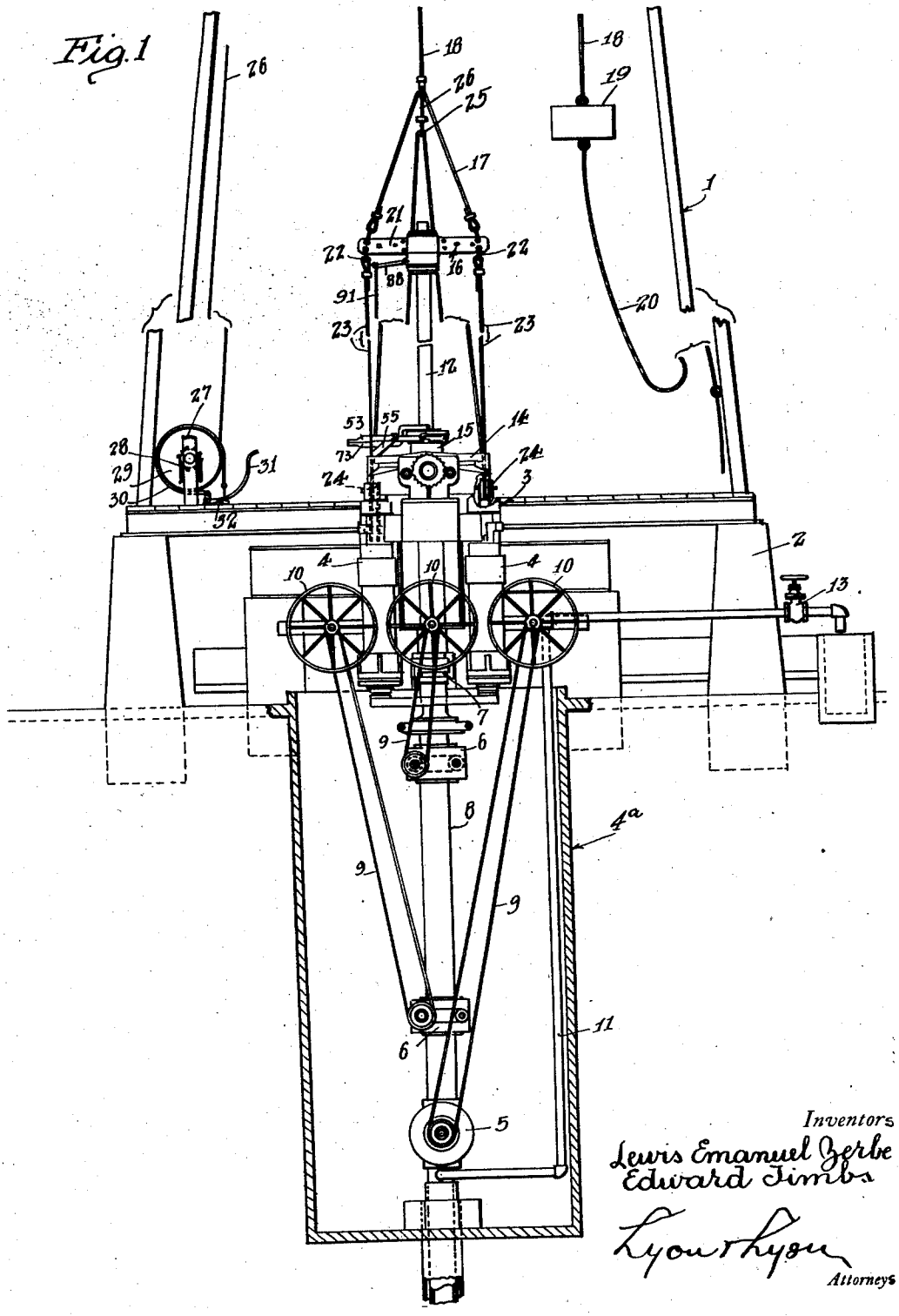
Aug. 28, 1934. L. E. ZERBE ET AL 1,971,473

WELL DRILLING EQUIPMENT FOR HANDLING DRILL PIPE AND CASING IN HIGH PRESSURE WELLS

Filed Oct. 19, 1931 6 Sheets-Sheet 1

Fig. 1



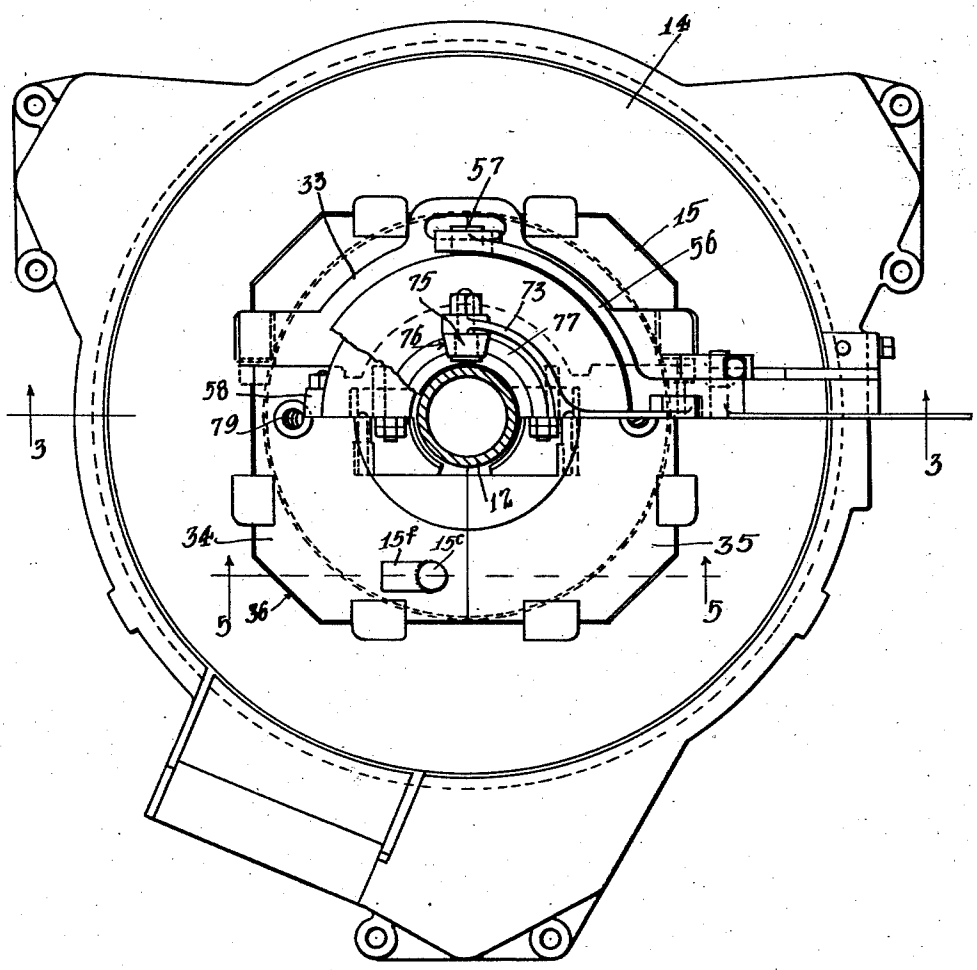
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WELL DRILLING EQUIPMENT FOR HANDLING DRILL PIPE AND CASING IN HIGH PRESSURE WELLS

