

Sept. 1, 1970

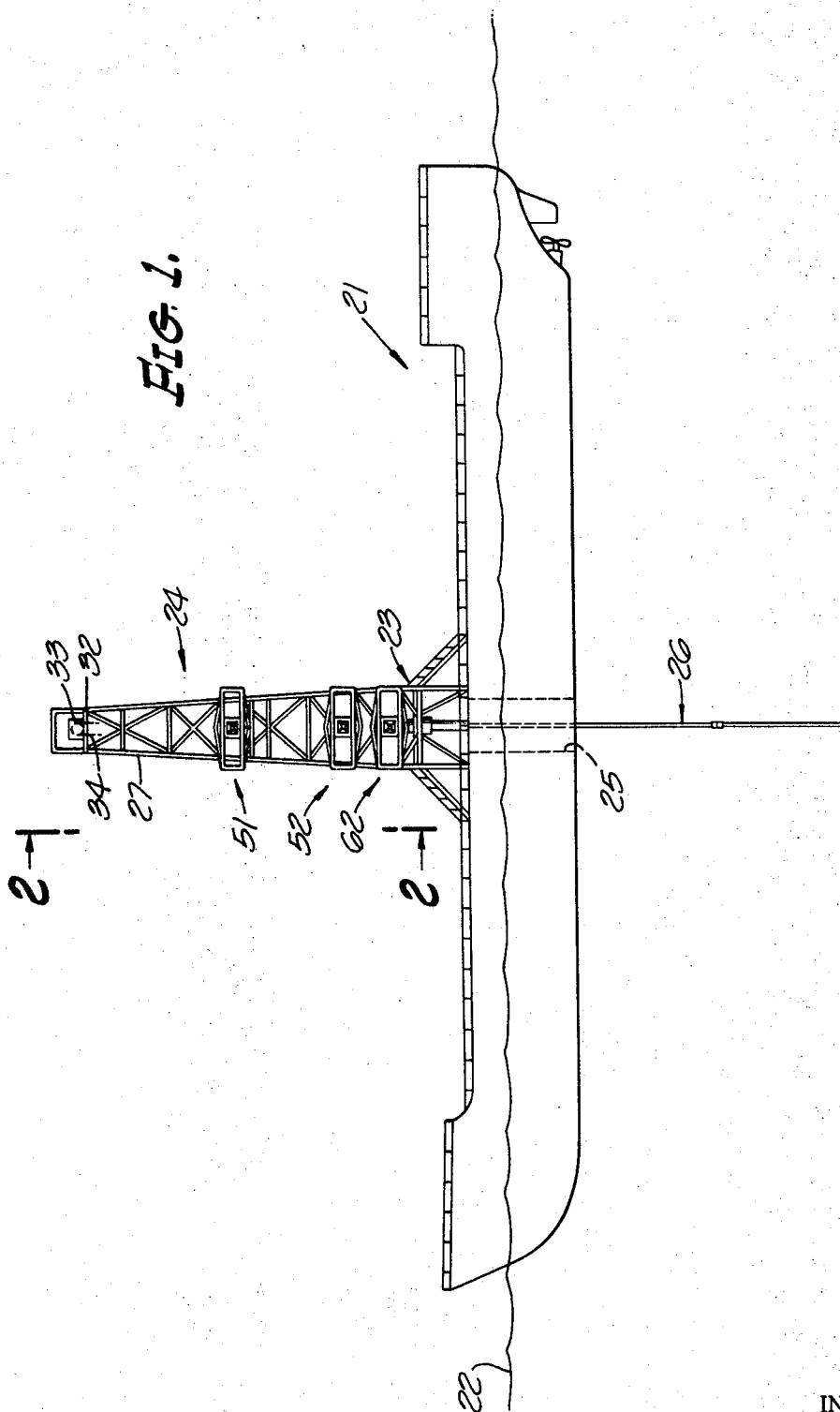
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3,526,425

LINK STABILIZER FOR WELL DRILLING RIGS

Filed Dec. 4, 1967

7 Sheets-Sheet 1



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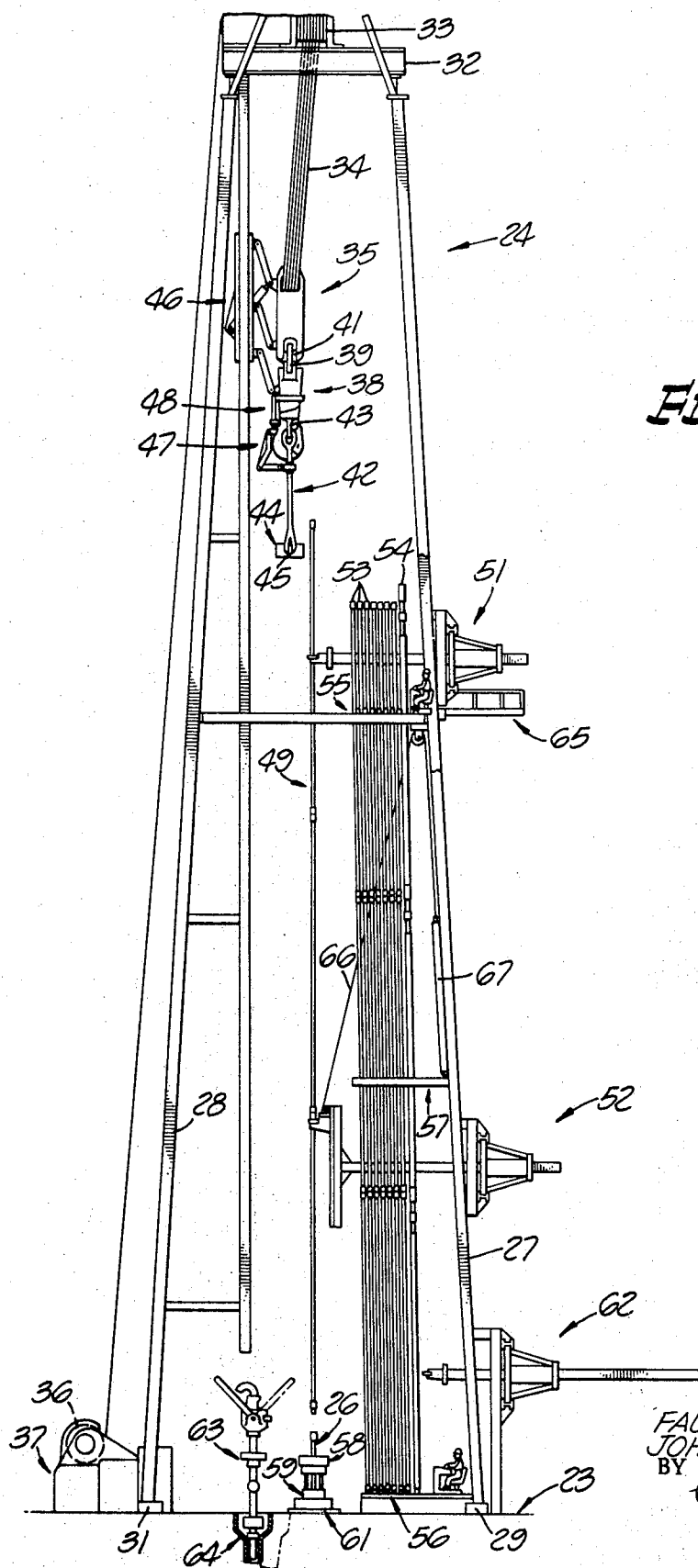


FIG. 2.

