example, put the drill string with new drill bit back into the well, lower a downhole tool such as a packer, or insert a casing string into the wellbore to complete the well.

[0006] Since modern wells may become extremely deep, tripping out or tripping in operations may require a large number of threaded pipe joints to be disconnected (broken out) or connected (made up). Traditionally, the same drawworks, roughneck, and slips are used to make or break each connection. As the operation of a drilling rig can be extremely expensive, the need to trip in or trip out a tubular string may be a very costly operation. Additionally, damage may be caused to the wellbore simply by removing the tubular string from or inserting the tubular string into the wellbore. For instance, wellbore pressure may, in some circumstances, be rapidly increased or decreased by a rapid movement of a downhole tool. Commonly referred to as “swabbing”, these pressure fluctuations may cause, for example, reservoir fluids to flow into the wellbore or may cause instability in a formation surrounding a wellbore.

Summary

[0006a] According to a first aspect of the present disclosure, there is provided a system, including: an outer frame, the outer frame including one or more vertical supports; an inner frame slidingly coupled to the outer frame and positioned to be moved vertically with respect to the outer frame, wherein the inner frame comprises a base disposed as a bottom portion of the inner frame; and an iron roughneck disposed in the inner frame and configured to make up or break out a threaded joint between a first tubular member and a second tubular member, wherein the iron roughneck comprises fixed jaws configured to grip and prevent rotation of the first tubular member and makeup/breakout jaws configured to grip the second tubular member and impart a high-torque low-speed rotation on the second tubular member, wherein the iron roughneck is configured to be selectively movable between a first position above the base of the inner frame and a second position above the base of the inner frame.

[0006b] According to a second aspect of the present disclosure, there is provided a method, including: lifting a string at a relatively constant speed defining a tripping speed; moving an inner frame, comprising a base disposed as a bottom portion of the inner frame, downward with respect to an outer frame to a first location; moving an iron roughneck relative to the inner frame into an upper position above the base inside of the inner frame as the inner frame is moving downward with respect to the outer frame; moving the inner frame upwards relative to the outer frame at the tripping speed to align the iron roughneck with a threaded joint of the string while the string is being lifted at the tripping speed; and breaking out the threaded joint with the iron roughneck while the string is being lifted at the tripping speed in a common direction with the base with respect to the outer frame.

[0006c] According to a third aspect of the present disclosure, there is provided an apparatus, including: an inner frame configured to be slidingly coupled to an outer frame, wherein the inner frame is configured to be moved vertically from a first position relative to the outer frame to a second position relative to the outer frame, wherein the inner frame comprises a base disposed as a bottom portion of the inner frame; and an iron roughneck configured to be coupled to the inner frame, wherein the iron roughneck is configured to be movable between a first position above the base of the inner frame and a second position above the base of the inner frame while the string and the base move in a common direction with respect to the outer frame.

[0007] Disclosed herein is an automated pipe tripping apparatus. The automated pipe tripping apparatus may include an outer frame, the outer frame including one or more vertical supports; an inner frame, the inner frame slidingly coupled to the outer frame and positioned to be moved vertically by a lifting mechanism coupled between the inner and outer frames. The inner frame may include a tripping slips, the tripping slips positioned to receive a tubular member and selectively grip and support the tubular member; and an iron roughneck, the iron roughneck positioned above the tripping slips and positioned to receive the tubular member and make up or break out a threaded joint between a first and a second segment of the tubular member.

[0008] Disclosed herein is a method of removing a tubular member from a tubular string being removed from a wellbore. The tubular string may be made up of a series of threadedly connected tubular members. The method may include providing an automated pipe tripping apparatus. The automated pipe tripping apparatus may include an outer frame, the outer frame including one or more vertical supports; an inner frame, the inner frame slidingly coupled to the outer frame and positioned to be moved vertically by a lifting mechanism coupled between the inner and outer frames. The inner frame may include a tripping slips, the tripping slips positioned to receive a tubular member and selectively grip and support the tubular member; and an iron roughneck, the iron roughneck positioned above the tripping slips and positioned to receive the tubular member and make up or break out a threaded joint between a first and a second segment of the tubular member. The iron roughneck may be selectively movable in a vertical direction between a lower and an upper position by a roughneck lifting mechanism. The method may further include positioning the automated pipe tripping apparatus on a drilling floor of a drilling rig above the wellbore, the drilling rig including a drawworks, an elevator, an automated pipe handling device, and a drilling floor slips, the tubular string extending through the automated pipe tripping apparatus; lifting the tubular string with the elevator at a relatively constant speed defining a tripping speed; moving the inner frame downward; moving the iron roughneck into the upper position; moving the inner frame upwards at the tripping speed so that the iron roughneck is aligned with the threaded joint between the uppermost tubular member and the next tubular member; actuating the tripping slips; transferring the weight of the tubular string to the tripping

