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Zachariasen et al.(10) **Pub. No.: US 2009/0053015 A1**(43) **Pub. Date: Feb. 26, 2009**(54) **PIPE HANDLING EQUIPMENT****Publication Classification**(75) Inventors: **Erik Zachariasen**, Kristiansand
(NO); **Finn Engenes**, Sogne (NO)(51) **Int. Cl.**
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FALLS CHURCH, VA 22040-0747 (US)(52) **U.S. Cl.** **414/22.66; 414/22.51**(57) **ABSTRACT**

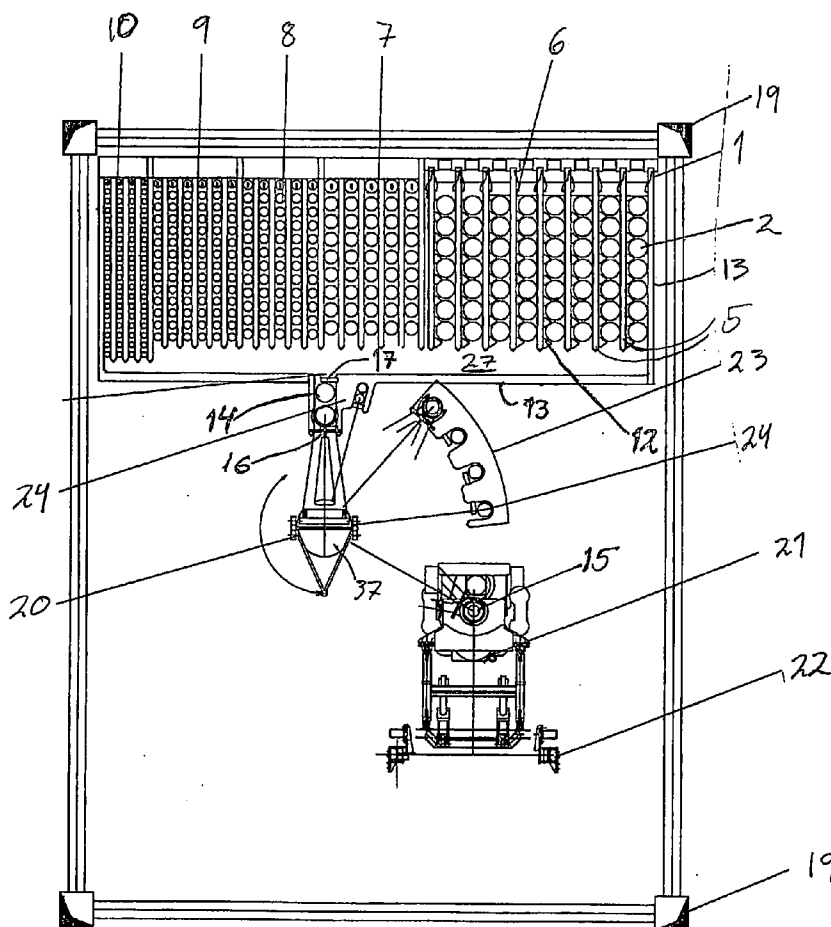
System for handling pipes on a drilling deck, comprising a pipe-handler (20) that is rotary around a vertical axis, a storage device (1) which in turn comprises an opening (14) through which pipes can be retrieved and inserted, and an intermediate storage (14) in connection to the opening. The storage (14) having the function of a lock gate dividing the drill floor into two separate pipe handling areas. The pipe-handler (20) is arranged to reach both the intermediate storage (14) in connection to the opening and the drilling centre (15). The storage device (1) comprises a pipe transport device which in turn comprises a gripper (30) that is arranged to grip at least one pipe from above and transport the pipe hanging from the gripper (30) between a storage position and the opening (14). The storage device (1) is surrounded by a closure (13) that prevents pipes from unintentionally getting outside the storage device (1).

(73) Assignee: **Sense EDM AS**, Kristiansand (NO)(21) Appl. No.: **11/885,747**(22) PCT Filed: **Mar. 6, 2006**(86) PCT No.: **PCT/NO06/00082**

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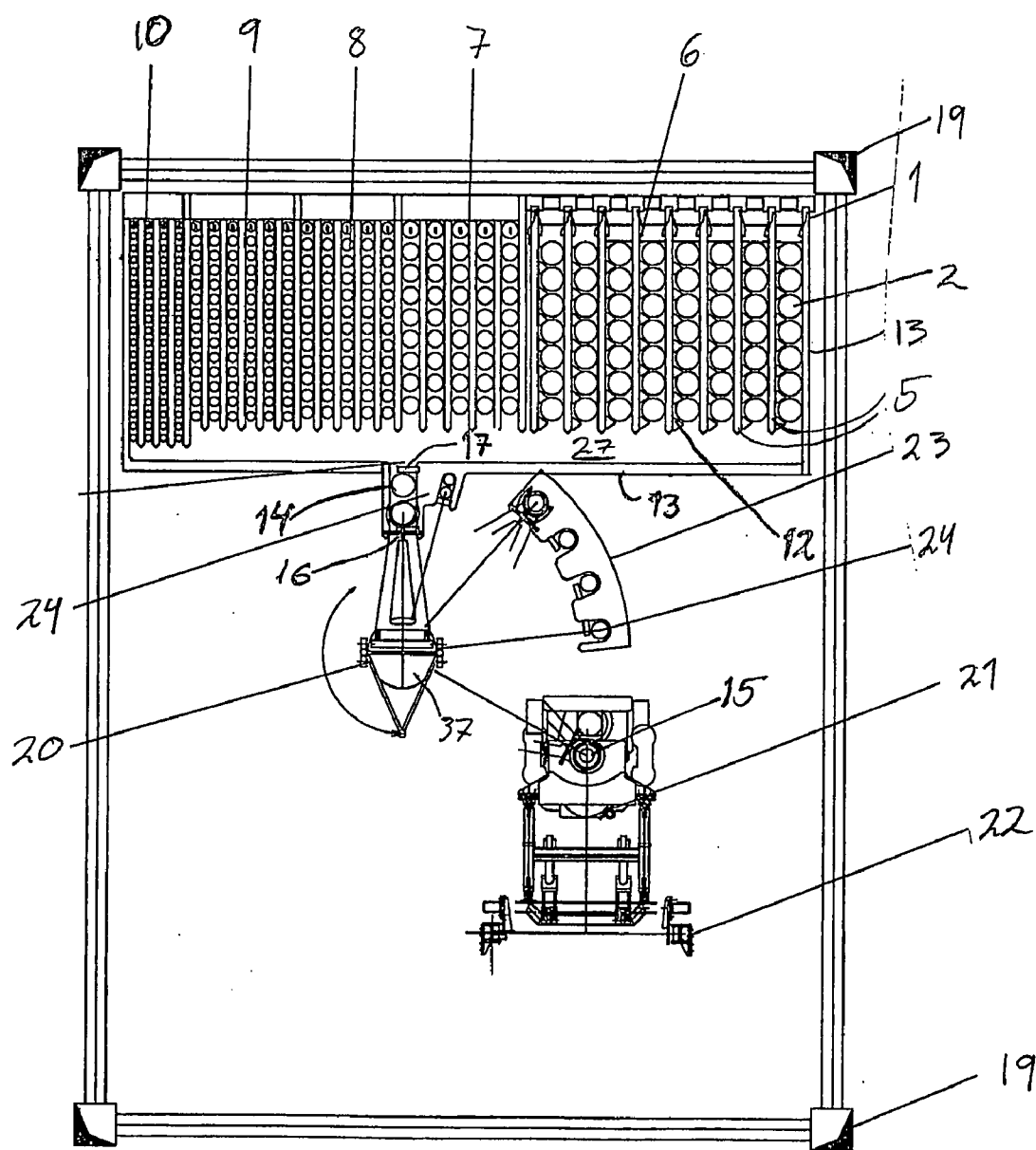