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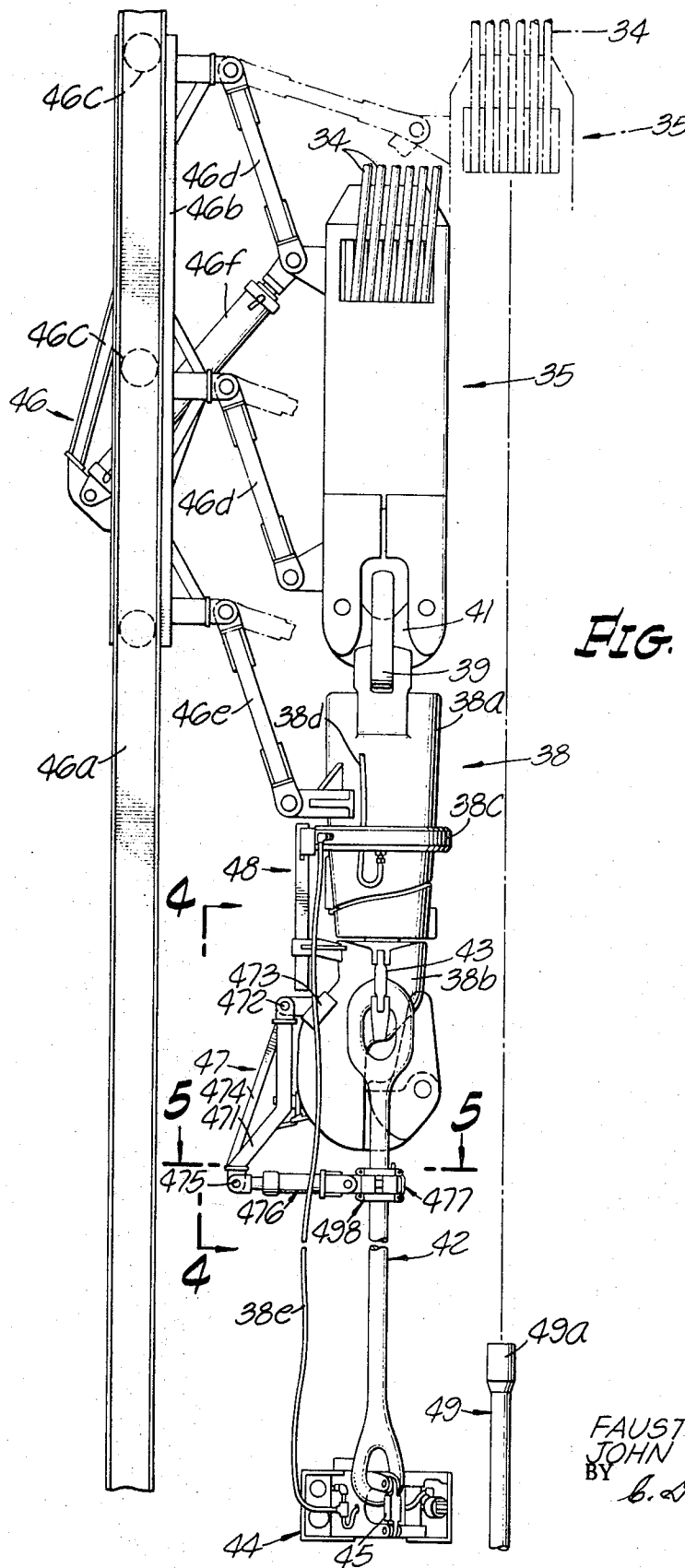


Fig. 3.

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7 Sheets-Sheet 4

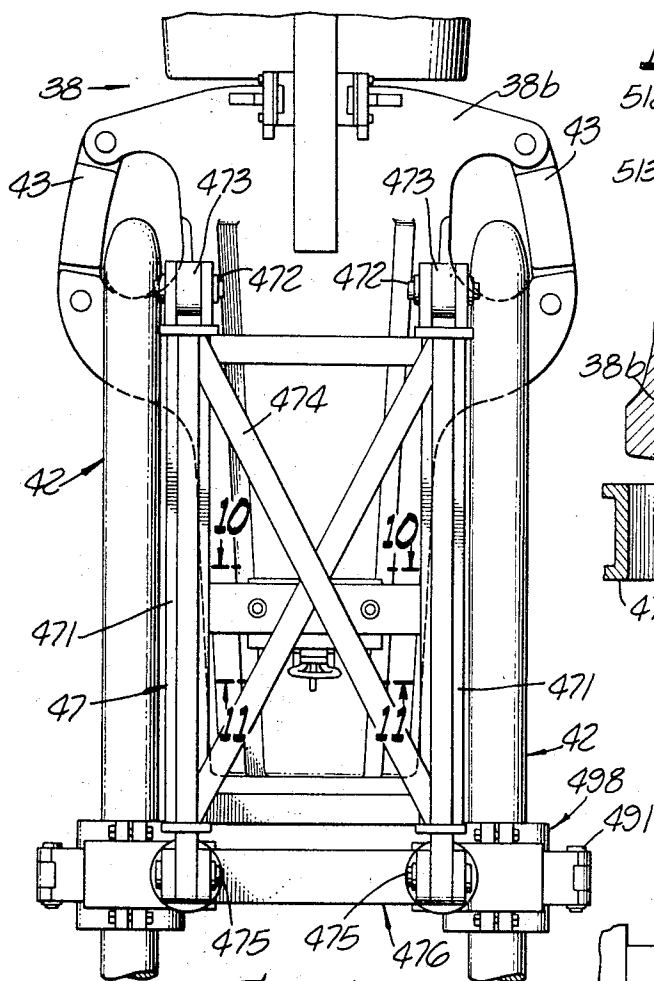


FIG. 4.

