METHODS AND SYSTEMS FOR PIPE MANAGEMENT ON A DRILLING RIG

TECHNICAL FIELD

The present ~~disclosure~~ invention is directed to systems, devices, and methods for managing pipe on a drilling rig. More specifically, the present ~~disclosure~~ invention is directed to systems, devices, and methods for racking, manipulating, and using pipe on a drilling rig.

BACKGROUND OF THE DISCLOSURE

The exploration and production of hydrocarbons require the use of numerous types of tubulars also referred to as pipe. Tubulars include but are not limited to drill pipes, casings, and other threadably connectable elements used in well structures. Strings of joined tubulars, or drill strings, are often used to drill a wellbore and, with regards to casing, prevent collapse of the wellbore after drilling. These tubulars are normally assembled in groups of two or more commonly known as "stands" to be vertically stored in the derrick or mast. The derrick or mast may include a storing structure commonly referred to as a fingerboard. Fingerboards typically include a plurality of vertically elongated support structures or "fingers" each capable of receiving a plurality of "stands."

Rotary drilling and top drive drilling systems often use these stands, instead of single tubulars, to increase efficiency of drilling operations by reducing the amount of connections required to build the drill string in or directly over the wellbore. However, the manipulation of tubulars from a horizontal to a vertical position, assembly of stands and presentation of stands between the fingerboard and well center are dangerous and can be rather inefficient operations.

In addition, a lack of organization of the tubulars in the fingerboard can raise inefficiencies. For example, in a drilling operation, certain sizes or types of tubulars may be required at certain times in the drilling process, while other sizes or types of tubulars may be required at other times. Moving certain tubulars around in order to merely access other tubulars can slow the drill process, which increases rig time and well-operating expense.

Further, since some tubulars are reused at different wells, some tubulars may be repetitively exposed to high stress scenarios, leading to earlier than expected failure, delaying well progress and increasing drilling costs.

~~The~~Embodiments of the present ~~disclosure is~~invention are directed to systems and methods that overcome one or more of the shortcomings of the prior art.

SUMMARY

According to a first aspect of the present invention, there is provided a drilling rig apparatus comprising: a racker device for moving tubular stands on a drilling rig; a fingerboard cooperatively disposed to receive tubular stands from the racker device and to support the tubular stands in a vertical arrangement; and a racking control system in communication with the racker device and configured to control the racker device, the racking control system comprising a tubular management system that receives data relating to a well plan and driller settings, assesses the well plan and driller settings, and based on the well plan and driller settings, develops a racking plan setting out proposed racking locations for the tubular stands to be used in a drilling procedure.

According to a second aspect of the present invention, there is provided a method of developing a racking plan for a drilling rig, which comprises: receiving information for a well plan in a racking control system for drilling a wellbore with a drilling rig; receiving driller setting information in the racking control system; and determining a fingerboard plan with the racking control system that assesses the received well plan information and the received driller setting information and, based on the assessment, allocates tubular stand locations within a fingerboard for tubular stands to carry out the well plan.

According to a third aspect of the present invention, there is provided a non-transitory computer readable medium with computer executable instructions stored thereon for determining racking locations in a fingerboard for tubulars and tubular stands, the computer executable instructions comprising instructions for: receiving information regarding a well plan in a racking control system for drilling a wellbore with a drilling rig; receiving driller setting information in the racking control system; and determining a fingerboard plan with the racking control system that assesses the received well plan information and the received driller setting information and, based on the assessment, allocates tubular stand locations within a fingerboard for tubular stands to carry out the well plan.

CLAIMS

What is claimed is:

1. A drilling rig apparatus ~~(100)~~ comprising:

a racker device ~~(104)~~ for moving tubular stands ~~(150)~~ on a drilling rig;

a fingerboard ~~(108)~~ cooperatively disposed to receive tubular stands from the racker device and to support the tubular stands in a vertical arrangement; and

a racking control system ~~(180)~~ in communication with the racker device and configured to control the racker device, the racking control system comprising a tubular management system that receives data relating to a well plan and driller settings, assesses the well plan and driller settings, and based on the well plan and driller settings, develops a racking plan setting out proposed racking locations for the tubular stands to be used in a drilling procedure.

