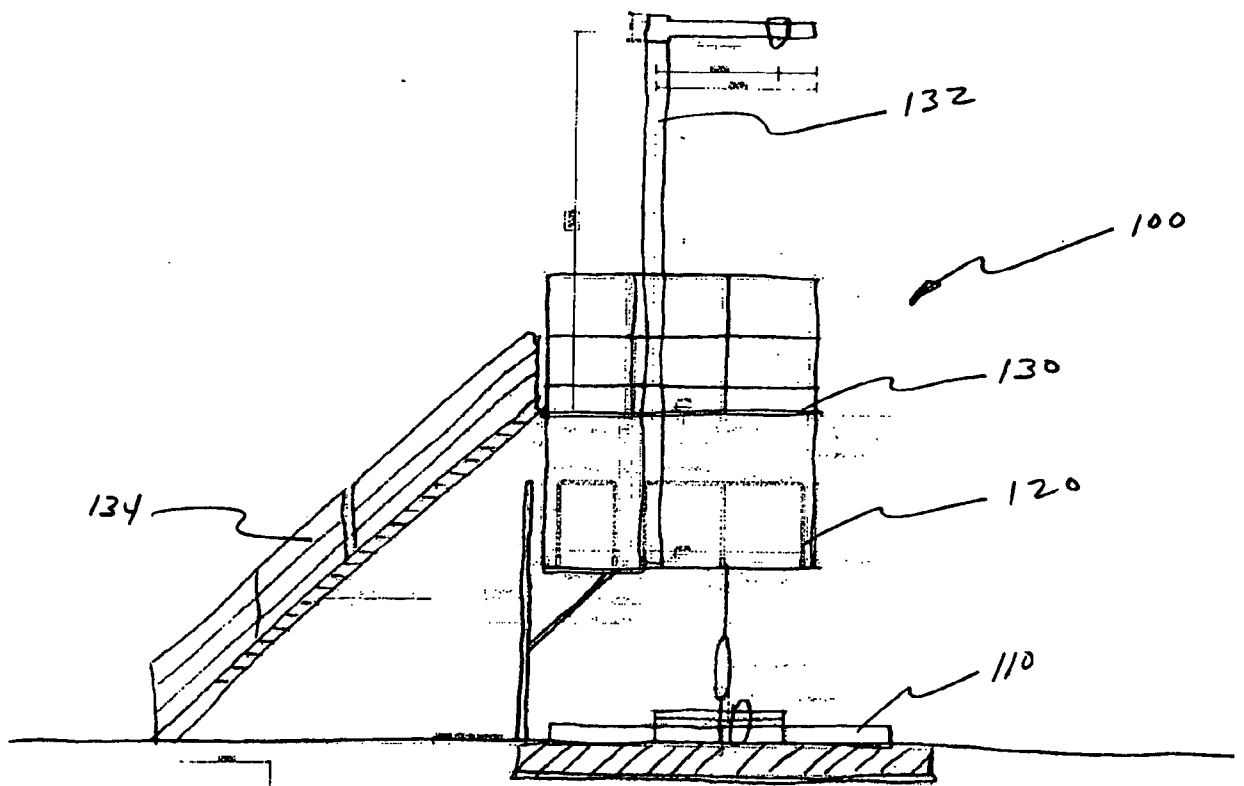


FIG. 1

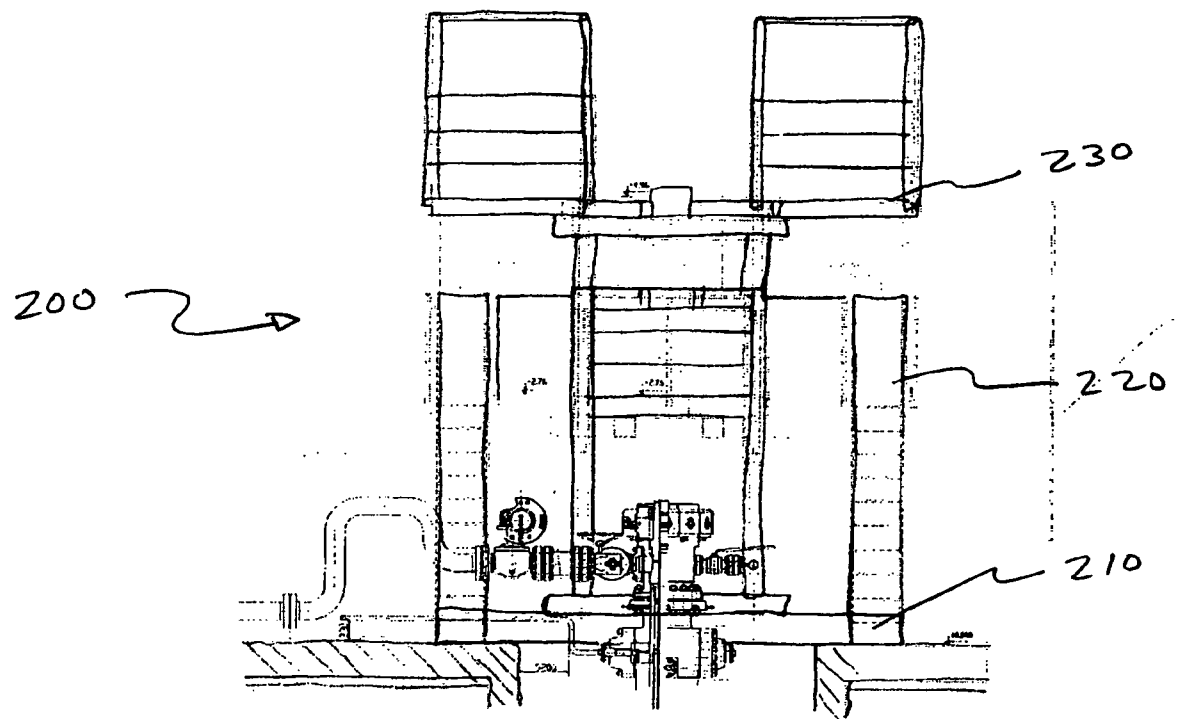
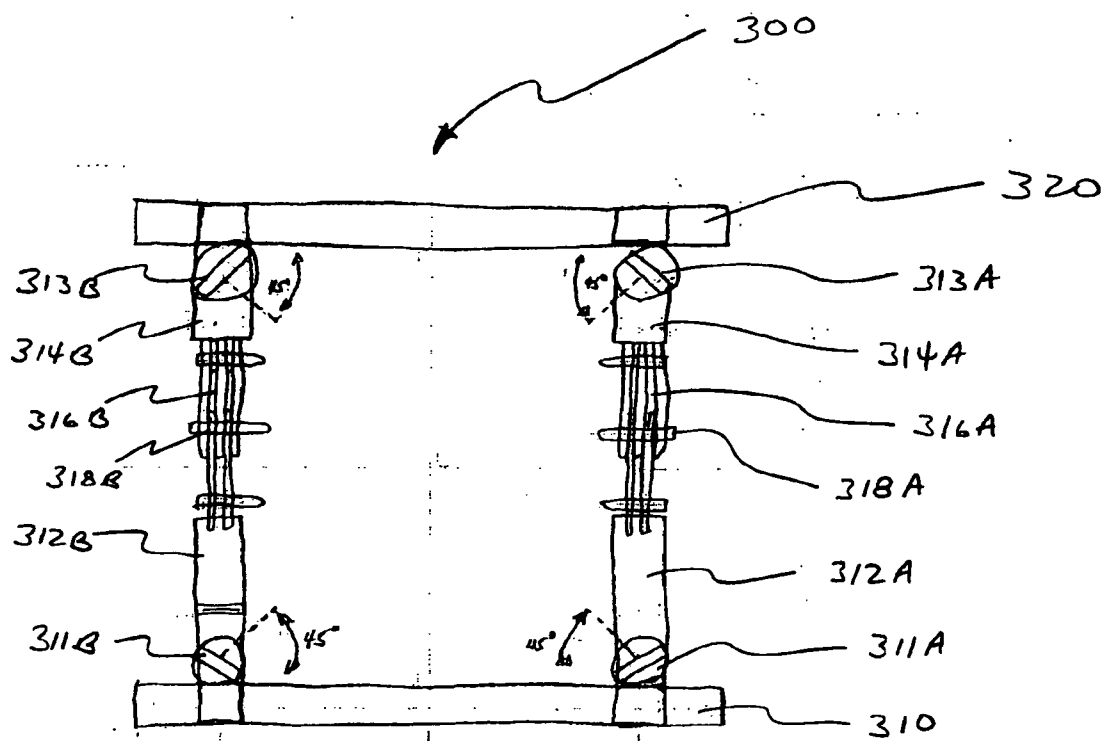