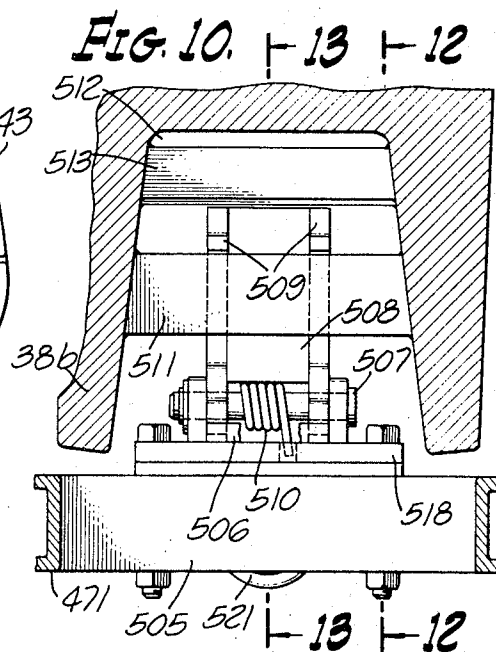


FIG. 10. 13 12

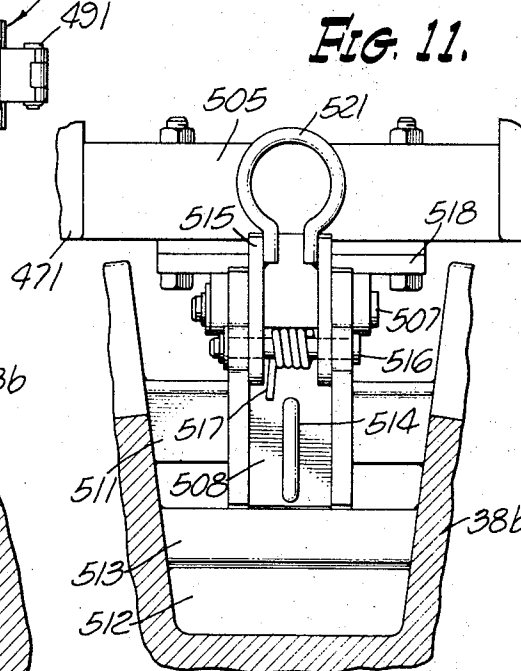


FIG. 11.

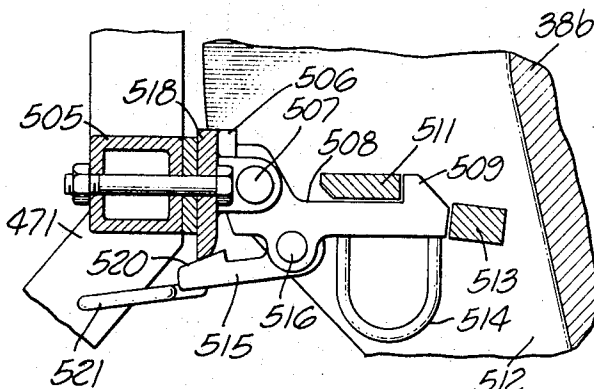


FIG. 12.

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7 Sheets-Sheet 5

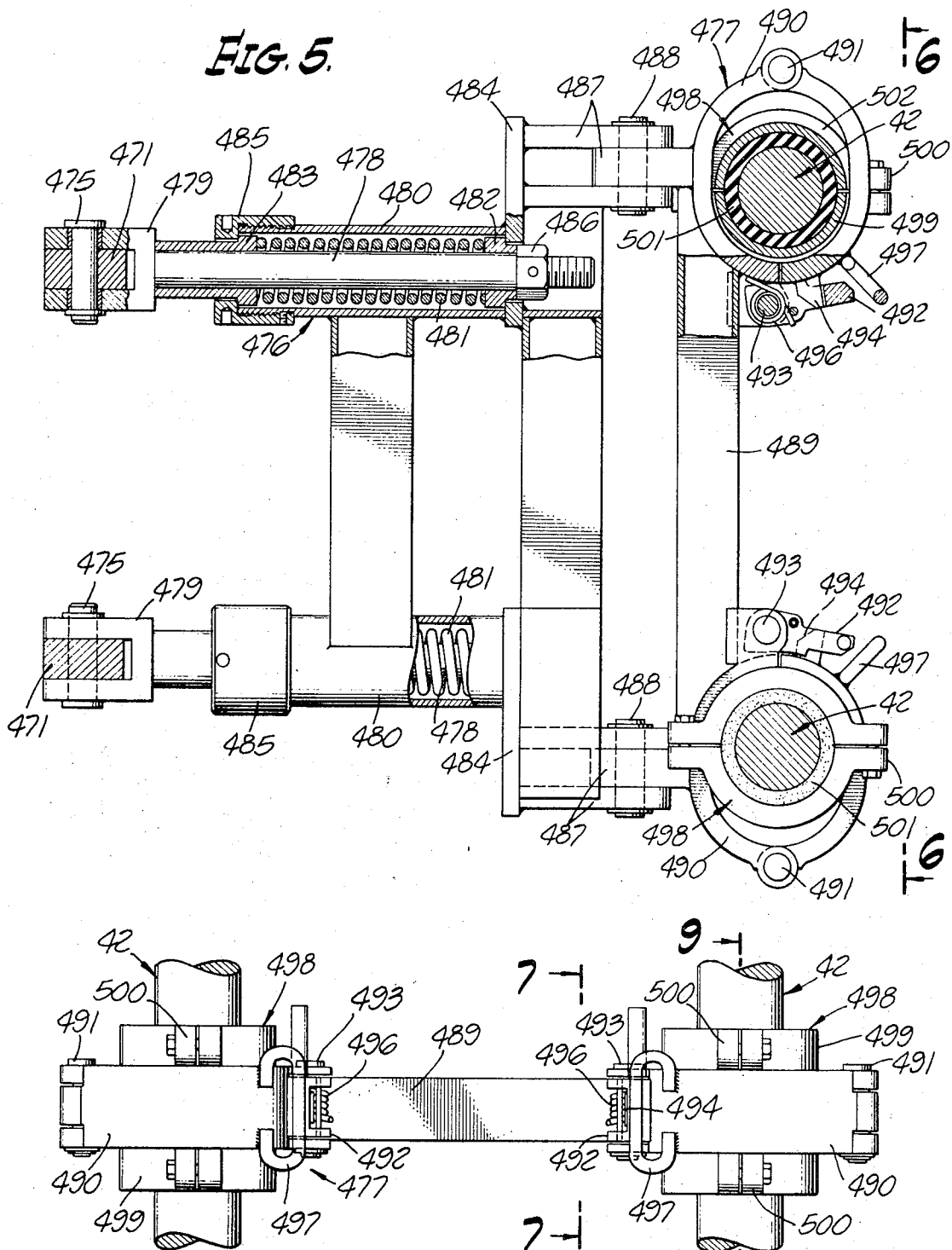


FIG. 6.