Filed Oct. 19, 1931 6 Sheets-Sheet 2

Fig. 2



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WELL DRILLING EQUIPMENT FOR HANDLING DRILL PIPE AND CASING IN HIGH PRESSURE WELLS

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Fig. 3

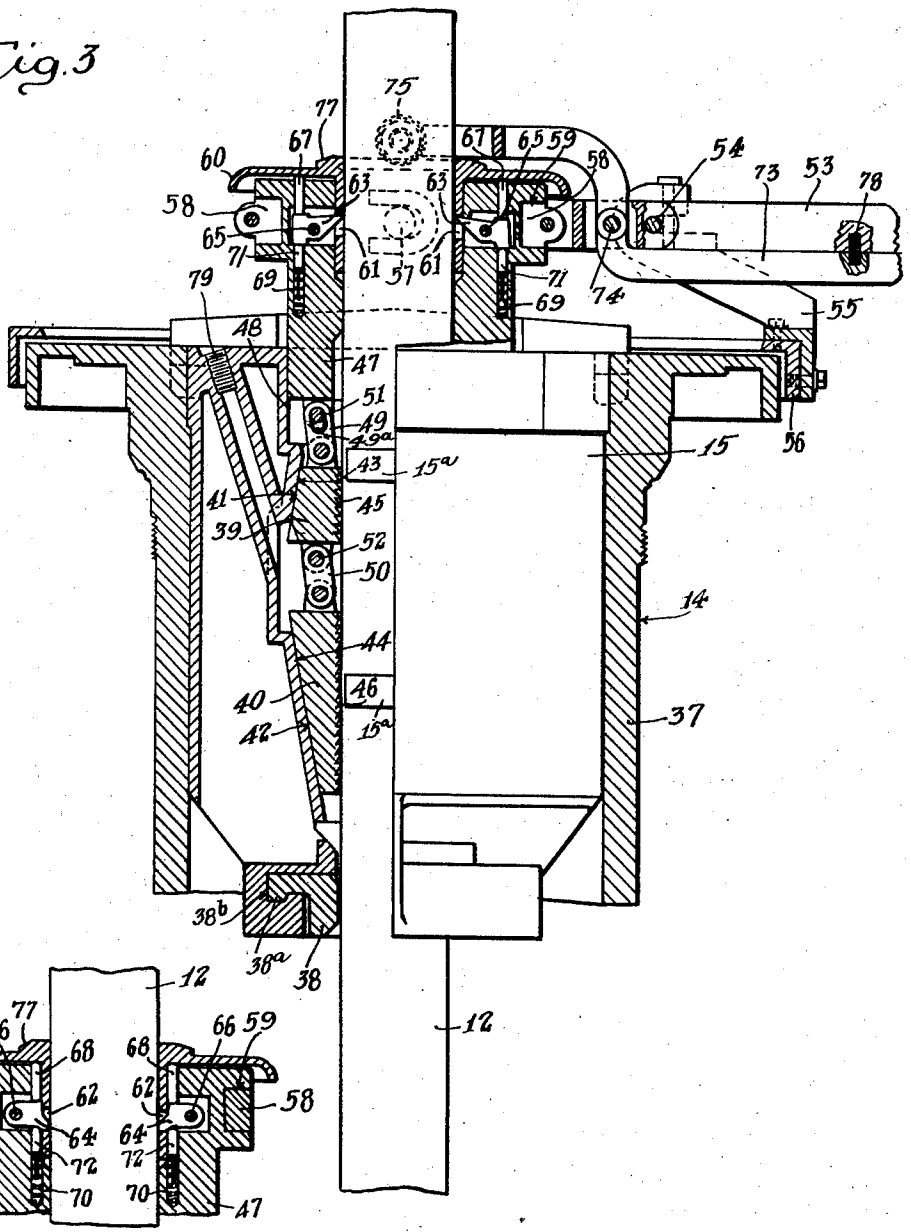


Fig. 4

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WELL DRILLING EQUIPMENT FOR HANDLING DRILL PIPE AND CASING IN HIGH PRESSURE WELLS