Fig. 1

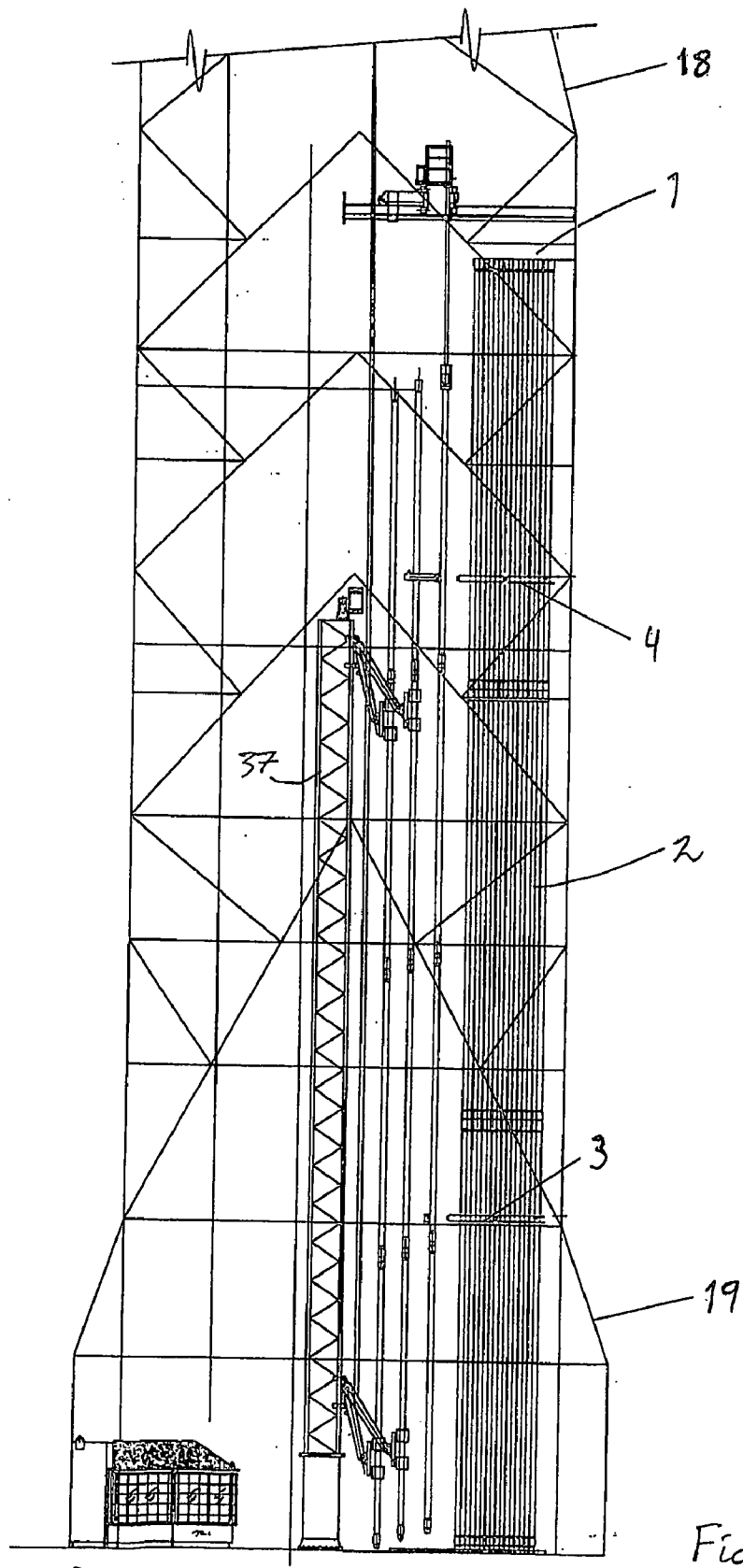
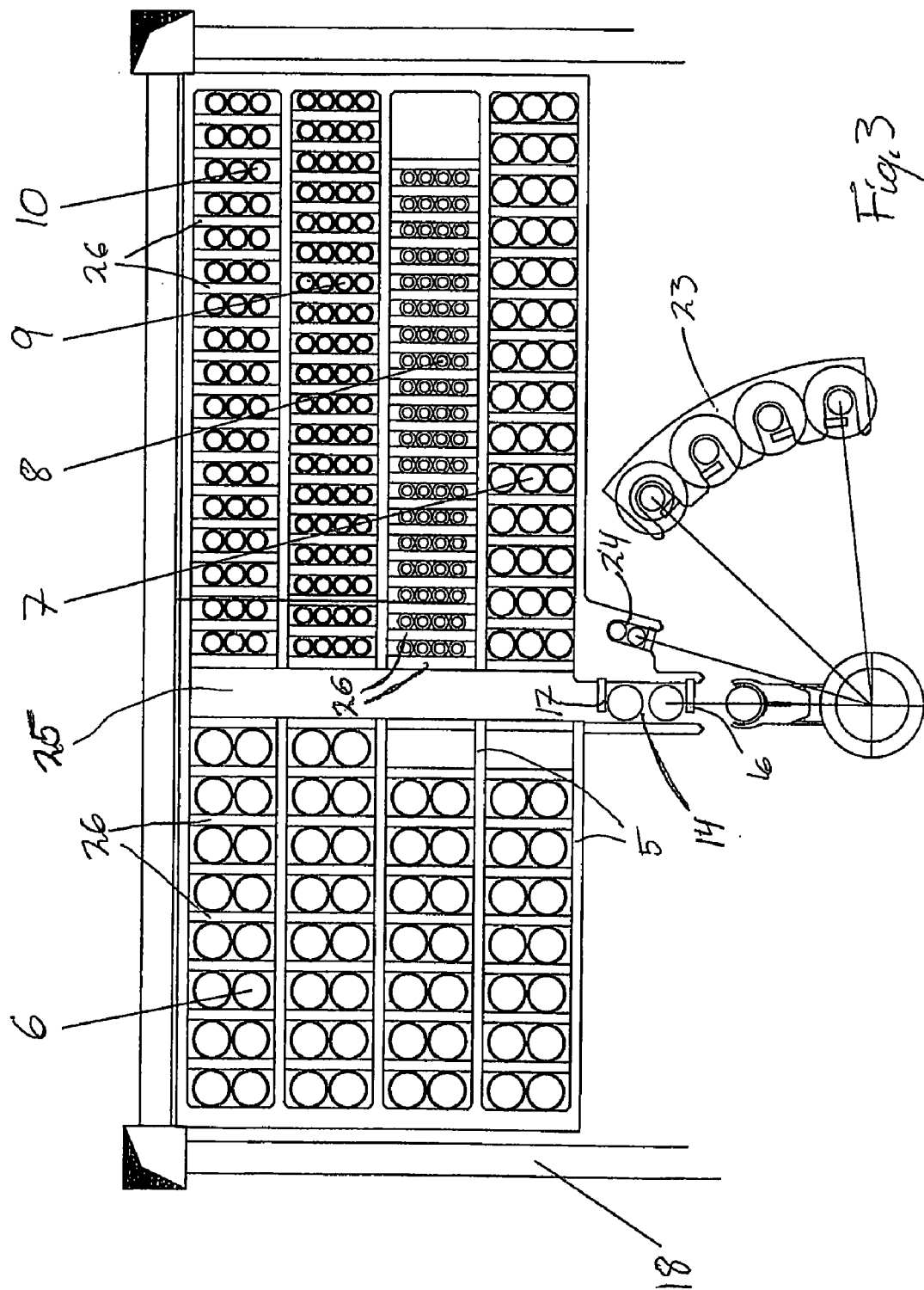
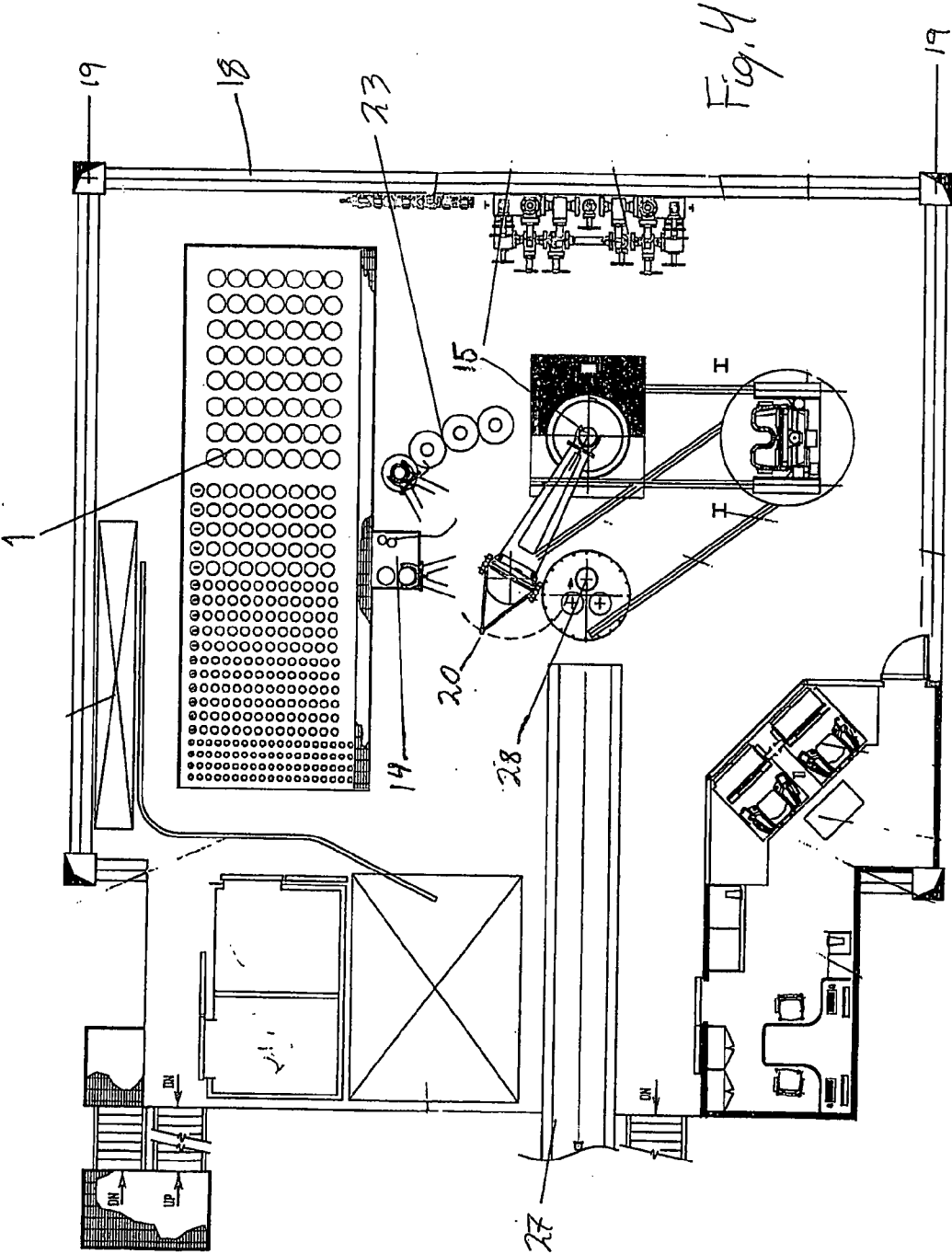