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LINK STABILIZER FOR WELL DRILLING RIGS

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7 Sheets-Sheet 6

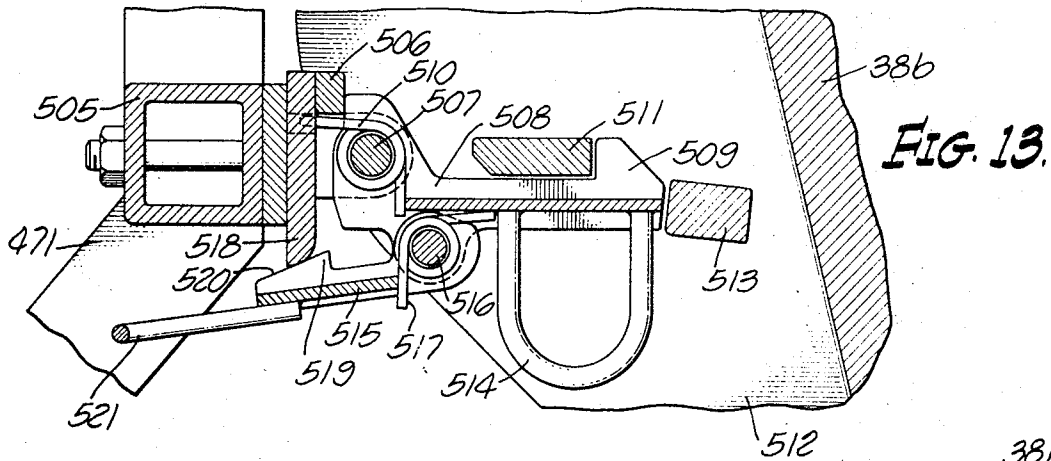


FIG. 14

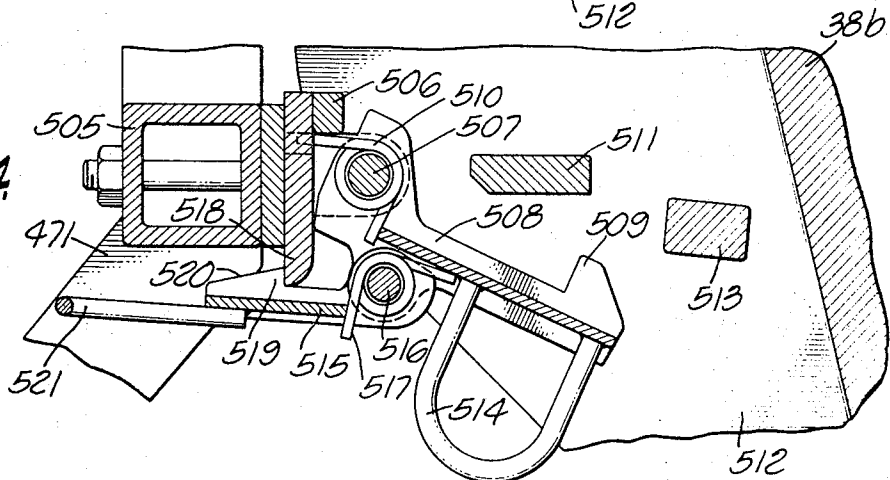


FIG. 8

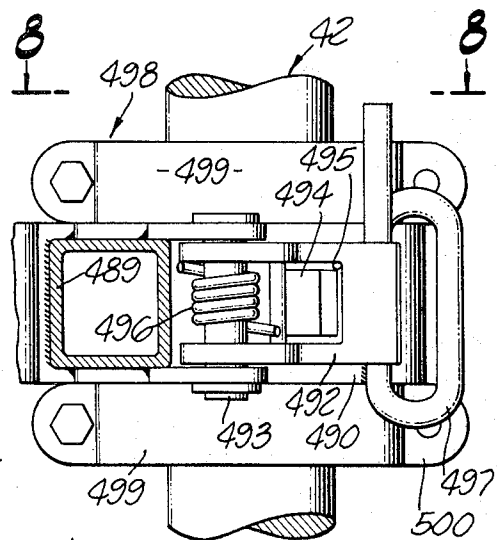
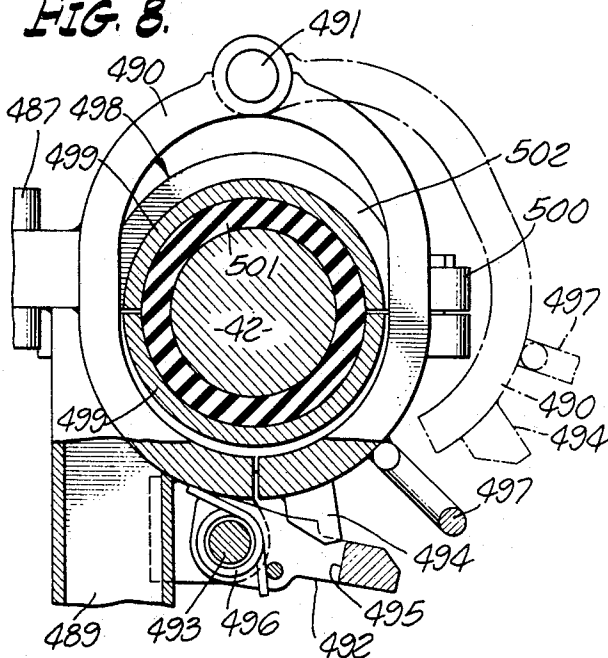


FIG. 7

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7 Sheets-Sheet 7

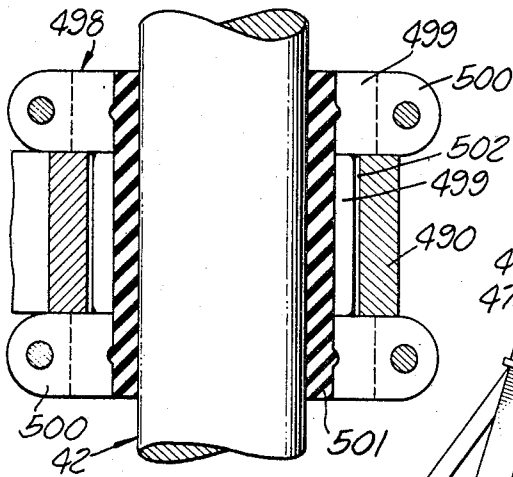


FIG. 9.