FIG. 2

FIG. 3

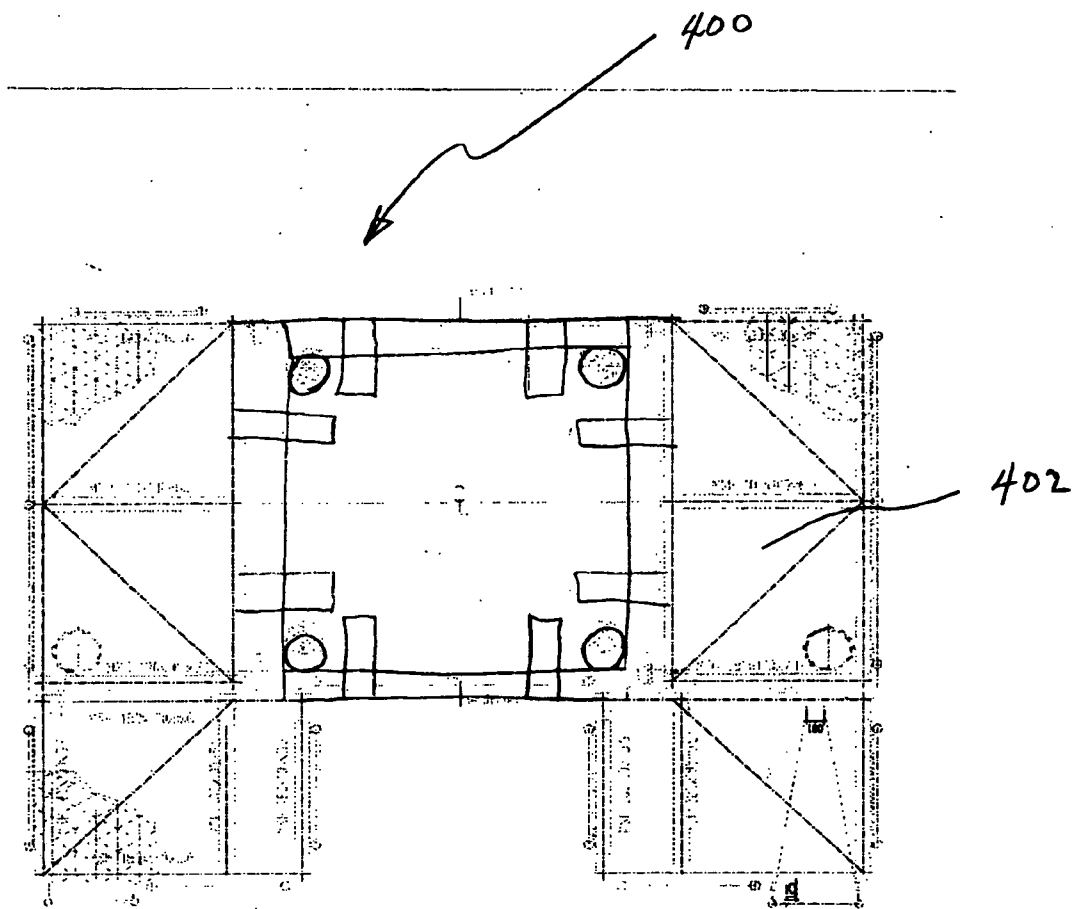


FIG. 4