Filed Oct. 19, 1931 6 Sheets-Sheet 4

Fig. 6

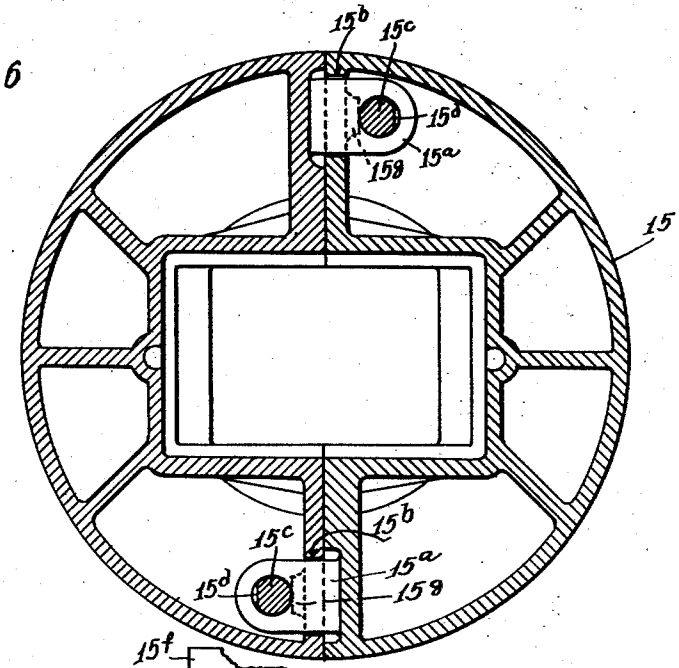
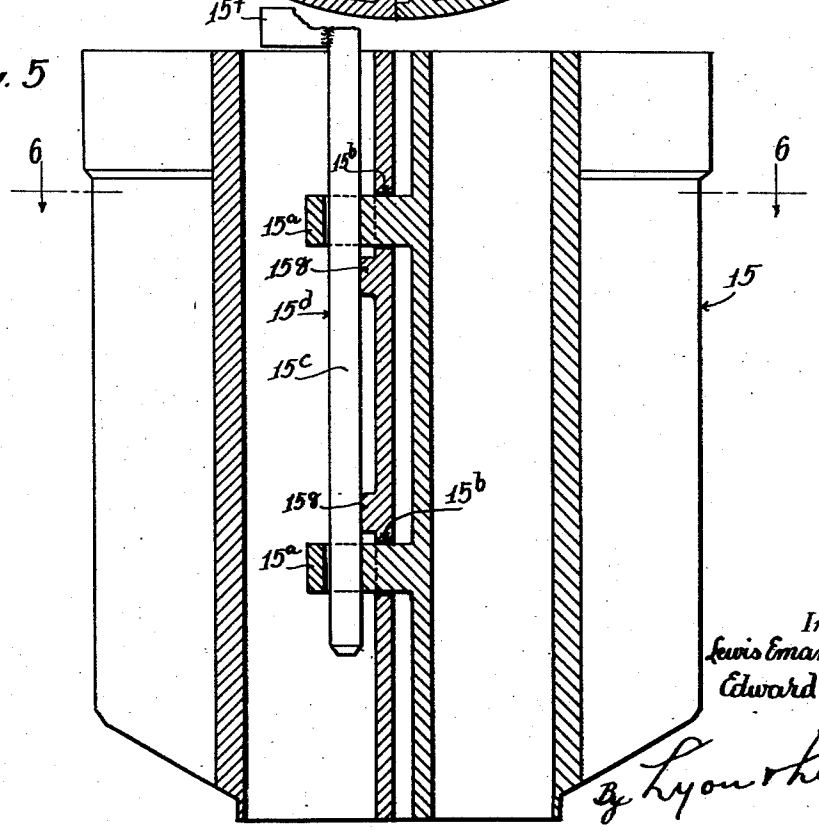


Fig. 5



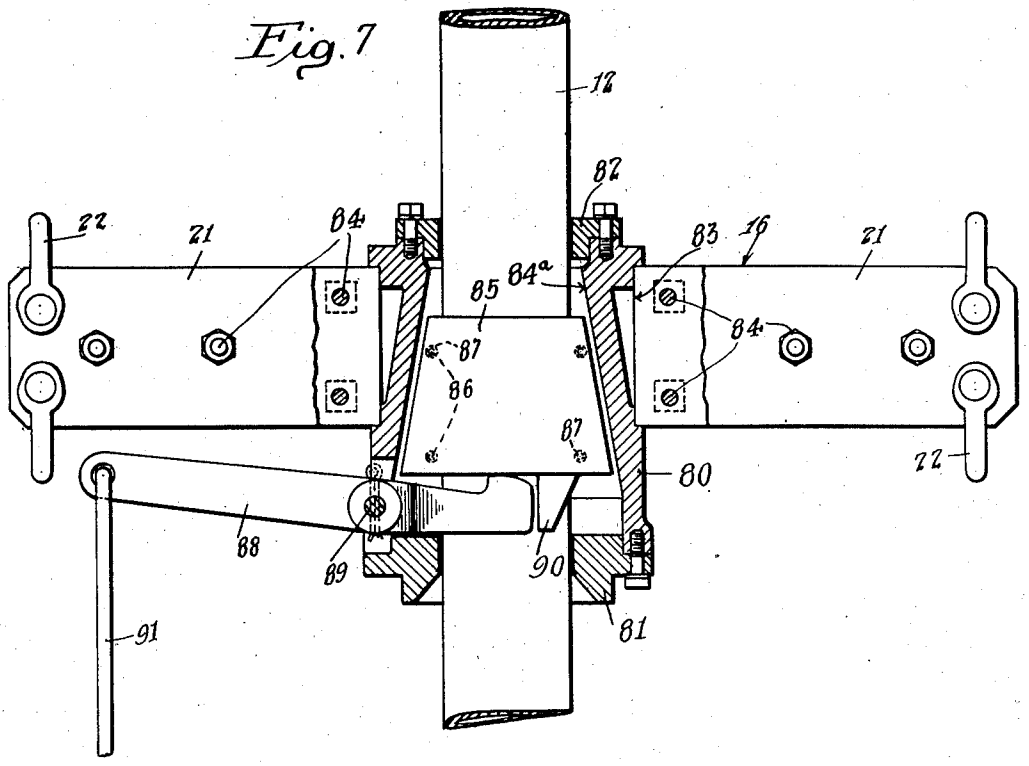
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WELL DRILLING EQUIPMENT FOR HANDLING DRILL PIPE AND CASING IN HIGH PRESSURE WELLS