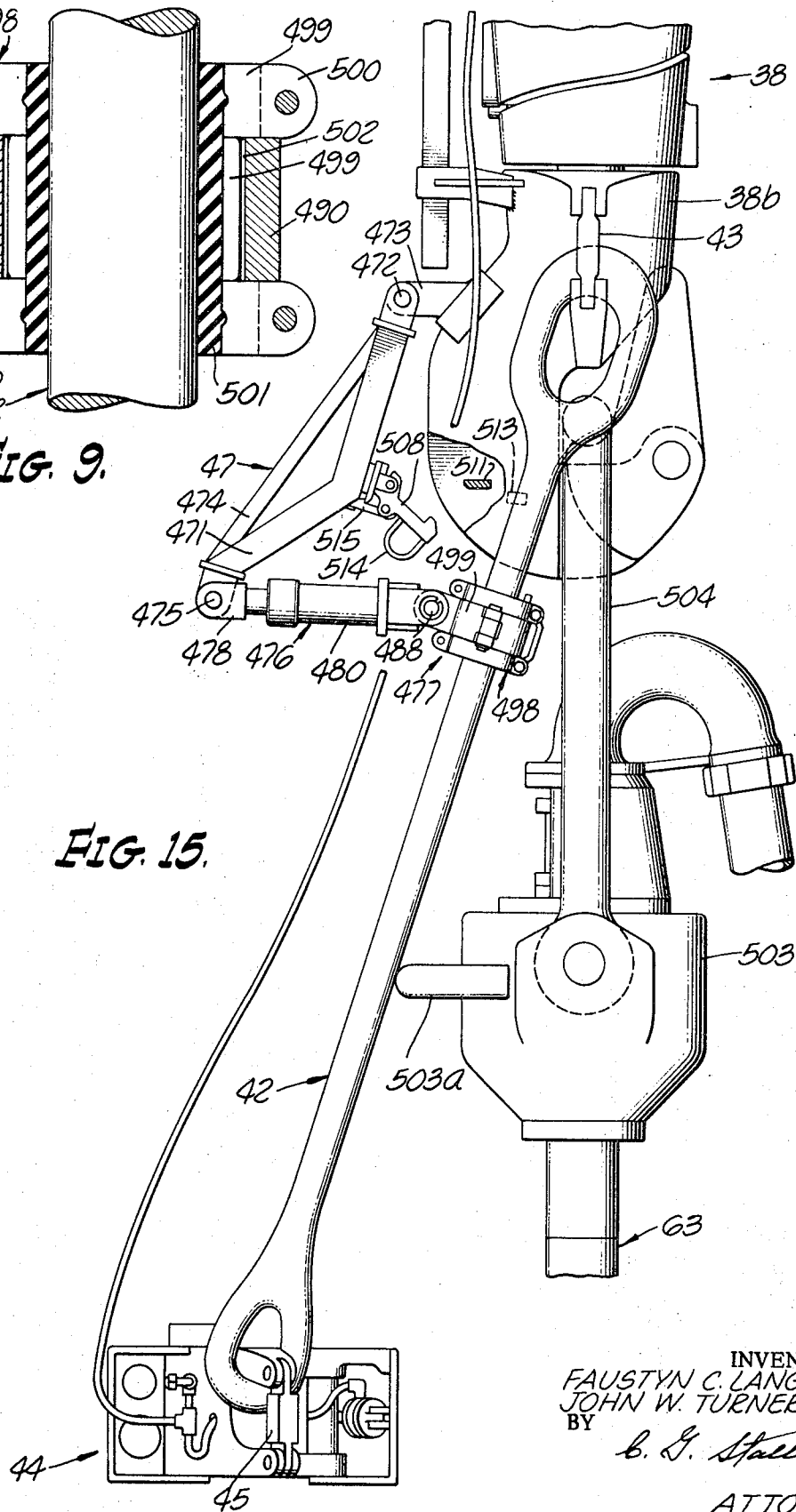


FIG. 15.

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3,526,425

LINK STABILIZER FOR WELL DRILLING RIGS
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Filed Dec. 4, 1967, Ser. No. 687,817

Int. Cl. B64d 17/38

U.S. Cl. 294—82

16 Claims

ABSTRACT OF THE DISCLOSURE

A stabilizer for the elevator links which depend from the hook of a well drilling rig in which the links are limited in their relative lateral motion and are also restrained against swinging motions to facilitate and assure engagement of a pipe joint by the elevator, the stabilizer being releasable to allow pivotal movement of the links to an out of the way position when a drilling swivel is supported by the hook.

BACKGROUND OF THE INVENTION

In the drilling of oil and gas or other wells into the subsurface earth formation, rigs have heretofore been proposed and sometimes employed which are so equipped as to be operable through the entire drilling and well casing operations with a small crew who can control the operations from a remote location. Such operations include the handling of the drill pipe in a rack, as well as the manipulation of the drill string supporting equipment in such a manner that the usual drilling hook and supporting traveling block are held in an out of the way position to one side of the center of the derrick while being hoisted or lowered in the running or pulling of pipe, respectively.

Some drilling rigs are adapted for operation on a floating vessel when the well is being drilled under water, thereby subjecting the drill string hoisting equipment to variable forces tending to cause undesirable motion of the traveling block and hook, as well as undesirable motion of the usual elevator suspended from the hook by links. Efforts to effect engagement of the elevator with the pipe are thus hampered and an operator is required to attempt to synchronize the timed operations involved in engaging the pipe with the elevator.

In addition, any tendency of the elevator to be in motion is detrimental to automation of the operations, since automation of the operations would require that the block, hook, links, and elevator be in known positions at the point in time at which the elevator is to be engaged with the pipe, and unpredictable movement would result in failure of the elevator to be properly closed on the pipe, for example.

SUMMARY

Accordingly, an object of the present invention is to provide means for stabilizing the usual links which support the elevator on the drilling hook so that the elevator is maintained in a known location relative to the hook and thereby relative to a pipe to be engaged by the elevator as pipe is being run into or pulled from the well bore.

Another object of the invention is to provide a stabilizer for the usual links which support the elevator on the drilling hook so that the elevator is maintained in a known position relative to the hook and thereby relative to a pipe to be engaged by the elevator as pipe is being run into and pulled from the well, and the links being releasable for movement to an out of the way position when the hook supports the well drilling swivel during the drilling operation.

Still another object is to provide a link stabilizer carried by the drilling hook which supports the elevator links, and acting to normally resiliently bias the links to positions at which the elevator is centrally located beneath the hook in a position to be engaged with a pipe.

Yet another object is to provide a link stabilizer carried by the drilling hook which supports the elevator links, the stabilizer being releasably latched in a position at which the links are in positions supporting the elevator centrally beneath the hook in a position to be engaged with a pipe, and the links being movable to an out of the way position upon release of the latch to allow engagement of the hook with a drilling swivel.

More specifically, a further object is to provide a link stabilizer in accordance with the preceding object in which a second latch is provided to hold the first latch released until it is desired that the stabilizer be again latched in a working position.

And still another object is to provide a link stabilizer for holding the elevator links in positions at which the elevator is supported centrally beneath the drilling hook in a position for engagement with a pipe, and wherein the links are respectively engaged in restraining shackles which are adapted to allow sufficient relative movement of the links to enable the elevator to open and close.