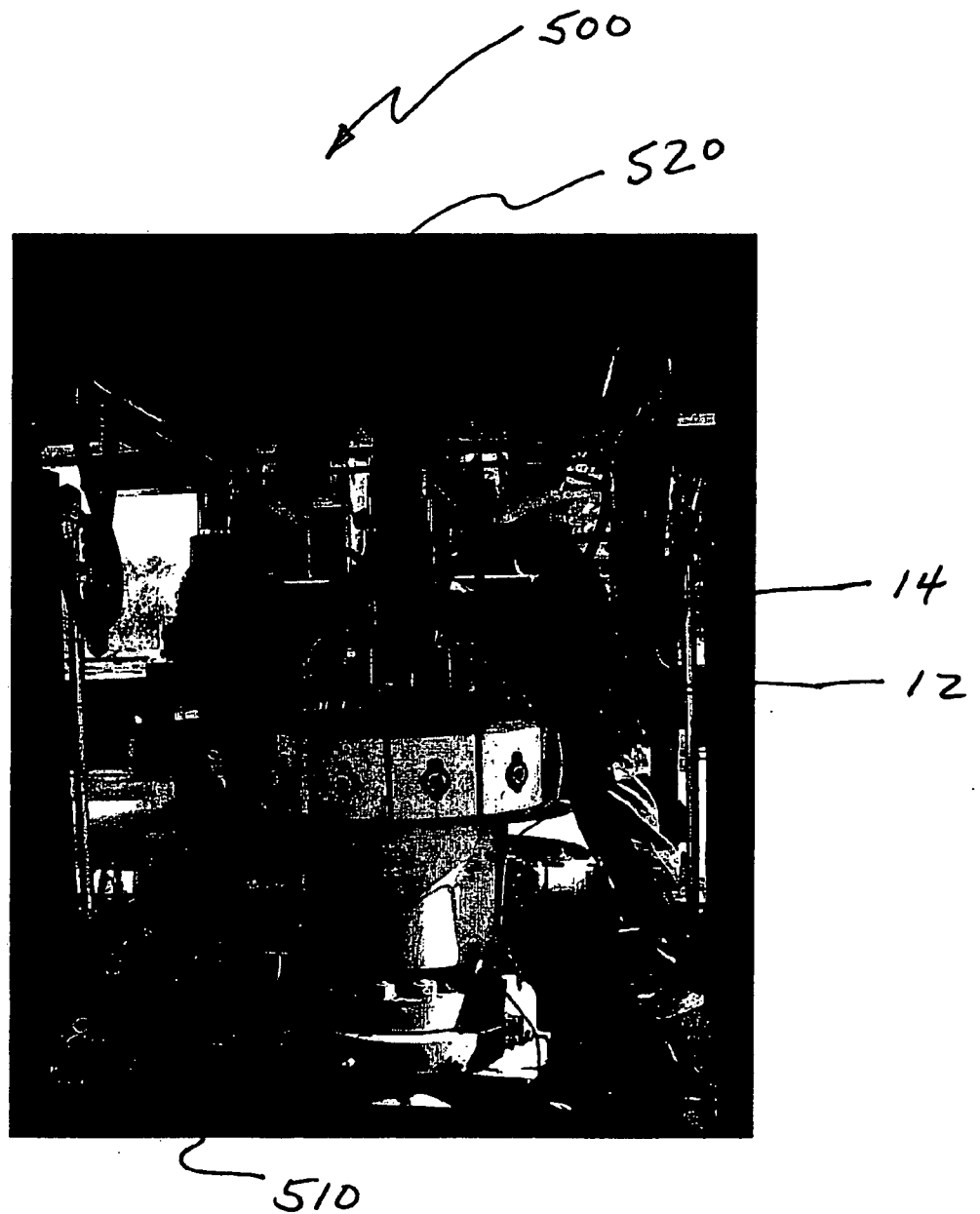


FIG. 5

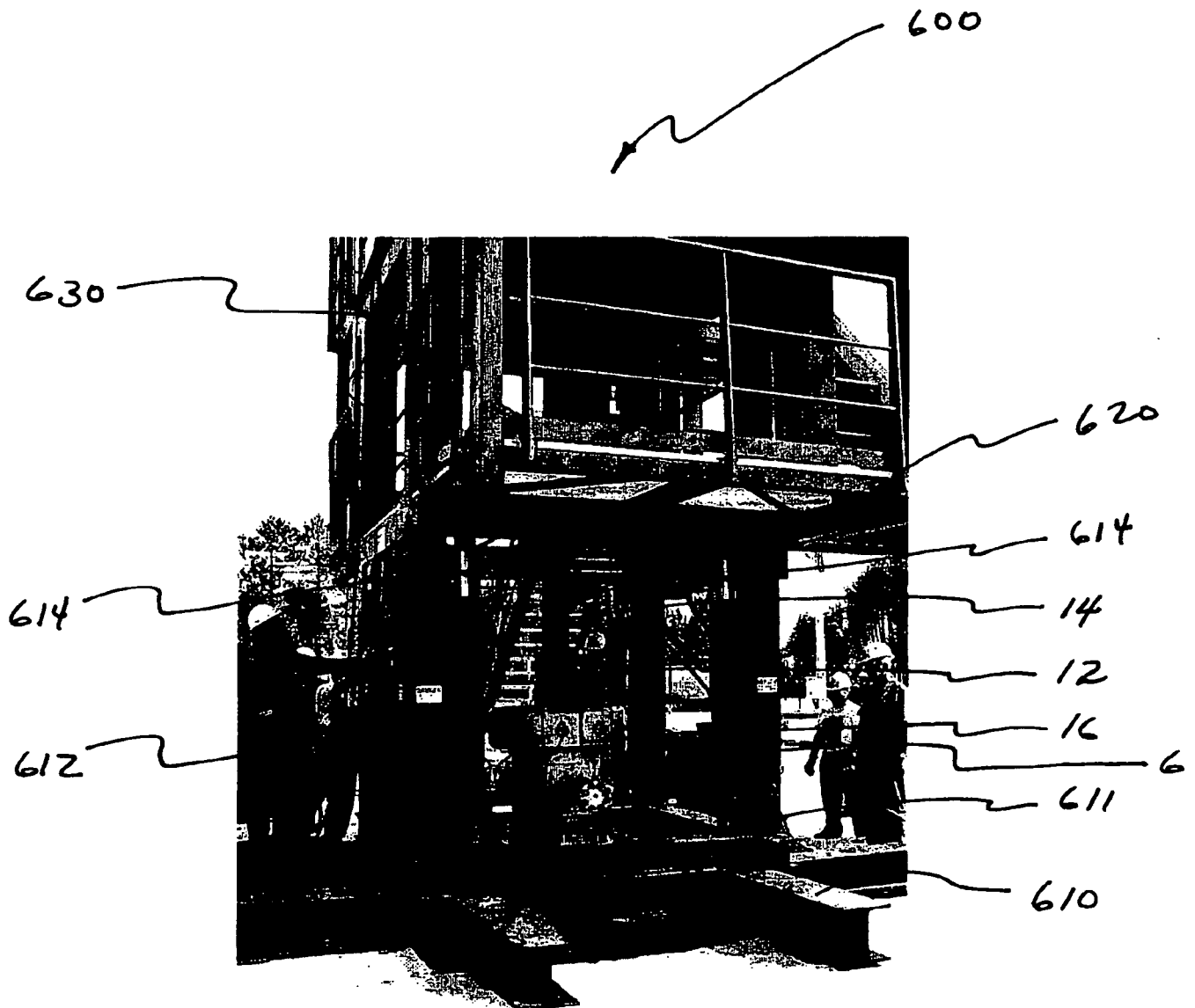