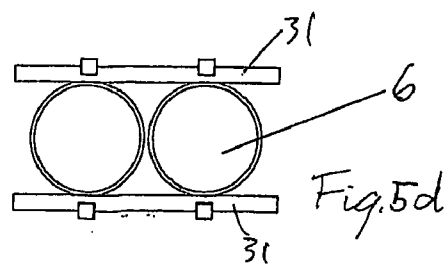
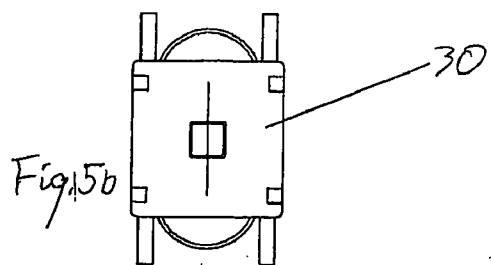
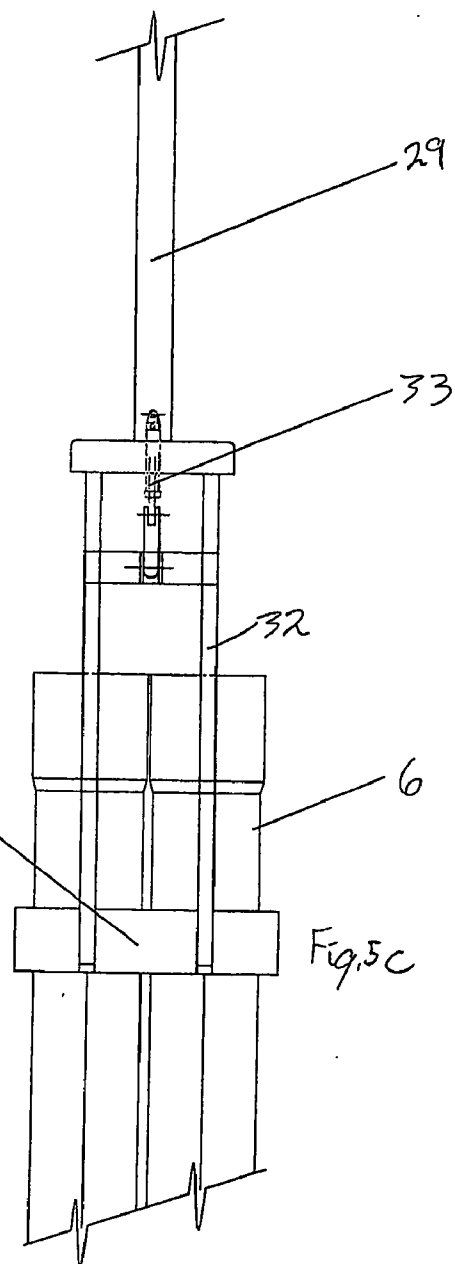