2. The drilling rig apparatus of claim 1, wherein the tubular management system is configured to receive driller preferences for a drilling rig, and wherein the racking control system is based in part on the driller preferences as the racking plan is developed.

3. The drilling rig apparatus of claim 1, wherein the tubular management system is configured to determine the number of tubular stands required to make up a drilling section of the well plan and allocate locations in the fingerboard for each of the tubular stands.

4. The drilling rig apparatus of any one of claims 1, 2, or 3, wherein the driller settings include at least one of tubular arrangement, location in fingerboard for bottom hole assembly, and drill pipe size, the racking control system configured to take the driller settings into account when developing the racking plan.

5. The drilling rig apparatus of any one of claims 1, 2, or 3, wherein the well plan specifies BHA and hole size by casing section, the racking control system being configured to take the BHA and hole size into account when developing the racking plan.

6. The drilling rig apparatus of any one of claims 1, 2, or 3, wherein the tubular management system is configured to allocate a racking location for a tubular stand based on historical data for one or more tubulars or tubular stands.

7. The drilling rig apparatus of any one of claims 1, 2, or 3, wherein the racking control system comprises an asset management system configured to track information relating to specific tubulars or tubular stands.

8. The drilling rig apparatus of claim 7, wherein the information includes historical loading information including an amount of stresses applied to a tubular or tubular stand.

9. The drilling rig apparatus of claim 7, wherein the information includes specification of particular tubular of a tubular stand including at least one of a length, a diameter, and a manufacturer.

10. The drilling rig apparatus of claim 7, wherein the asset management system shares a memory, a processor, or both, with the tubular management system.

11. A method of developing a racking plan for a drilling rig, which comprises:

receiving information for a well plan in a racking control system ~~(180)~~ for drilling a wellbore with a drilling rig;

receiving driller setting information in the racking control system ~~(180)~~; and

determining a fingerboard plan with the racking control system that assesses the received well plan information and the received driller setting information and, based on the assessment, allocates tubular stand locations within a fingerboard ~~(108)~~ for tubular stands to carry out the well plan.

12. The method of claim 11, which further comprises: generating control signals with the racking control system to control a racker device to make up tubular stands and rack the tubular stands in the allocated locations in the fingerboard.

13. The method of claim 11, which further comprises determining the number of tubular stands required to make up a drilling section of the well plan and allocating locations in the fingerboard for the stands based on the number of tubular stands required to make the drilling section.

14. The method of any one of claims 11, 12, or 13, wherein receiving the driller settings comprises receiving at least one of a tubular arrangement in a fingerboard, a location in the fingerboard for a bottom hole assembly (BHA), and a drill pipe size.

15. The method of any one of claims 11, 12, or 13, wherein receiving the well plan includes receiving at least one of BHA and hole size by casing section, a mud depth, or a total vertical depth from the drilling rig.

16. The method of any one of claims 11, 12, or 13, which further comprises taking into account historical data relating to one or more specific tubular to be used to make up one or more of the tubular stands, with the historical data being used to allocate a position in the fingerboard for a tubular stand comprising each specific tubulars.

17. The method of claim 16, wherein taking into account historical data comprises taking into account historical loading information including the amount of stresses applied to a tubular or tubular stand.

18. The method of claim 16, wherein taking into account historical data comprises taking into account at least one of a length, a diameter, and a manufacturer.

19. The method of claim 16, comprising an automated rig control system and wherein the racking control system is integrated into the automated rig control system resulting in the automated rig control system having autonomous control capability for controlling all functions of the rig including drawworks, top drive, mud pumps, roughneck, racking, hydraulic elevators, slips, solids control, power systems, and anti-collision.

20. A non-transitory computer readable medium with computer executable instructions stored thereon for determining racking locations in a fingerboard for tubulars and tubular stands, the computer executable instructions comprising instructions for:

receiving information regarding a well plan in a racking control system ~~(180)~~ for drilling a wellbore with a drilling rig;

receiving driller setting information in the racking control system ~~(180)~~; and

determining a fingerboard plan with the racking control system ~~(180)~~ that assesses the received well plan information and the received driller setting information and, based on the

assessment, allocates tubular stand locations within a fingerboard ~~(108)~~ for tubular stands to carry out the well plan.