FIG. 6

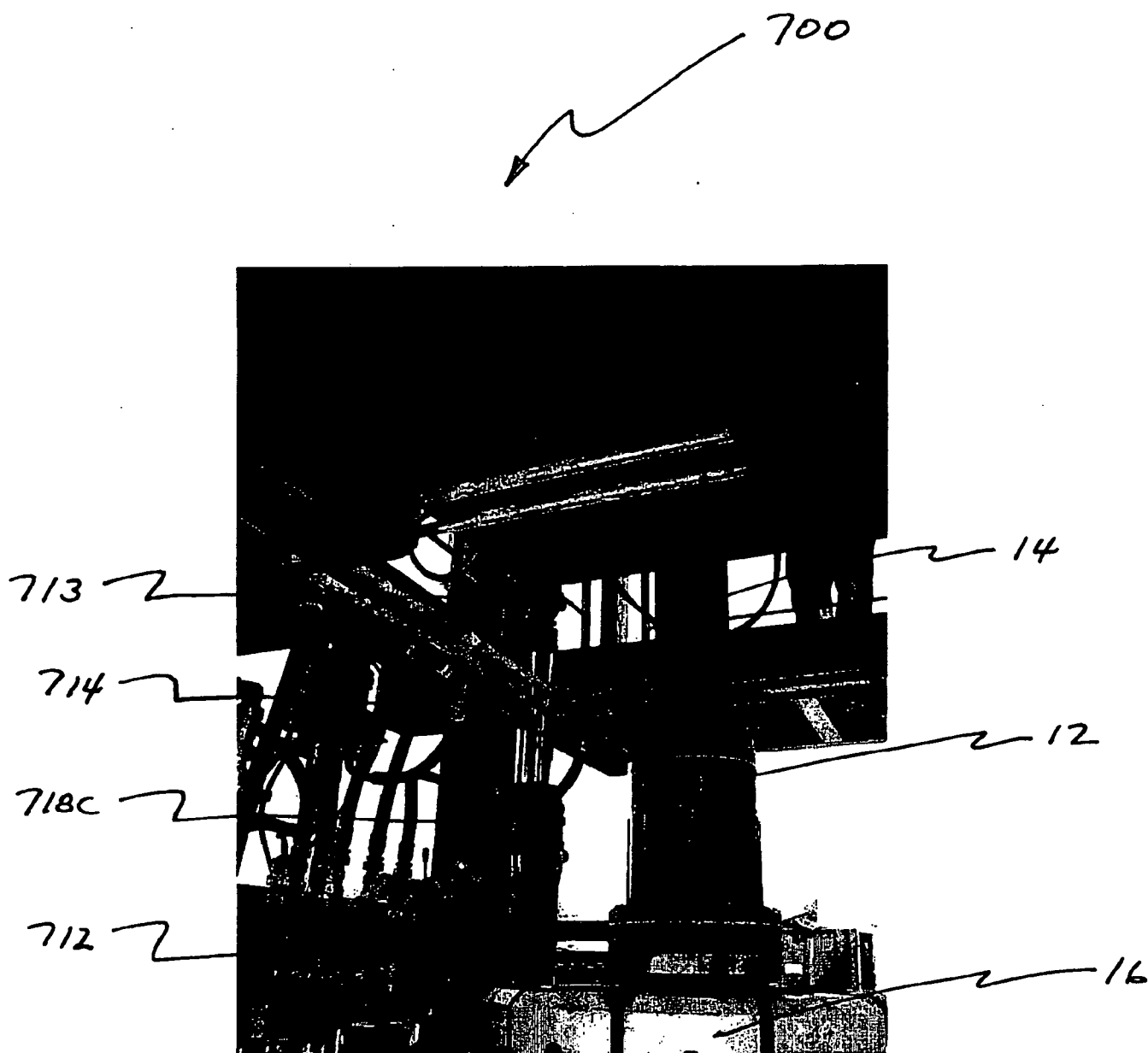


FIG. 7

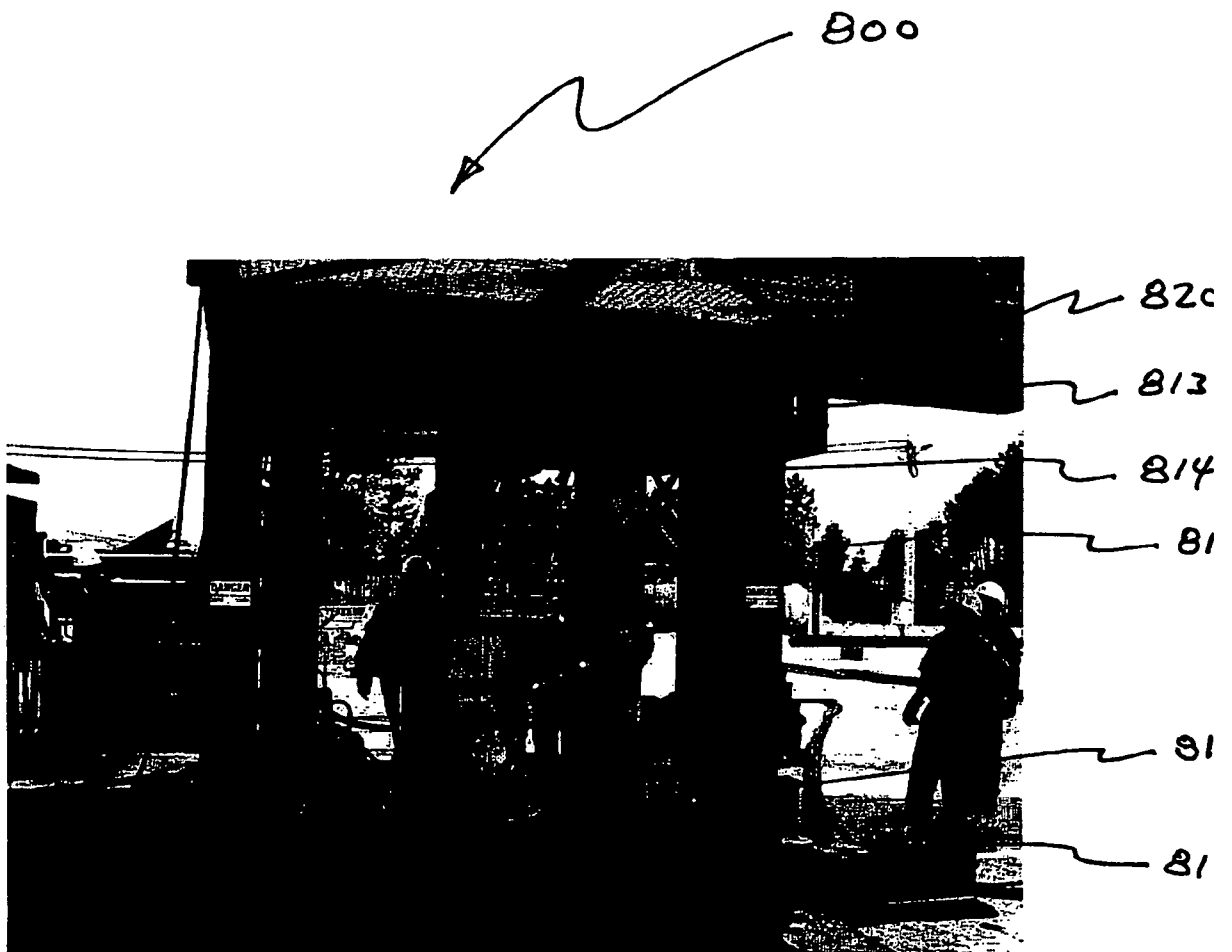