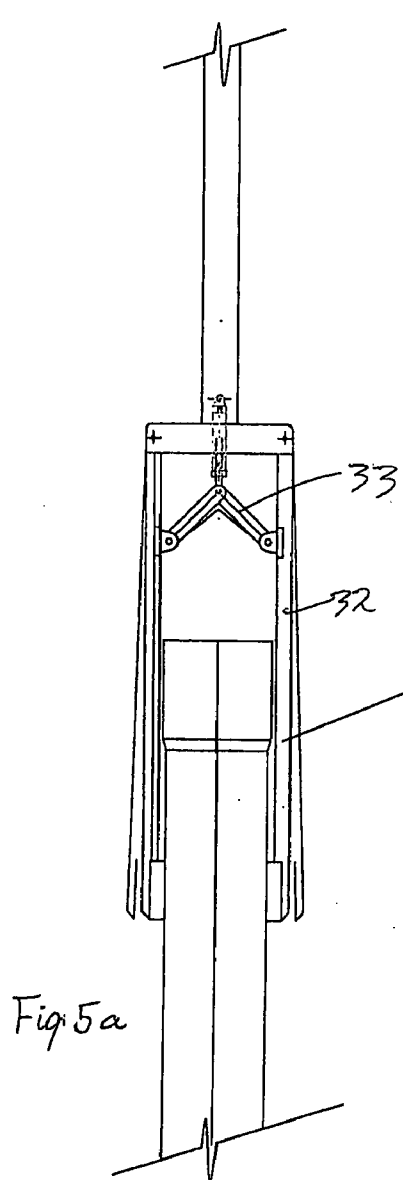
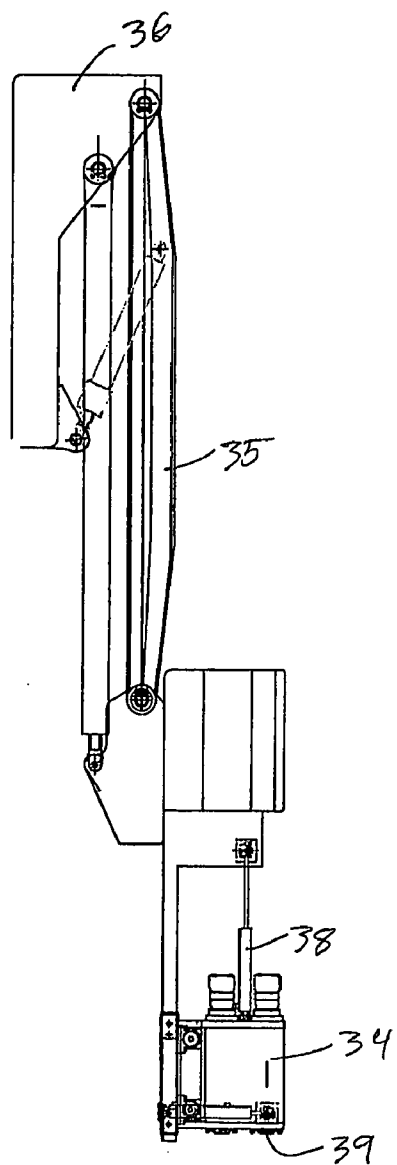
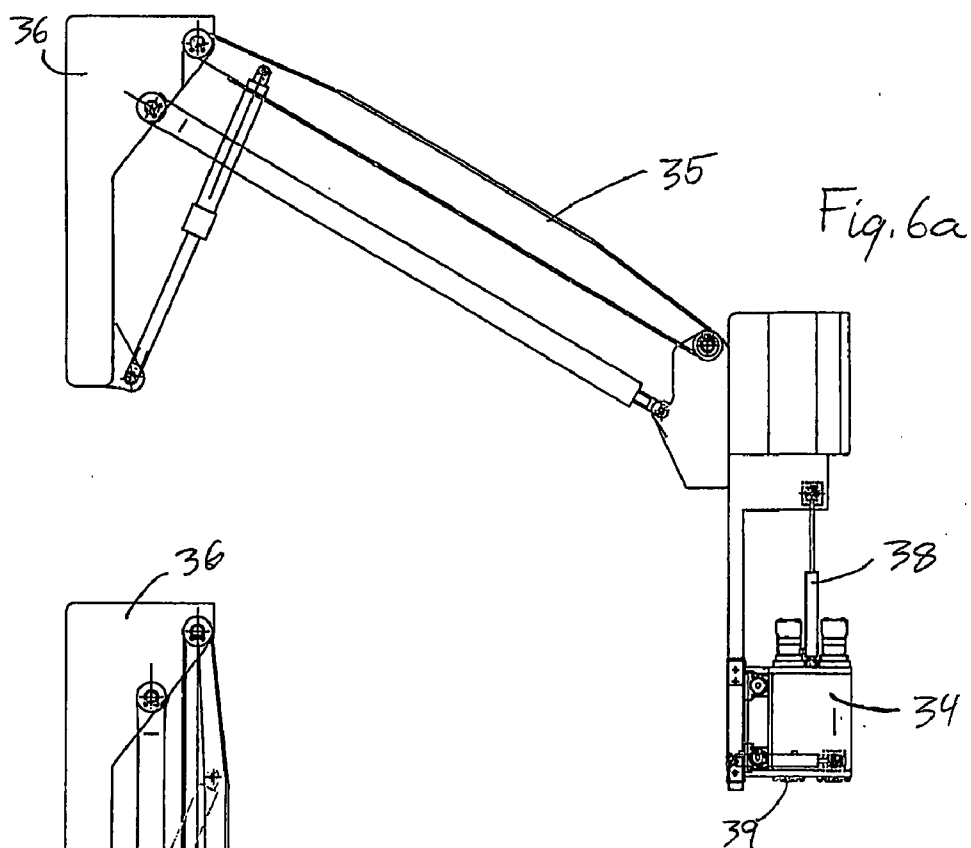