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Fig. 7



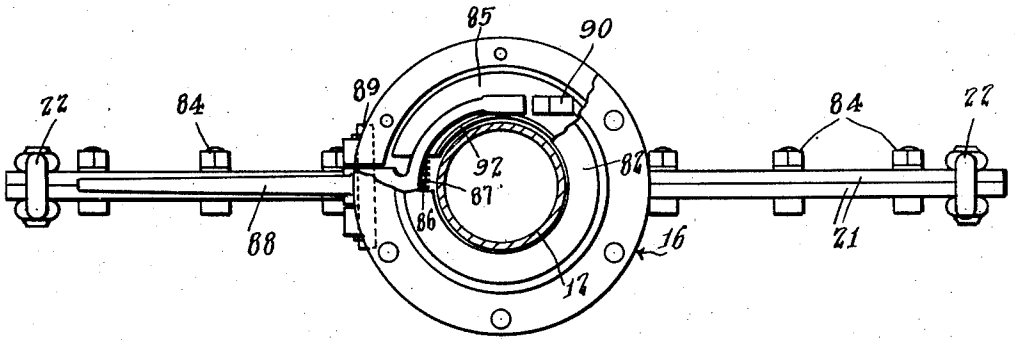


Fig. 8

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WELL DRILLING EQUIPMENT FOR HANDLING DRILL PIPE AND CASING IN HIGH PRESSURE WELLS

Filed Oct. 19, 1931 6 Sheets-Sheet 6

Fig. 9

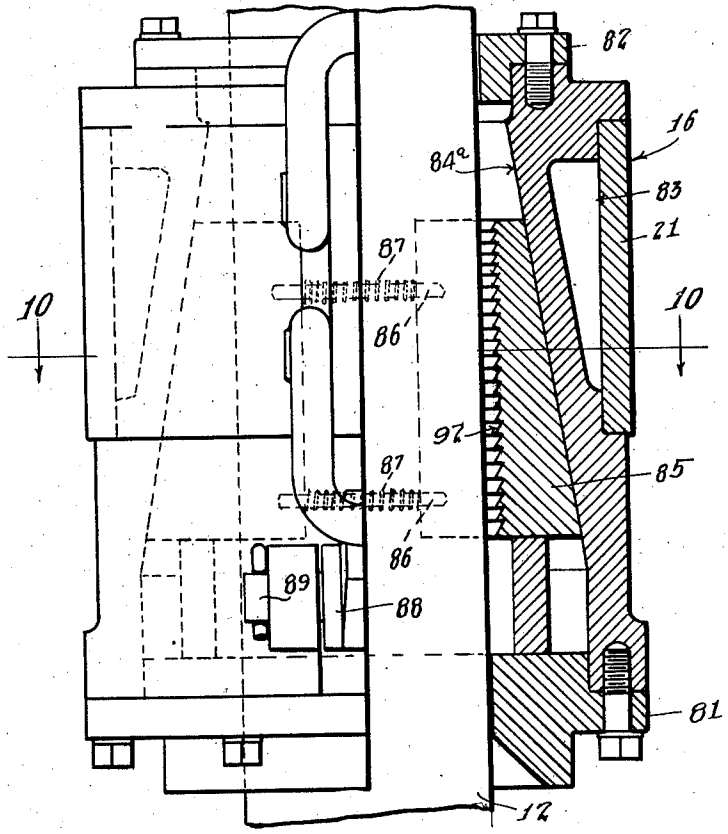
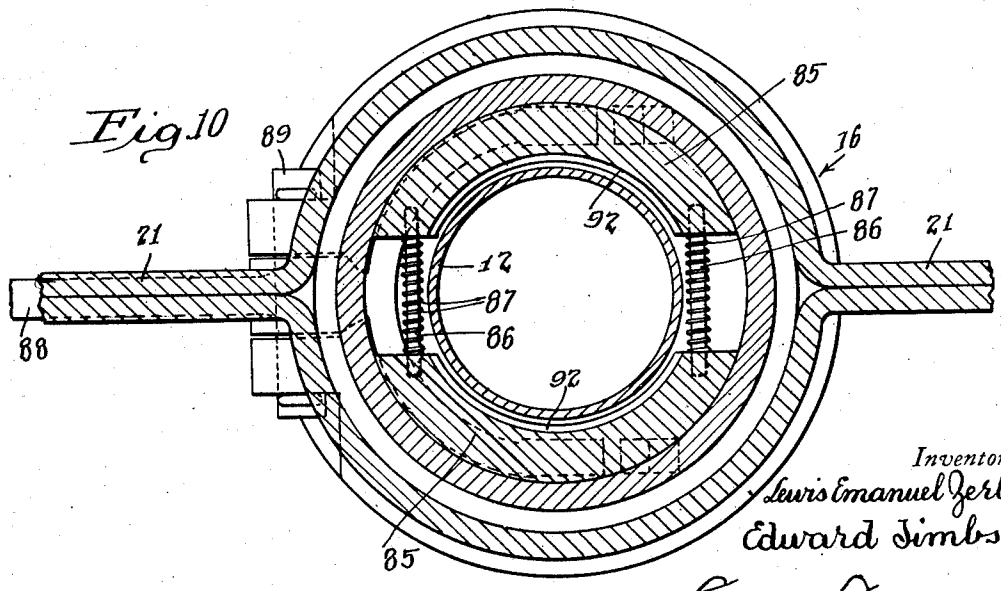


Fig. 10



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Patented Aug. 28, 1934 1,971,473

UNITED STATES PATENT OFFICE

1,971,473

WELL DRILLING EQUIPMENT FOR HANDLING DRILL PIPE AND CASING IN HIGH PRESSURE WELLS

Lewis Emanuel Zerbe, Moneta, and Edward Timbs, Los Angeles, Calif., assignors, by mesne assignments, to The National Superior Company, Toledo, Ohio, a corporation of Delaware

Application October 19, 1931, Serial No. 569,648

34 Claims. (Cl. 255—19)

This invention relates to well drilling equipment for handling drill pipe and casing in high pressure wells, and more particularly to apparatus for use in the drilling of oil, gas or like wells when using the rotary drilling process in areas where high pressure gas is found.