FIG. 8

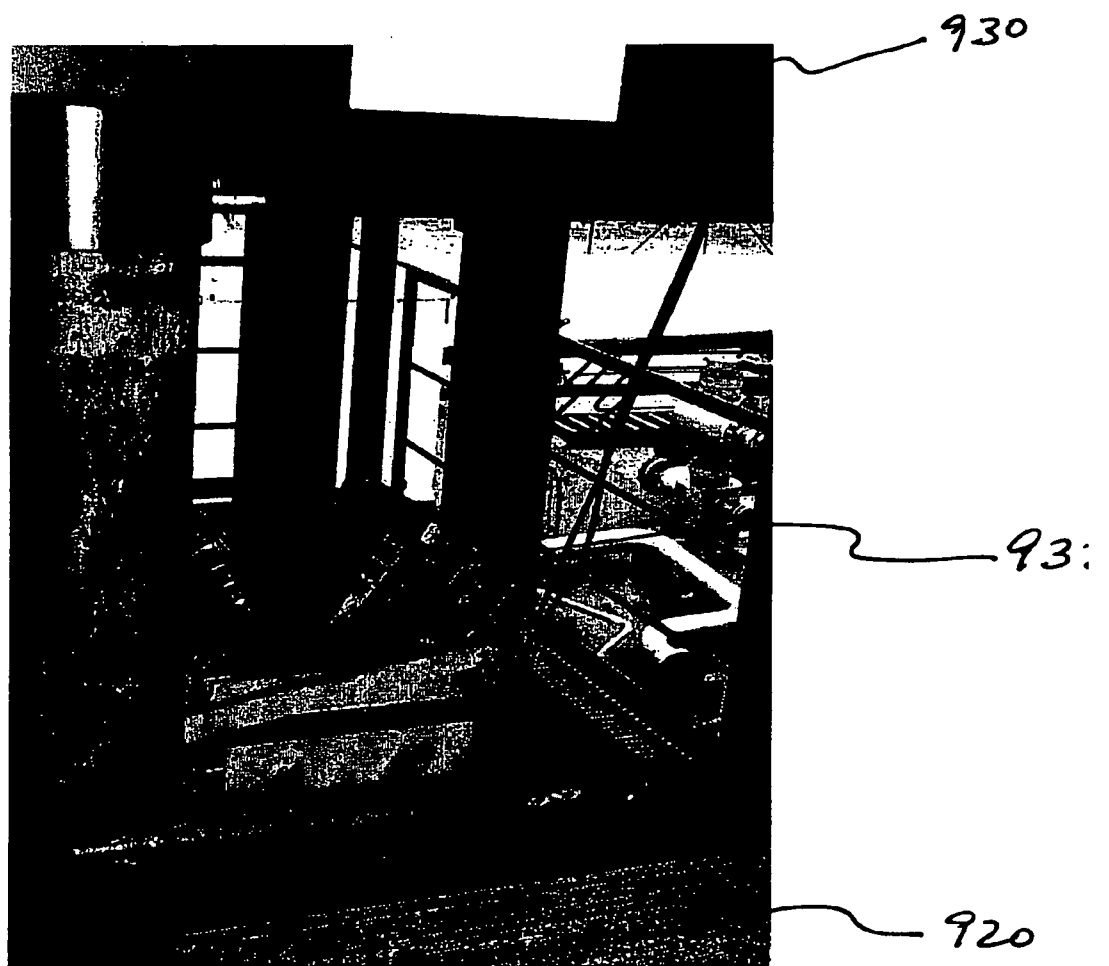


FIG. 9