CLAIMS

1. A system, comprising:

an outer frame, the outer frame including one or more vertical supports;

an inner frame slidingly coupled to the outer frame and positioned to be moved vertically with respect to the outer frame, wherein the inner frame comprises a base disposed as a bottom portion of the inner frame; and

an iron roughneck disposed in the inner frame and configured to make up or break out a threaded joint between a first tubular member and a second tubular member, wherein the iron roughneck comprises fixed jaws configured to grip and prevent rotation of the first tubular member and makeup/breakout jaws configured to grip the second tubular member and impart a high-torque low-speed rotation on the second tubular member, wherein the iron roughneck is configured to be selectively movable between a first position above the base of the inner frame and a second position above the base of the inner frame.

2. The system of claim 1, comprising a roughneck lifting mechanism coupled to the iron roughneck, wherein the roughneck lifting mechanism is configured to selectively move the iron roughneck between the first position above the base of the inner frame and the second position above the base of the inner frame.

3. The system of claim 1, comprising tripping slips disposed in the base of the inner frame, the tripping slips configured to receive the first tubular member and selectively grip and support at least a portion of a string comprising the first tubular member and the second tubular member.

4. The system of claim 3, wherein the iron roughneck is positioned above the tripping slips in the inner frame.

5. The system of claim 1, comprising a lifting mechanism coupled to the inner frame and configured to selectively move the inner frame with respect to the outer frame.

6. The system of claim 5, wherein the lifting mechanism comprises one of one or more hydraulic pistons, jack screws, racks and pinions, cable and pulley, or travelling block.

7. The system of claim 1, wherein the iron roughneck comprises a pipe spinner configured to impart a high-speed, low-torque rotation on the second tubular member.

8. The system of claim 1, comprising a tubular filling apparatus positioned to fill at least one of the first tubular member and the second tubular member with drilling fluid.

9. The system of claim 1, comprising a control system configured to control a lifting mechanism to selectively move the inner frame with respect to the outer frame or control a roughneck lifting mechanism configured to selectively move the iron roughneck between the first position above the base of the inner frame and the second position above the base of the inner frame.

10. The system of claim 1, comprising a control system configured to control movement of the inner frame with respect to the outer frame or control movement in the vertical direction of the iron roughneck between the first position above the base of the inner frame and the second position above the base of the inner frame.

11. The system of claim 1, wherein the first tubular member and the second tubular member comprise a portion of a drill string, a casing string, a tool string, or a riser string.

12. A method, comprising:

lifting a string at a relatively constant speed defining a tripping speed;

moving an inner frame, comprising a base disposed as a bottom portion of the inner frame, downward with respect to an outer frame to a first location;

moving an iron roughneck relative to the inner frame into an upper position above the base inside of the inner frame as the inner frame is moving downward with respect to the outer frame;

moving the inner frame upwards relative to the outer frame at the tripping speed to align the iron roughneck with a threaded joint of the string while the string is being lifted at the tripping speed; and

breaking out the threaded joint with the iron roughneck while the string is being lifted at the tripping speed in a common direction with the base with respect to the outer frame.

13. The method of claim 12, comprising:

transferring weight of the string to tripping slips; and

lifting an uppermost member of the string away from the iron roughneck.

14. The method of claim 13, comprising moving the iron roughneck from the upper position inside of the inner frame to a lower position inside of the inner frame.

15. The method of claim 14, comprising:

moving an elevator upward at the tripping speed in conjunction with attaching the elevator to the string;

transferring the weight of the string to the elevator; and

releasing the tripping slips from the string.

16. The method of claim system of claim 12, wherein breaking out the threaded joint comprises breaking out a portion of a drill string, a casing string, a tool string, or a riser string.

17. An apparatus, comprising:

an inner frame configured to be slidingly coupled to an outer frame, wherein the inner frame is configured to be moved vertically from a first position relative to the outer frame to a second position relative to the outer frame, wherein the inner frame comprises a base disposed as a bottom portion of the inner frame; and

an iron roughneck configured to be coupled to the inner frame, wherein the iron roughneck is configured to be movable between a first position above the base of the inner frame and a second position above the base of the inner frame, wherein the iron roughneck is

configured to make up or break out members of a string while the string and the base move in a common direction with respect to the outer frame.

18. The apparatus of claim 17, wherein the outer frame does not completely encompass the inner frame.

19. The apparatus of claim 18, wherein the outer frame comprises a rail coupled to a top drive rail.