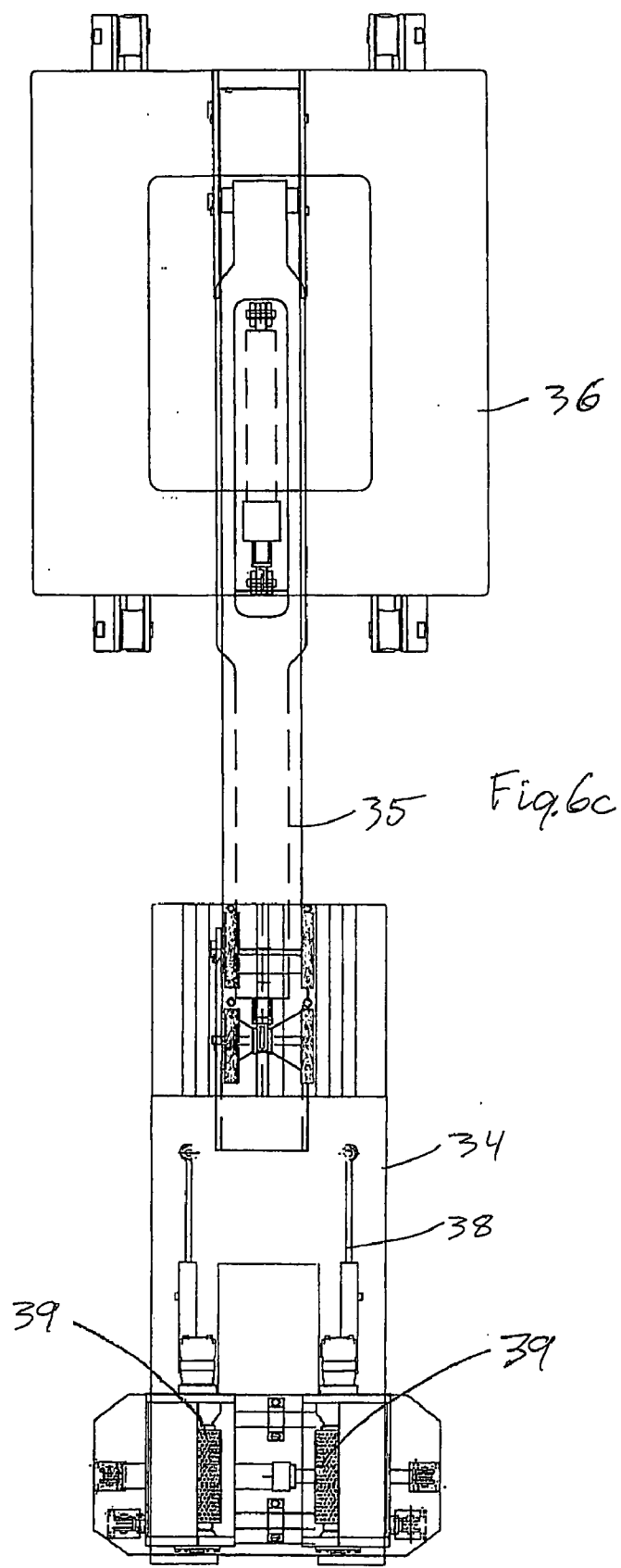
Fig. 2

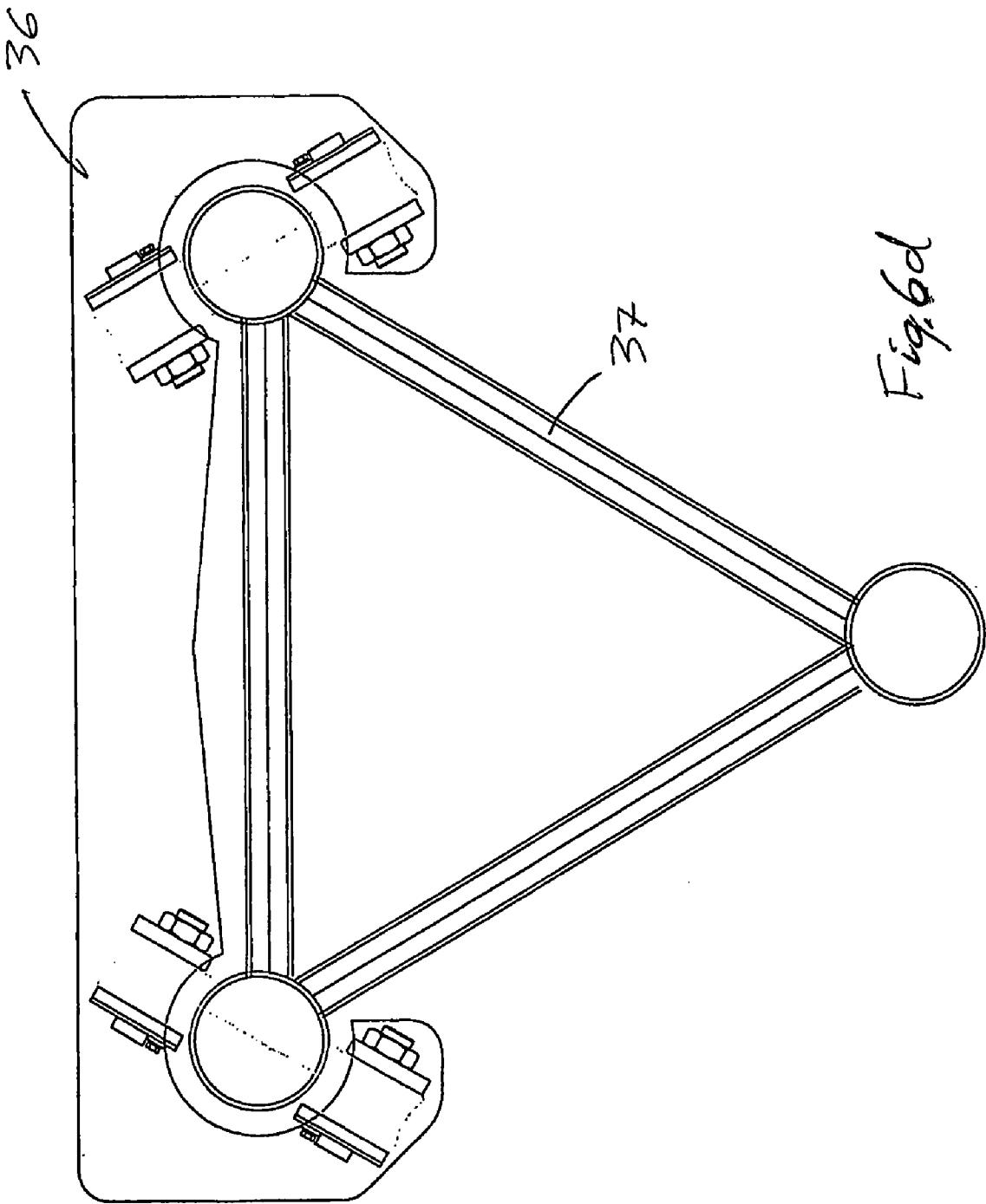












PIPE HANDLING EQUIPMENT

[0001] The present invention relates to devices for handling of pipes on the drilling floor onboard a drilling rig.

[0002] In the extraction of petroleum products a derrick is used, which is a part of a rig. The rig can either be placed on land or in water. In water, the rig can be a fixed construction that stands on the ocean bottom, or can be a floating construction, which is either anchored to the ocean bottom or dynamically positioned.

[0003] The main task for the derrick is to serve as a body for suspension of lifting equipment that lowers drill strings, risers, casings and other continuous pipe strings down to, or in a well, and also to lift the pipe string up from the well.

[0004] A time critical factor in the execution of drilling operations and others that involve lowering down and bringing back up a long pipe string (the technical jargon for which is tripping) is transport to and from the derrick. Therefore, there has been a strong wish for making the pipe sections (a pipe section is comprised of 2, 3 or 4 drill pipes) as near to the derrick as possible. However, the available space is very limited as other essential equipment must also be located here. Another argument for moving pipe sections away from the drilling deck itself is to place them at a lower level to lower the centre of gravity. These stores near the derrick can therefore contain only a limited amount.

[0005] Much has been done to develop equipment that can transport pipe sections quickly to the derrick, in some cases directly to the drilling centre (the line the drill string follows through the tower). It is just as important to quickly remove pipes that are disconnected from the pipe string.

[0006] Much emphasis has also been placed on the safety aspect of the development of this type of equipment for handling of pipes. Therefore, steadily more automated equipment that demands a minimum of crew on the drilling floor has been developed.

[0007] Examples of prior art are:

[0008] GB 1250424 which shows a pipe storage on the drill floor within the derrick. The storage is equipped with finger boards to support the pipes.

[0009] U.S. Pat. No. 6,513,605 which shows a pipe storage similar to the storage of GB 1250424.