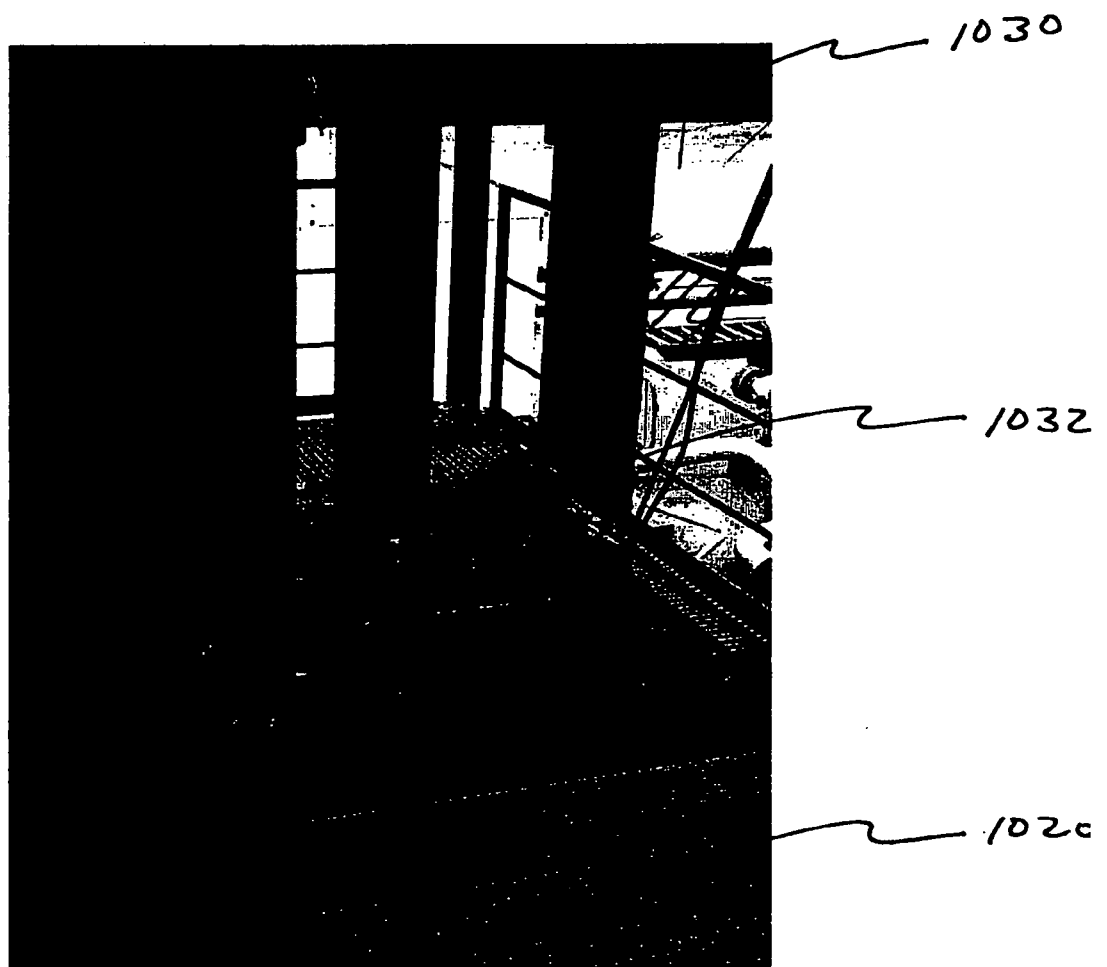


FIG. 10

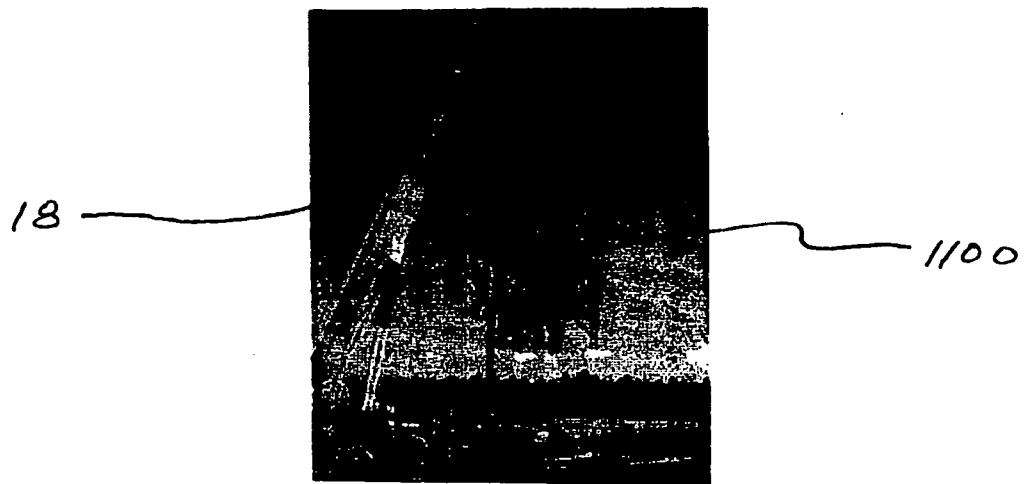