Other objects and advantages of the invention will be hereinafter described or will become apparent to those skilled in the art and the novel features of the invention will be defined in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in side elevation showing a vessel including a derrick provided with pipe handling equipment made in accordance with the invention;

FIG. 2 is an enlarged view of the derrick assembly along the line 2—2 of FIG. 1, with certain of the parts broken away;

FIG. 3 is an enlarged fragmentary view illustrating the traveling block, hook, elevator links and elevator included in the pipe handling equipment of the derrick;

FIG. 4 is an enlarged fragmentary view in elevation of the link stabilizer means as embraced by the line 4—4 of FIG. 3;

FIG. 5 is a view in horizontal section, as taken on the line 5—5 of FIG. 3;

FIG. 6 is a view in side elevation showing the link shackle assembly embraced by the line 6—6 of FIG. 5;

FIG. 7 is a view in vertical section, as taken on the line 7—7 of FIG. 6;

FIG. 8 is a view in horizontal section, as taken on the line 8—8 of FIG. 7;

FIG. 9 is a view in vertical section, as taken on the line 9—9 of FIG. 6;

FIG. 10 is an enlarged fragmentary detail view in horizontal section, as taken on the line 10—10 of FIG. 4, illustrating the releasable stabilizer latch;

FIG. 11 is an enlarged fragmentary detail view in horizontal section, as taken on the line 11—11 of FIG. 4, also illustrating the releasable stabilizer latch;

FIG. 12 is a fragmentary detail view in vertical section, as taken on the line 12—12 of FIG. 10;

FIG. 13 is a fragmentary detail view in vertical section, as taken on the line 13—13 of FIG. 10, showing the releasable latch in engagement;

FIG. 14 is a view generally corresponding to FIG. 13, but showing the releasable latch released; and

FIG. 15 is a fragmentary view in side elevation illustrating the link stabilizer released and the links pivoted to an out of the way position by a drilling swivel.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown a vessel 21 afloat in the water, the surface of the water being designated 22. The ship has an elevated platform 23 positioned amidships. Erected on the platform is a drilling derrick 24. The ship has a moon hole 25 through which a string of drill pipe 26 extends from above the platform 23 into the water and thence into the earth (not shown) below. As this type of vessel with a platform and a derrick is widely known in the field to which the invention pertains, it need not be described here in further detail.

Turning now to FIG. 2, the derrick 24 is shown somewhat schematically, sway braces, guy wires and similar structural members being omitted to enable working apparatus to be shown more clearly. The derrick has generally vertical corner posts 27 and 28 supported on the platform 23 on base members 29 and 31. A water table 32 near the top of the derrick carries the usual crown block 33 which is aligned with the vertical center line of the derrick. Suspended from the crown block by cable 34 is a traveling block 35. As is usual, the dead end (not shown) of the cable 34 is anchored to the ship's structure or to the platform, and the other end is led to the drum 36 of a draw works 37 for raising and lowering the traveling block and the load supported thereby.

A hook structure 38 is swingably suspended from the bottom of the traveling block 35 by inter-engaged bails 39 on the hook end 41 on the block. Elevator links 42, only one of which is seen in FIG. 2, are swingably suspended from ears 43 on the hook structure, and the links have an elevator 44 swingably attached by ears 45 to the lower end of the links 42.

The general reference numeral 46 denotes apparatus for positioning and guiding the block and hook structure. An elevator link stabilizing device is designated by the general reference numeral 47. The general reference numeral 48 designates apparatus for supplying compressed air to the elevator 44 to actuate it.

A stand 49 of drill pipe is shown as being supported by pipe handling equipment including rackers 51 and 52. Other stands 53 of drill pipe and a stand 54 of drill collars are shown at rest in a pipe rack having a finger board 55, a base 56, and an intermediate rack member 57. The upper end of the string of drill pipe 26 is shown projecting above the power tongs 58, the slips 59, and the rotary table 61. Casing manipulating apparatus is shown at 62. A swivel and kelly assembly 63 is disposed in the rat hole 64.

Projecting outwardly from the derrick and positioned under the racker 51 is a horizontal stage 65 upon which an operator may stand to adjust or repair the racker. Associated with the racker 52 is a cable 66 actuated by a fluid-powered piston-and-cylinder motor 67 for raising and lowering a component of the racker 52.

The present invention is more particularly concerned with the link stabilizer structure generally denoted at 47, such structure having broader application, as, for example, to any drilling rig in which automatic handling of pipe is to be accomplished, but being herein illustrated in an environment in which the effects of rolling of the vessel 21 on the one hand, or pitching of said vessel on the other hand, are prevented from causing undesired motion of the elevator links 42 and the elevator 44 supported thereby beneath the hook structure 38. The block and hook structure positioning means denoted at 46 is the present disclosure is more particularly the subject of the copending application of Jones and Turner filed concurrently herewith entitled Block and Hook Structure Positioning and Guiding Apparatus, Ser. No. 687,819, filed Dec. 4, 1967.

The details of the finger boards 55 and 57, as well as the base 56, that is, the pipe racking apparatus and its mode of operation, are more particularly the subject of the application filed concurrently herewith in the names

of Johnson and Turner and entitled Finger Board and Racking Apparatus and Method, Ser. No. 687,820, filed Dec. 4, 1967, now U.S. Pat. No. 3,501,017, issued Mar. 17, 1970. The hook structure 38 and its relationship to the elevator 44, that is, the means of conducting elevator operating fluid pressure to the elevator from the hook so as to effect the remote operation of the elevator 44, are more particularly the subject matter of the application filed concurrently herewith in the name of Edward J. McFadden and entitled Fluid Conductor Means for Hook-Mounted Elevator, Ser. No. 687,829, filed Dec. 4, 1967, now U.S. Pat. No. 3,479,062, issued Nov 18, 1969. Accordingly, the details of the rig assembly, except to the extent necessary to describe the structure and mode of operation of the link stabilizer means of the present invention, will not be further described herein.

Referring more particularly to FIG. 3, it will be noted that the hook structure generally designated 38 comprises a hook body 38a and a hook 38b having the above-described ears 43 thereon by which the links 42 are suspended. The hook body 38a is relatively stationary, that is, is non-rotatable, while the hook 38b is adapted to be rotated from a normal position, as shown in FIG. 3, to angularly displaced positions during certain of the pipe handling operations. Accordingly, the hook body 38a is provided with a manifold 38c for air under pressure supplied through a conduit 38d, air passing from the manifold 38c through a flexible conductor 38e to the elevator 44 so as to cause opening of the elevator 44 when desired. An exemplary air-operated elevator is shown in the patent to Chrisman and Nicolson granted Nov. 23, 1954, Pat. No. 2,695,189, from which it will be noted that characteristically such an elevator will be air opened, but automatically closed, upon the forceful movement of a pipe into the open elevator in a lateral direction.