[0010] Norwegian Patent application no. 2004 5263, by the same applicant, describes equipment for transporting pipes between a main store and a drilling floor. The present invention aims to be a supplement or an alternative to the equipment described in the above mentioned patent application.

[0011] The invention is comprised of several devices that can work together or operate individually. In the following, the devices shall firstly be described individually and thereafter the operation between these shall be explained with reference to embodiment examples shown in the enclosed figures, in which:

[0012] FIG. 1 shows a planar view of a drilling floor inside a derrick having a set-back according to the present invention,

[0013] FIG. 2 shows a sectional elevation of the derrick in FIG. 1,

[0014] FIG. 3 shows a detail of a set-back in an alternative embodiment.

[0015] FIG. 4 shows a planar view of a drill floor area comprising the set back of FIGS. 1-3 and further pipe handling equipment,

[0016] FIG. 5a-5d show a lifting yoke for simultaneous lifting of several pipes, where

[0017] FIG. 5a shows the lifting yoke in sectional elevation,

[0018] FIG. 5b shows a plane diagram of the lifting yoke,

[0019] FIG. 5c shows the lifting yoke in sectional elevation perpendicular to FIG. 6a,

[0020] FIG. 6d shows the lifting yoke in cross section,

[0021] FIGS. 6a-d show a spinner for a pipe handler for simultaneous lifting and screwing and unscrewing of pipes.

[0022] The invention will first be explained referring to FIGS. 1 and 2, in which FIG. 1 shows a plane diagram of a drilling floor area with the pipe arrangement location according to the present invention, and FIG. 2 shows a sectional elevation of a derrick 18 having legs 19, and with the pipe arrangement area of FIG. 1. In FIG. 1 the derrick legs 19 are shown in cross section. FIGS. 1 and 2 illustrates the combined finger board and pipe storage (set back) 1 according to the invention. This finger board and set-back device (in the following called set-back for simplicity) is set up to store pipes 2 on the drill floor and is fitted with finger boards 3 and 4 in two levels.

[0023] An upper level 4 has fingers 5 that separates each row with drill pipes/casings 6, 7, 8, 9, 10 and has a lock 12 for each individual pipe 2. The lower board 3 separates each row from each other, but has no lock.