When drilling wells and high pressure gas is encountered, it is imperative that the high pressure gas be kept under control if the drilling operations are to be proceeded with.

In some areas gas under pressure of approximately 3,000 pounds per square inch has been encountered, and not only is drilling under this condition extremely difficult, but is attended with many hazards.

In the usual drilling procedure, the drilling bit is rotated by the drill pipe with additional sections of drill pipe added as the well is deepened. When the bit requires redressing or replacement, the whole length of the drill pipe in the well hole is withdrawn in sections. When drilling under these high pressure conditions, the upward force on the drill stem or pipe at the top of the well tends to eject the pipe from the well and is sufficient to overcome the weight of the submerged pipe and bit positioned within the well. Under these conditions it is therefore necessary to actually hold the drill pipe down and to feed the drill pipe down rather than to hold the drill pipe from falling under the force of gravity in the well.

It is therefore an object of this invention to provide an apparatus for handling and controlling the entry and withdrawal of drill pipe in the oil or gas well while the well is under relatively high gas pressure.

Another object of this invention is to provide a device for drilling oil wells wherein means are provided for automatically effecting the clamping action of the drill pipe to support the weight of the same or to prevent the ejection of the drill pipe from the well in case the drilling crew abandons the well derrick in anticipation of some mishap.

Another object of this invention is to provide a device for clamping the drill pipe with the rotary driving element for driving the drilling bit wherein, as the drill bit is rotated, it is fed downwardly at the same time.

Another object of this invention is to provide a device for use in the drilling of wells which require drilling of the well under applied pressure, that is, where the hydrostatic fluid pressure of the drilling fluid or mud used is not adequate to prevent caving in of certain earth formations, applied pressure is produced by the use of mud fluid pumps with a return flow of the drilling fluid or mud controlled through a valve to maintain the desired pressure on the well.

Other objects and advantages of this invention it is believed will be apparent from the following detailed description of a preferred embodiment thereof as illustrated in the accompanying drawings:

In the drawings:

Figure 1 is a side elevation partly in vertical section of the lower portion of an oil well derrick and derrick cellar illustrating apparatus as embodying our invention as mounted therein.

Figure 2 is a top plan view of the rotary machine table as embodied in our invention.

Figure 3 is a sectional elevation taken substantially on the line 3—3 of Figure 2 illustrating the slips as in disengaged position.

Figure 4 is a fragmental sectional view of the operating head taken at 90° from the view thereof contained in Figure 3.

Figure 5 is a sectional view of the split table bushing taken substantially on the line 5—5 of Figure 2.

Figure 6 is a sectional top plan view illustrating the bushing locking means embodied in our invention, taken on line 6—6 of Figure 5.

Figure 7 is an elevation partly in vertical midsection of another portion of the apparatus embodied in our invention illustrating the slips as disengaged.

Figure 8 is a top plan view partly in horizontal section of the structure illustrated in Figure 7.

Figure 9 is an enlarged side elevation partly in vertical midsection of a portion of the apparatus embodied in our invention illustrated in Figure 7.

Figure 10 is a sectional plan view thereof taken substantially on the line 10—10 of Figure 9.

In the preferred embodiment of our invention as illustrated in the accompanying drawings, 1 indicates a well derrick which is supported upon a suitable foundation 2. Supported within the derrick 1 is a rotary machine 3 which may be of any suitable or desirable construction but is preferably of the hydraulic type as illustrated in the copending application of Lewis E. Zerbe and David S. Faulkner, filed May 28, 1930, Serial No. 456,395.

The hydraulic rotary machine table is so constructed that it may be elevated and lowered on hydraulic cylinders 4. Below the derrick 1 is a cellar 4a within which a casing assembly is supported and in the casing 8 of which there is mounted a control valve 5 and blow-out preventers 6 respectively.

Positioned on the top of the casing 8 is a stuffing box assembly 7. The control valve 5 and blow-out preventers 6 may be of any suitable or desirable construction, and preferably of the type which are remotely controlled through sprocket chain drives 9 and hand-wheels 10 which permits the actuation of the control valves and blow-out preventers from points accessible above the ground.

In the casing 8, below the control valve 5, is a conduit 11 for the return circulating fluid which is pumped by means of "slush pumps" into the drill stem 12 during the drilling operation. Mounted within the conduit 11 is a valve 13, by means of which a back pressure may be imposed upon the drilling fluid or mud to enable drilling under greater pressures where required.

In drilling under pressure, it is preferable to utilize a flush joint drill stem 12, so that the drill stem 12 may pass through the stuffing box 7 without having any obstruction, such as couplings or pipe joints, which would be required to pass through the stuffing box 7.

In carrying out the drilling process, a swivel of any suitable or desirable construction well understood in the art, but not shown, is connected to the upper end of the rotary drill stem or pipe 12 and is also connected with drilling fluid or mud circulating pumps likewise not shown in the usual manner.

The rotary machine 3 includes a customary base and rotary table which is rotatably supported upon the base and is generally indicated at 14.

A split table bushing 15, of a construction which will be hereinafter specifically pointed out, is mounted within the rotary table 14 and is provided with means which are operable either manually or automatically for holding the drill stem or pipe 12 from vertical movement relative to the table 14.