The apparatus generally denoted at 46, which is adapted to position and guide the traveling block 35 and the hook structure 38, generally comprises a vertically extended guide rail 46a displaced laterally to one side of the derrick and adapted to guide a carriage 46b having rollers 46c vertically as the traveling block and hook are moved vertically by the cable 34. The carriage 46b is provided with parallel link means 46d connected to the traveling block 35 and a third parallel link mechanism 46e connected to the hook structure 38, so that, upon extension of a fluid pressure actuator cylinder means 46f, the traveling block and hook will be shifted laterally inward to a position overlying the rotary table 61 above the well being drilled, from a normal laterally retracted position. It will also be apparent that such inward movement of the traveling block and hook structure will effect corresponding inward movement of the links 42 and the elevator 44, so that, when the elevator 44 is open as shown in FIG. 3, it will be moved laterally into engagement with the upper end of the stand of pipe 49, herein illustrated as drill pipe having a tool joint 49a adapted to be engaged by the elevator 44, whereby the elevator will support the stand of drill pipe shown in FIG. 2 so that the same may be lowered into engagement with the tool joint of the drill string 26 which extends upwardly through the power tong 58, whereupon the tong 58 may be slightly elevated to engage the tool joint at the lower end of the stand of pipe 49 to rotate the same relative to the drill string to make up an additional length of the drill string.

Referring now more particularly to FIGS. 3 and 4, the link stabilizer means of the invention will be seen to include a frame composed of side members 471 pivoted at 472 to supporting brackets 473 carried by the hook 38b. The frame sides 471 are suitably reinforced with crossed braces 474, as best seen in FIG. 4. At their lower ends the frame sides 471 are pivotally connected at 475 to a shock absorber assembly generally denoted at 476, which in turn supports a shackle assembly generally denoted at 477.

5

Referring to FIG. 5, the shock absorber assembly 476 includes a pair of horizontally extended and laterally spaced rods 478 having yokes 479 pivotally connected to the frame sides 471. Disposed about the respective rods 478 is a tubular spring housing 480 having a spring 481 therein, the spring seating at its opposite ends against spring seats 482 and 483 relative to which the rod 478 is slidable. Seat 482 abuts with a transversely extended plate 484, to which each of the tubular spring housings 480 are suitably attached, as by welding; the spring seat 483 abuts with a retainer cap 485. Rods 478 are retained within the spring housings by means of nuts 486, so that each of the rods 478 is free to move axially in either direction, but such movement is resisted by the respective springs 481. Thus, the springs 481 constitute means normally resiliently biasing the shackle assembly 477 to a stabilized position, since the shackle assembly 477 is connected to the plate 484 by means of inter-engaged ears 487 and pins 488.

The shackle assembly 477 includes a transverse brace 489 interconnecting a pair of ring members 490, each of which is hinged at 491 so as to be openable and each of which is provided with latch means for normally holding the same closed. This latch means, as best seen in FIGS. 7 and 8, comprises a latch arm 492 pivoted about a pin 493 carried by one part of the ring member 490 and a latch projection 494 carried by the other part of the ring member 490, the latch arm 492 having an opening providing a shoulder 495 engageable with the lug 494 when the arm is in the normal position to which it is biased by a torsion spring 496 disposed about the pin 493 and acting to normally rotate the arm in a latching direction, as shown in FIG. 5. In addition, the part of the ring member 490 having the lug 494 may also be provided with a closing handle 497.

Each of the ring-like members 490 is transversely elongated so as to allow slight lateral movement of the links 42, and each of the links is preferably provided with a bushing adapted to be disposed within the respective ring members 490, such bushings being generally denoted at 498 and illustratively comprising a pair of bushing half sections 499 having interconnected ears 500, whereby the half sections are adapted to be clamped about a rubber sleeve 501 disposed about the respective links 42 and providing an annular channel 502 in which the ring parts 490 engage when the ring parts are latched in the closed positions.

From the foregoing it will be apparent that the link stabilizer means 47 will function as thus far described to provide a rigid support engaging the respective links 42 between the ends of the links to prevent the links from swinging on the hook ears 43, except within the limited confines of the transversely elongated ring members 490, such limited transverse swinging of the links being necessary to allow opening and closing of the elevator 44. Thus, the links are stabilized against rolling movements of the vessel 21 so that, when the actuator cylinder 46f of the block and hook structure positioning and guiding apparatus 46 is extended to move the open elevator towards the tool joint 49a, it is assured that the open elevator will be moved into engagement with the pipe, notwithstanding any tendency of the links to swing away from the pipe due to roll of the vessel. Likewise, inasmuch as the automated handling of pipe would require that the pipe be positively forced into the open elevator to assure non-failing closure of the latter, the link stabilizer means also is advantageous in the automatic handling of pipe where an attendant is not on hand to observe whether the elevator has, in fact, been engaged by the pipe so as to cause closure of the elevator.

While the stabilizer means is employed during the so-called round tripping of the drill pipe, or in the running of other pipe, such as casing, it is necessary that during the periods of drilling activity the links 42 and the elevator 44 be swung to an out of the way position, as illus-

6

trated in FIG. 15, at which time a drilling swivel 503 is supported by a bail 504 in the hook 38b.

Accordingly, releasable latch means are provided which, as illustrated in FIGS. 10 through 14, are adapted to releasably hold the stabilizer frame structure in fixed relation to the hook 38b. This releasable latch means includes a support member 505 extended transversely between the side members 471 of the stabilizer frame. Carried by the support member 505 is a support bracket 506, to which is pivotally mounted by a pin 507 a latch arm 508 having a latch lug 509 at its outer extremity. A torsion spring 510 disposed about the pivot pin 507 normally forces the latch arm 509 in a latching direction so that, as seen in FIG. 13 for example, the lug 509 will engage with a transversely extended keeper plate 511 welded to, or otherwise made a part of, the hook 38b within a channel 512 normally found in such hooks. An additional plate 513 is also provided in the channel 512 providing an abutment or guide to direct the latch lug 509 into the latching position. Latch arm 508 is provided with an eye 514, whereby the latch may be released, and, when released, secondary latch means are provided for releasably holding the latch arm 508 in a released condition.

This secondary latch means includes a latch arm 515 pivoted about a pin 516 carried beneath the latch arm 508, a torsion spring 517 providing the means normally tending to effect latch movement of the secondary latch arm 515. A keeper plate 518 extends transversely with the support member 505 and is adapted to be engaged by a latch lug 519 on the secondary latch arm 515 when the primary latch arm 508 is pulled downwardly to the position shown in FIG. 14. The secondary latch lug 519 has an elongated cam surface 520 slidably engaged beneath the keeper plate 518 to facilitate engagement of the secondary latch lug 519 with the plate 518. The secondary latch arm 515 is provided with an eye 521 whereby the latch arm 515 may be pivoted downwardly from engagement with the keeper plate 518.