[0024] The two finger boards 3, 4 are enclosed, surrounded by a frame 13. If a pipe-stand falls out of a finger 5 it will be caught by the frame 13 so that it does not fall out into the area for drilling and stops the operation here. In addition, the frame 13 will function as a limiting factor in the transport path on the drilling floor so that pipe transport in areas where there can be people will be reduced to a minimum. In this way, one can easier optimise the equipment that is used inside the set-back.

[0025] There is only one opening 14 into the set-back 1, and that is through a so-called "single point entry" 14 opening that is combined with an intermediate storage location for drill pipes/casings 2. By using an intermediate storage 14 one can optimise a system for handling of pipe-stands in the set-back area 1. This gives new possibilities for use of other types of gripping heads and handling of pipes faster and with a reduced lifting height and larger extent of automation, as will be explained in more detail in the following.

[0026] The intermediate storage 14 at the entrance of the set-back 1 on the drill floor has two fingers 16, 17 that can be adjusted horizontally to take different dimensions of drill pipes/casings. The fingers 16, 17 can be tilted to open the intermediate storage towards the set-back or towards the outside of the set-back, respectively. Thereby the intermediate storage 14 functions as a lock chamber for the pipes, dividing the drill floor into two separate pipe handling areas.

[0027] One advantage with the above mentioned device is that the system for a travelling crane to lift and transport the pipes and casing between the set 1 back area and the intermediate storage 14 can be given defined positions in all three planes, x-y-z, so that one avoids problems in placing of pipes with the travelling crane.

[0028] The set-back is formed so that several pipes 2 can be located (drill pipes and/or casings) between each finger 5. This ensures that it is possible to carry more pipes with a travelling crane, which lifts from above. There is no need to support the pipes at their lower end during transport within the set-back since no persons have the possibility to enter the

set-back during operation. Consequently, the pipes may be allowed to dingle to a certain degree during transport within the set-back.

[0029] From the intermediate storage 14 the pipes 2 are transported individually by a drill floor pipe handler 20, which grips the lower and upper parts of the pipe 2 and moves it to the drill centre 15. Here it can be gripped by a top drive 21 running on rails 22 in the derrick 18.

[0030] In FIG. 1 is also shown a small auxiliary set-back 23, which is used for storing pipes during assembling and disassembling of pipe stands 24. The auxiliary set-back 23 is curved in shape so that the distance from the rotational axis of the pipe handler 20 is substantially the same for all slots in the auxiliary set-back 23. The auxiliary set-back 23 may also be used for storing drill collars or other special elements.

[0031] FIG. 1 also shows a small side-storage 24, which also can act as an intermediate storage when stands are being build up or down or to hold pipes in cases when the pipe handler 20 temporarily must put these down while it carries out other tasks.

[0032] The fingers 5 can be directed in two directions, namely towards the drill centre 15 from the one wall of the derrick to the other, as shown in FIG. 1, or towards each other with an opening 25 between them for transport of pipes, as shown in FIG. 3. As mentioned, the set-back has two finger boards, an upper finger board 4, and a lower finger board 3. The upper board 4 has a lock 26 for a row of pipes 6, 7, 8, 9, 10.

[0033] From two to four pipes 6, 7, 8, 9, 10 are arranged between each finger 5 of the finger boards 4 in FIG. 3. Between each row of two to four pipes there are locking pins 26 that hold the pipes 6, 7, 8, 9, 10 in place. The locking pins 26 can be swung up or down when pipe rows are to be retrieved or put back.

[0034] In the configuration in FIG. 3, a pipe row will first be led out to the passage 25 and thereafter be led 90° towards the gate 14. This is slightly different from the configuration in FIG. 1, in which a pipe row (of two or four pipes) will first be led out into the passage 27 and thereafter must be turned 90° and led towards the gate 14. Here in the configuration of FIG. 3, it must be turned back 90° so that it can be led into the combined gate and intermediate storage 14.

[0035] An auxiliary storage 23 for pipe collars and a side storage 24 are also shown in FIG. 3. As for the FIG. 1 configuration the intermediate storage 14 is placed at the entrance of the set-back 1 on the drilling floor. It has two fingers 16 and 17 that can be adjusted horizontally to take different dimensions of drill pipes/casings.

[0036] Transport to the intermediate storage 14 from the outside of the set-back 1 is by the pipe handler 20, which can also reach the drilling centre 15 and the catwalk (the catwalk is a transport path that brings pipes to the derrick; which will be explained in connection with FIG. 4). With the use of the intermediate storage 14, one can release extra possibilities for the pipe transporter (see the description below in connection with FIGS. 5a-d) inside the set-back so that this can perform new tasks and carry out the tasks in a much more rational way. The intermediate storage 14 makes it possible to take and put back more than one pipe at the same time.

[0037] FIG. 4 shows an overview of the system for pipe handling on the drilling floor. The system comprises a catwalk 27 that transports pipes horizontally in the derrick 18. Here, the pipe can be lifted up into a vertical position by, for

example, a V-door lifter (not shown). The pipe is thereafter taken over by a pipe handler 20, which can be in the form of a column machine. Alternatively, the pipe handler 20 can pick up a pipe or other objects directly from the cat walk 27 and lift these up into vertical position (for example, with the help of a lower arm) or bring these directly into the drilling centre 15. The pipe handler 20 has the possibility of placing the pipe in a rotary mouse hole 28. Such a rotary mouse hole 28 is described in Norwegian Patent application no. 2004 5263, which is hereby incorporated in the present application by reference. The pipe can, alternatively after having been put together with several pipes to a pipe stand, be transported further to the intermediate storage 14. However, pipes can also be placed in the small side-storage 24 (see also FIG. 3), that is arranged to hold pipes in cases when the pipe handler 20 must temporarily put these down while it carries out other tasks.

[0038] Pipes can also be led into the drilling centre 15 by the pipe handler 20. To provide a nearby storage of a certain size, where pipes can be quickly retrieved or put back into, for example, in connection with tripping of the drill string, the pipes that are placed in the intermediate storage 14 can be brought further into the set-back 1. A lifting yoke which is described in connection with the FIGS. 5a-d is used for this. As this lifting yoke is arranged to grip the pipes from above, the set-back 1 can be configured with a minimum of distance between the pipes. It is possible to grip the pipes from above only and let the pipes hang freely from the lifting yoke during transport inside the set-back because the set-back is a closed-in area where personnel and other equipment have no access during normal operation. In this way, one will have room for a large number of pipes in a small area and achieve an efficient pipe handling.