In order to force down, or to withdraw the drill stem 12 from within the casing 8, as is required in carrying out the rotary drilling process, we provide a traveling spider 16 which is so coupled with the rotary machine 3 as to enable the actual forcing of the drill stem 12 down into the well, or the feeding of the drill stem 12 into the well under gas pressures normally sufficient to force the drill stem 12 out of the casing 8.

It is only necessary to employ the traveling spider 16 when the gas pressure within the well is sufficient to throw the drill stem 12 out of the well. The traveling spider 16 is suspended within the well by a sling 17 which is attached to a line 18 which passes over a pulley mounted in the upper portion of the derrick 1. The opposite end of the line 18 is secured to a weight 19 for the purpose of counterbalancing the weight of the spider 16 so that the traveling spider 16 may be easily operated within the derrick 1. Secured to the weight 19 is a handling rope 20 which is in turn secured to the derrick 1 at a point near the floor thereof.

Secured to the arms 21 of the traveling spider 16 by means of clevises 22, are cables 23 which are reeved under pulleys 24 mounted on the opposite sides of the rotary machine 3. The cables 23 extend upward from the pulleys 24 and are secured to a common connection 25. Secured to the connection 25 is a line 26 which extends over pulleys mounted in the upper portion of the derrick and down to an auxiliary hoist 27. The hoist 27 is power driven by any suitable or desirable means such, for example, as by means of a chain 28 which passes over a sprocket secured to the shaft of the hoist 27 and is driven by any suitable source of power.

The hoist 27, in addition to a spooling portion, includes brake rims 29 upon which brake bands 30 are mounted. The brake bands 30 are tightened to the brake rims 29 by any suitable or desirable means such, for example, as by means of a handle 31 secured to a rocking shaft 32.

The hoist 27 provides a means for actually forcing the drill stem 12 down through the stuffing box 7 through the power applied to the hoist 27 operating through the pulleys 24 to the upwardly extending portion of the cable 23 to pull downwardly upon the arms 21 of the spider 16. To control the pipe or drill stem 12 when it is withdrawn from the well under pressure it is only necessary to feed off the line 26 of the hoist 27 by use of the brake bands 30.

When the pipe or drill stem 12 is in any stationary position, slips are applied in the split table bushing 15 to secure the pipe 12 against movement in either direction. The split table bushing 15 is secured in position within the rotary table 14 against upward displacement by means of a locking bar 33 such, for example, as disclosed in the Letters Patent issued to Lewis E. Zerbe, No. 1,825,930 of October 6, 1931.

The split table bushing is preferably of a construction including two symmetrical halves 34 and 35 which, when positioned within the rotary table 14 form a cylindrical bushing having a polygonal top 36, fits within a correspondingly shaped opening formed in the top of the rotary table 14. In this manner split table bushing 15 is driven with the rotary table 14. The downwardly extending cylindrical portion of the split table bushing 15 is fitted within the cylindrical skirt 37 of the rotary table 14. A flanged guide ring 38 is secured to the lower portion of the split table bushing 11 to maintain the drill stem 12 in axial alignment with the rotary table 14 and the drill stem bushing 15.

Means are mounted within the split table bushing 15 for holding the drill stem 12 from vertical displacement relative to the rotary machine 3, which means preferably includes two sets of opposed tapered slips 39 and 40. The slips 39 and 40 are tapered on their outer faces 41 and 42, respectively, to fit complementary tapered seats 43 and 44 formed within the central passage provided by the split table bushing 15. The slips 39 and 40 are preferably, as herein illustrated, formed of two halves, but may obviously be formed of a greater number of segments if desired.

The inside diameter of the slips 39 and 40 are approximately the same as the outside diameter of the drill pipe 12, and the slips 39 and 40 are provided with suitable wickers 45 and 46 respectively to provide for a more effectual gripping of the drill stem 12 by the slips 39 and 40. The wickers 45 of the slips 39 are formed downwardly, while the wickers 46 of the slips 40 are formed upwardly.

In order to actuate the slips 39 and 40, the slips are connected with an operating head 47, which is slidably mounted in a cylindrical slideway 48 formed in the upper end of the split table bushing 15. The operating head 47 is connected by links 49 with the slips 39 and by means of links 50 with the slips 40.

In order to hold the slips 39 and 40 normally out of engagement with the drill stem 12 as the drill stem 12 is run into or out of the

hole, while the operating head 47 is in a neutral position, we prefer to so connect the slips 39 and 40 through the links 49 and 50 with the operating head 47 as the normal force of gravity tends to swing the said slips to a position outwardly away from the drill stem 12.

In order to accomplish this, the links 49 are pivotally connected to pins 51 carried by the operating head 47 at a point or position offset outwardly a greater distance from the axis of the drill stem 12, than the center of gravity of the slip 39. Likewise the point of pivotal attachment at 52 of the links 50 with the slip 39 is more remote from the axis of the drill stem 12 than is the center of gravity of the slips 40. The slips 39 and 40 being thus coupled with the operating head 47, the tendency is to swing outwardly from the drill stem 12 when the head 47 is in a neutral position.

Means are provided for actuating the slips 39 and 40 both manually or automatically, which means are preferably of the following construction:

An operating handle 53 is fulcrumed at 54 on a bracket 55 secured to the stationary rotary table guard 56. The operating handle 53 is forked on the inner side of the fulcrum 54 and fits over shifter lugs 57. The shifter lugs 57 are formed on a shifter ring 58 which is a split ring bolted together and fitted within an annular groove 59 formed in the upper portion of the head 47.

By a downward force exerted by the operator of the operating handle 53, the slips 39 are caused to engage the drill stem 12, securing the drill stem 12 against being blown outward from the well. By an upward force exerted on the operating lever 53, the slips 40 are dropped into engagement with the drill stem 12, supporting the drill stem 12 against downward vertical movement.