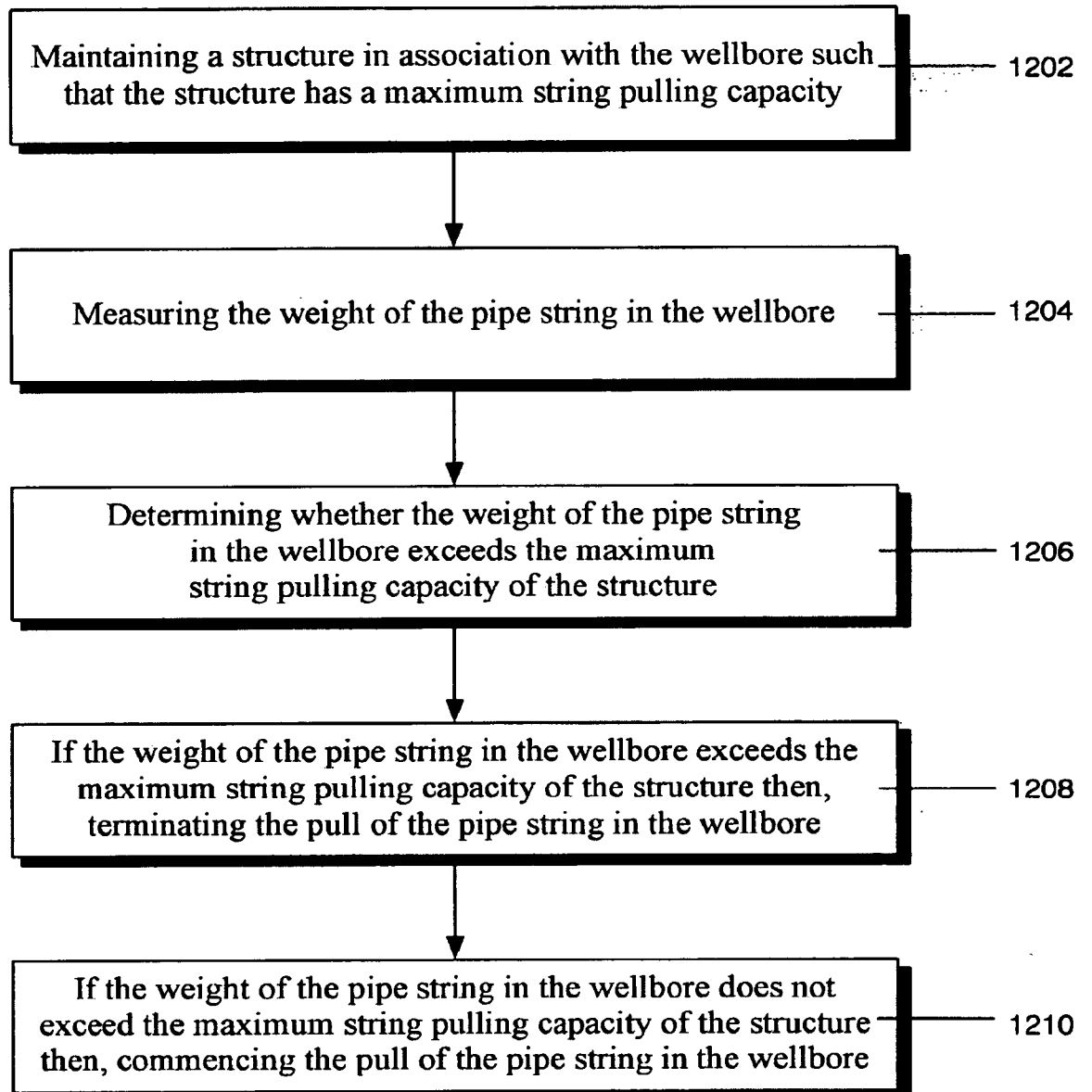
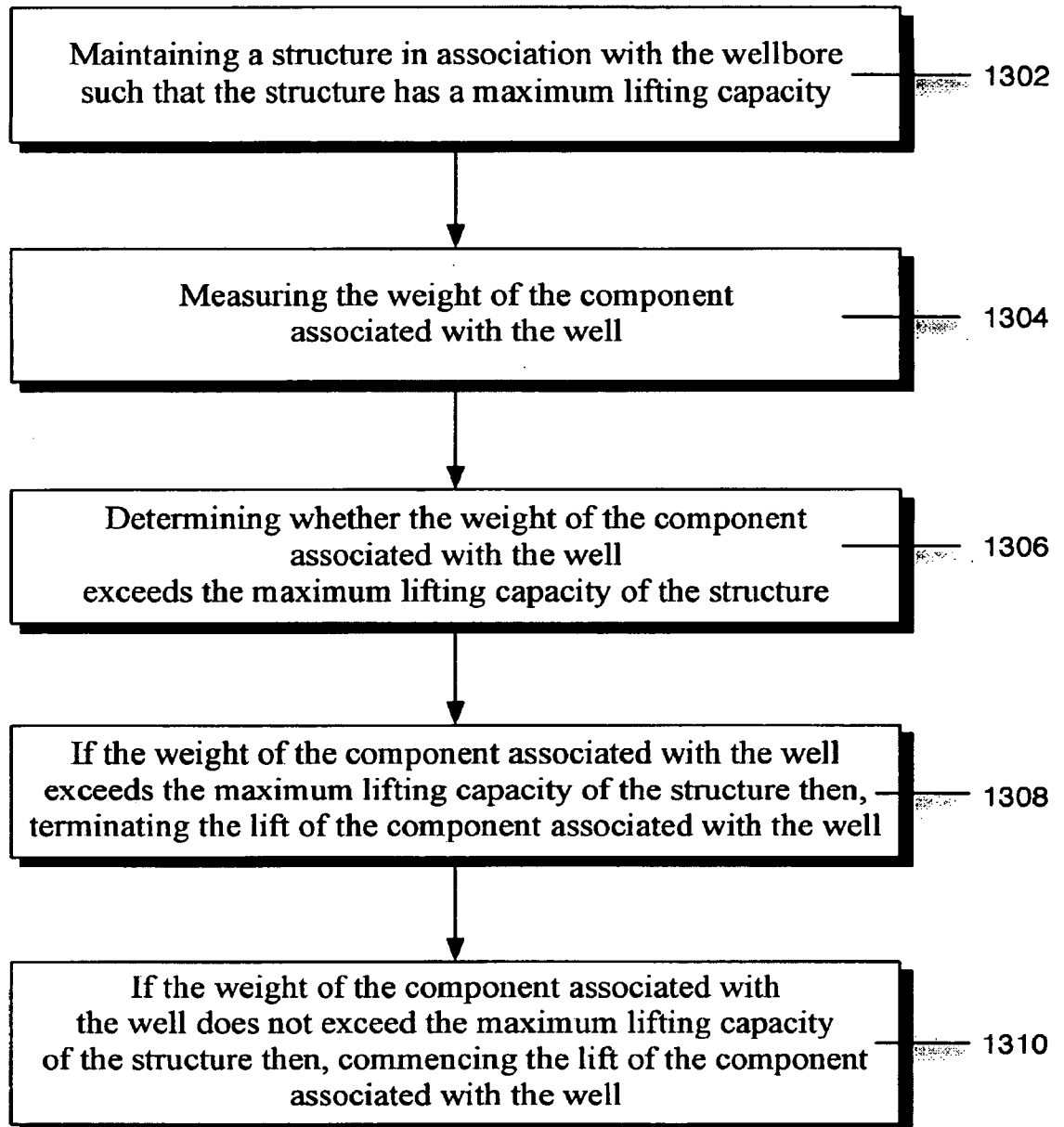