[0039] The lifting yoke can be arranged suspended from a trolley (not shown) that runs on a rail system above the set-back. Such a trolley and rail system are, in themselves, known devices and shall therefore not be described in more detail here.

[0040] The intermediate storage 14 is placed on the drilling floor at the same level as the set-back 1 and the level at which pipes are led into or taken out of the drilling centre. By having such a buffer of pipes as the intermediate storage 14 provides, it is possible to increase the speed to and from the drilling centre 15 in a safe way without increasing the speed of the pipe handling machine (lifting yoke) inside the set back 1, as the lifting yoke and the pipe handler 20 can operate independently of each other.

[0041] Next to the set-back 1, the auxiliary set-back 23 is arranged for drill collars and other special pipes (see also FIG. 3). This auxiliary set-back 23 is preferably arched with a curvature corresponding to the path which gripping heads of the pipe handler 20, so that the pipe handler 20 can reach the positions in the auxiliary set-back 23 by stretching out the gripping heads the same distance.

[0042] The pipe handler 20 can be equipped with a spinner, as shown in FIGS. 8a-d, instead of a conventional gripper. The column machine can thereby both transport pipes into and out of the drilling centre 15 and screw the pipes on and off the pipe string. Thereby, one does not have to change grip on the pipe before this is placed onto the pipe string and removed from this, respectively.

[0043] With the above mentioned configuration, the pipe handler 20 will be able to reach all actual positions where it is relevant to collect or put down pipes with a minimum of

movement. The pipe handler 20 can thus operate efficiently and, to a large extent, independently of associated equipment

[0044] The FIGS. 5a-d show a lifting yoke 29 for lifting of pipes 6 out of the set-back 1 and transport these out to the intermediate storage 14. To lift several pipes simultaneously between the setback 1 and the intermediate storage 14, it is an advantage to have a yoke 29 that can lift several pipes 6 at the same time. Thus, the yoke 29 that transports pipes between the finger boards 3, 4 of the set-back 1 and the intermediate storage 14 operates at a lower speed. The gripping head 30 is formed so that it can take more than one pipe stand at the same time, in parallel or in series. Consequently, the gripping head has grippers 31 forming gripping surfaces, which have a length that span the diameter of two or more pipes. The grippers 31 are fixed to arms 32 that are actuated by a hydraulic cylinder 33 acting through an actuation mechanism 33.

[0045] The FIGS. 6a-6d show a spinner 34 for fitting onto a lifting arm 35 for both lifting/transport and on and off screwing of drill pipes/casings. The lifting arm 35 is rotary connected to a trolley 36 that in turn can move along a column 37 (see FIGS. 1 and 2). This column can be a part of the pipe handler 20.

[0046] This spinner 34 can be arranged on the pipe handler 20 that lifts a drill pipe/casing into the drilling centre 15. The spinner 34 can rotate the pipe that hangs in it so that it enters the threads on the pipe that sticks up from the drill floor in the drilling centre 15. This makes a faster operation possible and releases time for the machine that screws together pipes to correct momentum.

[0047] The spinning head 34 is fitted with cylinders 38 that can lift the weight from a stand and at the same time rotate the pipe so that the threads are not damaged. The rollers 39 of the spinner are designed so that they can hold the weight of the stand whilst rotating it. The pipe will thereby be lifted up with a predetermined force.

[0048] When the pipes are screwed together, the cylinders 38 will yield and sink down as the pipe is screwed together so that the spinner head 34 is gradually lowered.

[0049] When one screws pipes from each other, the system will be able to take the weight of the pipe and lift it out of the threads with a predetermined force.

1. Device for storing pipes comprising at least one upper and one lower finger board, characterized in that the device is arranged on the drill floor and is surrounded by a closure (13) that defines a storage area (1) and prevents pipes from unintentionally falling outside the storage area (1), and having a defined opening for feeding pipes into the storage area and for retrieving pipes from the storage area (1), the opening having a lock chamber (14) being adapted to hold one or more pipes, and the lock chamber dividing the drill floor into two separate pipe handling areas.

2. Device according to claim 1, characterized in that the lock chamber is an intermediate storage (14) where a number of pipes can be placed temporarily whilst waiting to be brought out of the storage area (1) or to be fed into the storage area (1).

3. Device according to claims 1, characterized in that it comprises a further temporary storage next to the opening.

4. Device for lifting pipes, characterised in that it comprises a gripper that is arranged to grip at least one pipe from above and transport this suspended inside a storage area to and from an opening in the storage area.

5. Device for storing drill collars and other special pipes, characterized in that it comprises a pipe stand (23) which is arched with the centre of the circle sector co-inciding with the rotation centre of a rotary pipe-handler, such that the pipe-handler can reach the drill collars and the special pipes at the same distance from the centre of rotation and the pipe slots in the pipe stand (23) is only defined by an angular distance between the pipes.

6. Device for transporting pipes to and from a drilling centre, characterized in that it comprises a gripping head that is arranged to grip the pipe at its upper end and further comprises a device to rotate the pipe around its own axis, to be able to screw pipes off and on the upper end of another pipe.

7. System for handling pipes on a drilling deck, characterized in that it comprises a pipe-handler that is rotary about a vertical axis, a storage device which in turn comprises an opening through which pipes can be retrieved and inserted and an intermediate storage in connection with the opening, as the pipe-handler is arranged to reach both the intermediate storage and the drilling centre.

8. System according to claim 7, characterized in that it further comprises a mouse hole device for building up pipe stands, said mouse hole device comprising several chambers to receive pipes and that the pipe-handler is arranged to reach the mouse hole device.

9. System according to claims 7, characterized in that the storage device comprises a pipe transporting means which in turn comprises a gripper that is arranged to grip at least one pipe from above and transport the pipe hanging from the gripper between a storage position and the opening of the pipe storage.

10. System according to claims 7, characterized in that the storage device is surrounded by a closure that prevents pipes from unintentionally getting outside the storage device.

11. Device according to claims 2, characterized in that it comprises a further temporary storage next to the opening.

12. System according to claims 8, characterized in that the storage device comprises a pipe transporting means which in turn comprises a gripper that is arranged to grip at least one pipe from above and transport the pipe hanging from the gripper between a storage position and the opening of the pipe storage.

13. System according to claims 8, characterized in that the storage device is surrounded by a closure that prevents pipes from unintentionally getting outside the storage device.

14. System according to claims 9, characterized in that the storage device is surrounded by a closure that prevents pipes from unintentionally getting outside the storage device.

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