In order to operate the slips 39 and 40 automatically in accordance with the movement of the drill stem 12 to avoid the possibility of the operator abandoning the derrick and the drill stem 12 either being blown from, or dropping into the well, we prefer to provide the operating head 47 with a flanged sleeve 60, which surrounds the drill stem 12 and which is provided with two engaging dog openings 61. Two pair of toothed dogs 63 are mounted within the openings 61 in position to engage the periphery of the drill stem 12. At ninety degrees from the openings 61 two similar openings 62 are provided on diametrically opposite sides of the sleeve 60 through which similar dogs 64 are passed.

The dogs 63 and 64 are pivotally supported on pins 65 and 66 respectively within recesses formed in the head 47, and actuating pins 67 and 68 are provided for holding the dogs 63 and 64 into a neutral or non-operative position. The lower end of the pins 67 and 68 engage the dogs 63 and 64 respectively, while the upper ends thereof are engaged by the flanged sleeve 60. The dogs 63 and 64 are normally urged into an operating position by means of springs 69 and 70 positioned within bores formed in the head 47 and acting against plungers 71 and 72 which in turn engage the dogs 63 and 64.

The dogs 63 operate on the downward movement of the drill stem 12 to move the operating head 47 downwardly to allow the slips 40 to drop into position to engage the drill stem 12 and prevent further dropping of the drill stem 12 into the well. The dogs 64 operate when the drill stem 12 is being thrust from the well by the gas pressure to raise the operating head 47 and thereby cause the slips 39 to engage the drill stem 12 and thereby prevent further upward movement of the drill stem 12.

A safety lever 73 is pivotally secured to the operating lever 53 at the pivots 74 and is forked at its inner end. The forked ends of the lever 73 carry rollers 75, which are tapered as indicated at 76 complementary to a tapered track 77 formed on the top of the flanged sleeve 60. The two levers 53 and 73 are gripped together by the operator when the device is under manual control. Interposed between the levers 73 and 53 is a spring 78 which normally operates to separate the levers when they are released by the operator.

The spring 78 is provided for the purpose of relieving a downward pressure against the flanged sleeve 60 by the rollers 75 due to the actuation of the two levers 53 and 73 together by the operator so that the operating head 47 will be free to move in accordance with the friction developed by the movement of the drill stem 12 through the device after the operator has abandoned the rig or desires the apparatus to operate automatically.

The dogs 63 and 64 may be formed with a serrated cam face to compensate for any variation that may be found in the diameter of the drill stem 12.

Under ordinary drilling operations the slips 40 are forced into engagement with the drill stem 12 by means of long screws which screw into the split table bushing 15 at 79. The long screws are used only when the weight of the drill pipe 12 is not sufficient to prevent rotation or slipping of the pipe 12 in the slips 40 due to the torque and pressure exerted in driving the drilling bit secured to the lower end of the drill stem 12.

When drilling in shallow wells, particularly with rock or like bits, when the weight of the drill stem is not sufficient to produce the required pressure on the bit, or where excessive gas pressure is present within the well, then it is more desirable to utilize the upper slips 39 to drive the pipe and exert the desired downward pressure. The rate of feeding of the bit, or the progress of the hole, is controlled by the rotary machine when of the hydraulic type.

The split table bushing 15 is formed of two halves which are preferably loosely coupled together but which coupling is so constructed as to enable the two halves to be locked together. This locking of the two halves together enables the bushing 15 to be withdrawn from the rotary table with the last stand of drill stem.

Each half of the bushing 15 is provided with outwardly extending eyes 15*a* which fit within recesses 15*b* formed in the adjacent edge of the other half of the spider. Lock bolts 15*c*, having flat sides 15*d*, are passed through the eyes 15*a* in the recesses 15*b*. The lock bolts 15*c* are provided with handles 15*f* to enable their rotation. Lock pads 15*g* are formed on the body of the bushing halves immediately adjacent the recesses 15*b*. The lock pad 15*g* projects into the line of movement of the bolts 15*c* which pass through the eyes 15*a* with their flat side adjacent the flat sides of the lock pads 15*g*. The bolts 15*c* normally fit loosely in the eyes 15*a* and when rotated to locking position, lock the two halves of the bushing together by their round surfaces riding upon the flat pads 15*g*.

The guide ring 38 is secured to the two halves

of the bushing 15 in such a manner as to prevent its accidental loss in the hole. The ring 38 is provided with a lock flange 38*a* which fits into the annular recess 38*b* formed in the end of halves of the bushing 15. The ring 38 is split so that its halves may be inserted within the halves of the recess 38*b* when the two portions of the bushing are separated.

In order to permit the slips 39 or 40 to seat properly against the drill stem 12 the links 49 are slotted as indicated at 49*a* to accommodate for uneven gripping of the drill stem 12.

The traveling spider 16 is preferably of the following construction:

The traveling spider 16 consists of a cylindrical body 80 to which there is secured pipe guides 81 and 82 respectively. The pipe guides 81 and 82 are provided for the purpose of maintaining the drill stem 12 in axial alignment with the traveling spider 16. Horizontally extending arms 21 are formed by two bars which, at their central portion, are formed to provide a split ring which engages the body 80 within an annular recess 83. The two bars are bolted together as indicated at 84. Formed within the axial bore of the body 80 is a tapered slip seat 84*a*. Tapered slips 85 are mounted within the bore of the body 80 to seat upon the slip seat 84*a*. The slips 85 are of any suitable or desirable construction and are herein illustrated as formed of the two complementary slip members which are connected together by means of dowel pins 86, and upon which dowel pins 86 releasing springs 87 are mounted, which normally urge the two slips 85 outwardly to release the drill stem 12. Means are provided for actuating the slips 85 into pipe engaging position, which means are herein illustrated as including a fulcrum lever 88 fulcrumed to the body 80 at 89, and forked at its inner end to engage the under edge of the slips 85.

The slips 85 are provided with a lug 90 to prevent rotation of the slips within the body 80, the lug 90 being positioned to engage the inner end of the forked portion of the fulcrum lever 88. An operating rope 91 is secured to the end of the fulcrum lever 88 and extends downwardly in the derrick to where it may be gripped by the operator.