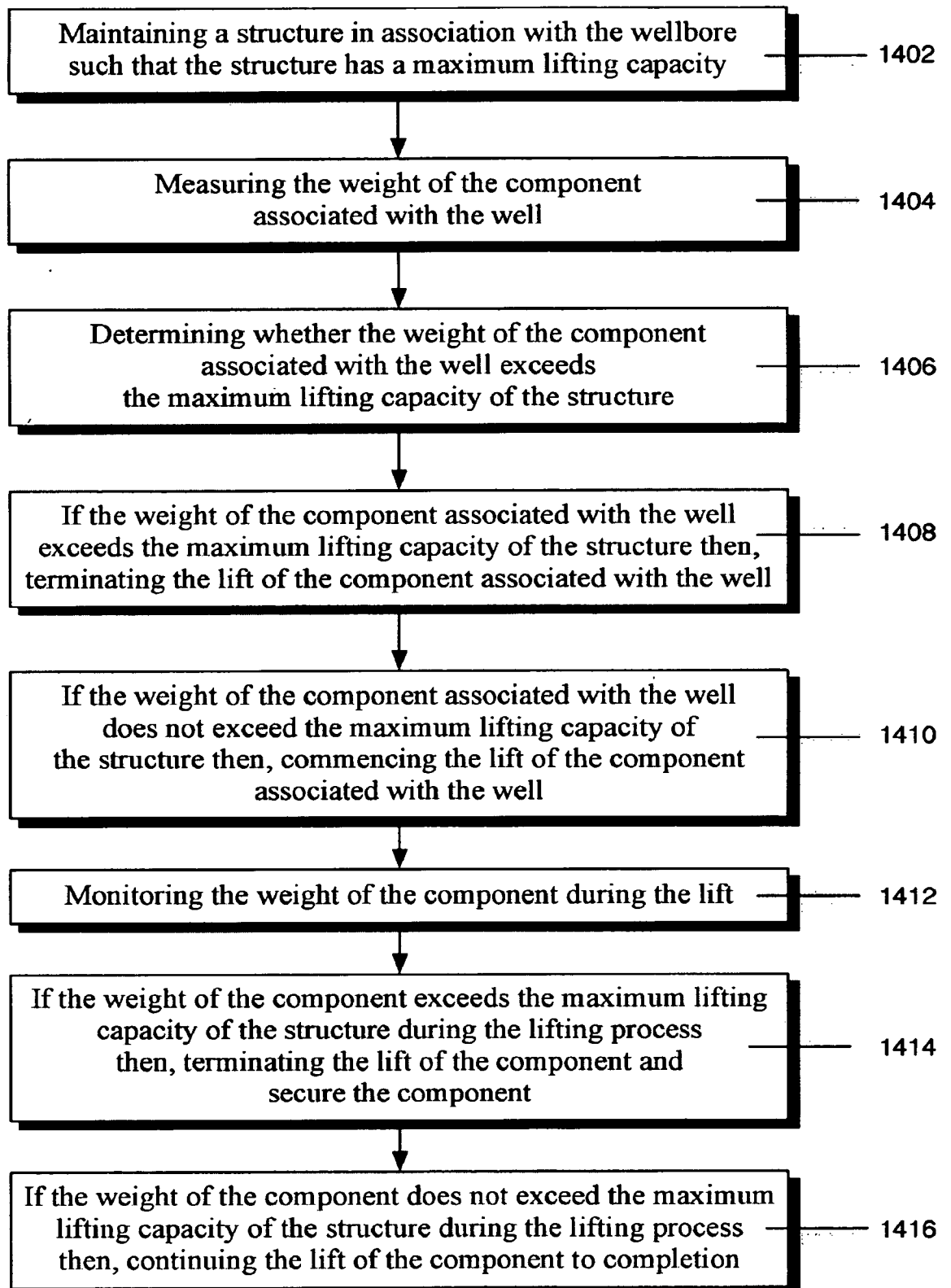


FIG. 11

FIG. 12

FIG. 13

FIG. 14