When the primary latch means is released, as seen in FIG. 14, and latched in the released position, as shown in FIG. 14, by the secondary latch means, the links 42 are free to swing about the hook ears 43, as shown in FIG. 15, upon engagement of the links with the swivel 503, bumper means 503a being provided between the links and the swivel to hold the links in the displaced position at which the swivel 503 may be supported by the drilling hook during the normal drilling operations. Thereafter, the swivel and kelly assembly 63 may be elevated and disconnected from the drill string so as to be stored in the rat hole 64 while the next stand of drill pipe is made up in the drill string.

From the foregoing, the mode of operation of the present invention will be fully apparent and needs no further description, and, while the specific details of an illustrative embodiment of the invention have been shown and described, changes and alterations may be made without departing from the spirit of the invention as defined in the appended claims.

We claim:

1. Pipe supporting apparatus for use in a well drilling derrick comprising: a hook structure adapted to be raised and lowered in the derrick and having ears, a pair of links swingably depending from said ears, a pipe elevator carried by said links, and stabilizer means connected to said hook structure and engaged with said links for restraining said links against swinging movements relative to said hook structure from positions aligned with the direction of movement of said hook structure in said derrick, wherein said stabilizer means includes shock absorber means normally resiliently biasing said links to a central position beneath said hook structure.

2. Pipe supporting apparatus for use in a well drilling derrick comprising: a hook structure adapted to be raised and lowered in the derrick and having ears, a pair of links swingably depending from said ears, a pipe

elevator carried by said links, and stabilizer means connected to said hook structure and engaged with said links for restraining said links against swinging movements relative to said hook structure from positions aligned with the direction of movement of said hook structure in said derrick, wherein said stabilizer means includes shackle means engaged with said links, said shackle means including a pair of ring members disposed about the respective links and having an opening elongated in a direction transversely of said links for allowing opening and closing of said elevator.

3. Apparatus as defined in claim 2, wherein said links are provided with bushings within said ring members.

4. Apparatus as defined in claim 2, wherein said links are provided with bushings within said ring members, said bushings providing channels and said ring members engaging said bushings within said channels.

5. Pipe supporting apparatus for use in a well drilling derrick comprising: a hook structure adapted to be raised and lowered in the derrick and having ears, a pair of links swingably depending from said ears, a pipe elevator carried by said links, and stabilizer means connected to said hook structure and engaged with said links for restraining said links against swinging movements relative to said hook structure from positions aligned with the direction of movement of said hook structure in said derrick, wherein said stabilizer means includes shackle means engaged with said links and wherein said shackle means comprise ring members disposed about said links, said ring members including pivotally interconnected parts and latch means for releasably closing said ring members about said links.

6. Pipe supporting apparatus for use in a well drilling derrick comprising: a hook structure adapted to be raised and lowered in the derrick and having ears, a pair of links swingably depending from said ears, a pipe elevator carried by said links, and stabilizer means connected to said hook structure and engaged with said links for restraining said links against swinging movements relative to said hook structure from positions aligned with the direction of movement of said hook structure in said derrick, wherein said stabilizer means comprises a frame pivotally connected to said hook, shackle means carried by said frame and connected to said links, and means releasably latching said frame to said hook to prevent pivotal movement of said frame.

7. Apparatus as defined in claim 6, wherein said latch means includes primary latch means for preventing said pivotal movement of said frame and secondary latch means for holding said primary latch means open.

8. Pipe supporting apparatus for use in a well drilling derrick comprising: a hook structure adapted to be raised and lowered in the derrick and having ears, a pair of links swingably depending from said ears, a pipe elevator carried by said links, and stabilizer means connected to said hook structure and engaged with said links for restraining said links against swinging movements relative to said hook structure from positions aligned with the direction of movement of said hook structure in said derrick, wherein said stabilizer means includes shock absorber means normally resiliently biasing said links to a central position beneath said hook structure and shackle means carried by said shock absorber means and connected to said links.

9. Pipe supporting apparatus for use in a well drilling derrick comprising: a hook structure adapted to be raised and lowered in the derrick and having ears, a pair of links swingably depending from said ears, a pipe elevator carried by said links, and stabilizer means connected to said hook structure and engaged with said links for restraining said links against swinging movements relative to said hook structure from positions aligned with the direction of movement of said hook structure in said derrick, wherein said stabilizer means includes a frame carried by said hook, shock absorber means carried by

said frame and connected to said links, said shock absorber means including a rod, a housing through which said rod extends, a spring in said housing about said rod, spring seats at opposite ends of said spring, and means for moving said spring seats one towards the other upon movement of said links towards and away from said frame.

10. A stabilizer for elevator links depending from the hook of a well drilling rig comprising a frame having means for connecting said frame to said hook, and means carried by said frame and engageable with said links for restraining the same against movement relative to said hook, wherein said means carried by said frame includes shock absorber means for normally biasing said links to a central position aligned with the hook.

11. A stabilizer as defined in claim 10, wherein said shock absorber means includes a rod, a housing through which said rod extends, a spring in said housing about said rod, spring seats at opposite ends of said spring, and means for moving said spring seats one towards the other upon movement of said links towards and away from said frame.

12. A stabilizer for elevator links depending from the hook of a well drilling rig comprising a frame having means for connecting said frame to said hook, and means carried by said frame and engageable with said links for restraining the same against movement relative to said hook, wherein said means carried by said frame and engageable with said links includes shackle means engaged with said links, and wherein said shackle means includes a pair of ring members disposable about the respective links and having an opening elongated transversely of said links.

13. A stabilizer for elevator links depending from the hook of a well drilling rig comprising a frame having means for connecting said frame to said hook, and means carried by said frame and engageable with said links for restraining the same against movement relative to said hook, wherein said means for connecting said frame to said hook includes means providing for pivotal movement of said frame, said frame having latch means thereon for interconnecting said frame with said hook.

14. A stabilizer as defined in claim 13, including means normally biasing said latch means closed.

15. A stabilizer for elevator links depending from the hook of a well drilling rig comprising a frame having means for connecting said frame to said hook, and means carried by said frame and engageable with said links for restraining the same against movement relative to said hook, wherein said means for connecting said frame to said hook includes means providing for pivotal movement of said frame, said frame having latch means thereon for interconnecting said frame with said hook, and secondary latch means for holding said first-mentioned latch means open.

16. A stabilizer as defined in claim 15, including means normally biasing both of said latch means closed.

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U.S. Cl. X.R.

24—201; 214—2.5; 254—139, 192