The slips 85 are mounted in inverted position to prevent or hold the drill stem 12 from being thrust out of the well, and also to enable the feeding of the drill stem 12 out under the pressure of the well, or down into the pressure of the well when required for the purpose of changing the tool or tools connected on the end of the drill stem 12. The slips 85 are formed at their inner surface with wickers 92.

The operation of the apparatus embodying our invention is as follows:

The drill stem 12 positioned within the well, and the rotary table 14 is rotated to rotate the drill carried at the bottom of the drill stem 12. Drilling fluid is forced under pressure through the drill stem 12 to lubricate the drill and to wash the cuttings out through the casing 8 through the conduit 11 to the drilling fluid or mud sumps.

When gas is encountered which is of sufficient pressure to tend to thrust the drill stem 12 out of the well, the drill stem 12 is fed downwardly by means of the auxiliary hoist 27 operating the pull downwardly on the traveling spider 16 to force the drill stem down. When it is necessary to add another length of drill stem, the slips 39 are set to hold the drill stem from being withdrawn from the well under the pressure of the gas, the traveling spider 16 is removed from the end of the drill stem 12, and another section or stand of drill stem is added thereto. The traveling spider is again connected to the upper end of the new stand of drill stem and the drill stem is again forced downwardly.

To release the slips 39 after the new stand of drill stem has been added and after the traveling spider 16 is connected thereto, the rotary machine table itself may be elevated slightly in the case where a hydraulic rotary machine is used or the traveling spider is forced downwardly until the slips release. Should trouble develop during the drilling of the well so that the operators abandon the well and the operator releases the control handles 53 and 73, the control handle 73 is forced away from the handle 53 to relieve the applied pressure on the flanged sleeve 60 and permit the dogs 63 and 64 to assume their automatic operation.

If the drill stem is then falling, the dogs 63 grip the pipe and set the downwardly acting slips 40 to hold the pipe from falling further into the well. If the drill stem 12 is being thrust from the well, the dogs 64 engage the pipe and set the upwardly acting slips 39 to hold the drill pipe 12 from further movement out of the well. When the drill pipe is thus held in position, the blow-out preventer 6 may be closed. With the blow-out preventer 6 closed, and with the passage of fluid through the drill stem 12 being closed through the hydraulic swivel back to the mud slush sumps, fluid may only pass from the well through the conduit 11 to the slush sumps, and this passage of fluid may be controlled by the valve 13.

In withdrawing of the drill pipe 12 from the well, the reverse action to that of feeding the drill stem into the well is performed so that at all times control of the movement of the drill stem is had against the pressure of the gas within the well. After withdrawing successive sections of the drill pipes or stem 12 from the well until the drilling bit comes up into the casing section above the drilling valve 5, the valve is then closed and the stuffing box 7 detached from the casing.

The long screws are screwed into the split drill stem bushing at 79 to force the slips 40 to engage the last section of the drill stem 12 remaining in the well. The locking bars 38 are then removed and the entire assembly, including the split drill stem bushing 15, drilling bit and stuffing box 7, is removed through the rotary machine opening. The drilling bit is replaced and the apparatus is then set up again in a reverse manner and the drill stem is again forced into the well and drilling is continued.

Having fully described our invention, it is to be understood that we do not wish to be limited to the details herein set forth, but our invention is of the full scope of the appended claims.

We claim:

1. In a well drilling apparatus, the combination of a casing, a drill stem within said casing, means for rotating the drill stem, the latter said means including a bushing, means including axially spaced slips having oppositely disposed tapers within the bushing for holding the drill stem from vertical movement in either direction relative thereto, the effectiveness of the holding means being substantially the same in either direction and being a function of the axial load transmitted from the drill stem.

2. In a well drilling apparatus, the combination of a rotary machine having a rotary table, a split

table bushing mounted in the rotary table, two pair of slips mounted within the bushing for holding the drill stem from vertical displacement relative to the rotary machine, and means for automatically actuating the slips on movement of the drill stem.

3. In a well drilling apparatus, the combination of a rotary machine having a rotary table, a split table bushing mounted in the rotary table, two pair of slips mounted within the bushing for holding the drill stem from vertical displacement relative to the rotary machine, and means for actuating the pairs of slips to engage and hold the drill stem from vertical movement relative to the rotary machine.

4. In a rotary machine having a rotary table, the combination of a bushing adapted to be mounted in the rotary table, means carried by the bushing for guiding a drill stem axially thereof, and means carried by the bushing for holding the drill stem from vertical movement relative thereto in either direction, the effectiveness of the holding means being substantially the same in either direction and being a function of the axial load transmitted from the drill stem.

5. In a device of the class described, the combination of a rotary table, a drill stem bushing mounted within the table, separate axially spaced slips having opposed tapered surfaces carried by the bushing for holding a drill stem from vertical movement relative to the table in either direction, and means for actuating the slips in position to engage the drill stem.

6. In a device of the class described, the combination of a rotary table, a drill stem bushing mounted within the rotary table, slips mounted within the bushing for holding a drill stem from downward movement relative thereto, a second set of slips mounted within the bushing for holding the drill stem from upward vertical movement relative thereto, a control mounted on the bushing, means connecting the control and the slips, and means for actuating the control to move the slips selectively to and out of drill stem engaging position.

7. In a device of the class described, the combination of a rotary table, a drill stem bushing mounted within the rotary table, slips mounted within the bushing for holding a drill stem from downward movement relative thereto, a second set of slips mounted within the bushing for holding the drill stem from upward vertical movement relative thereto, a control mounted on the bushing, means connecting the control and the slips, means for actuating the control to move the slips selectively to and out of drill stem engaging position, and automatic means operable on the movement of the drill stem for actuating the control.

8. In an apparatus of the class described, the combination of a drill stem, a rotary table, drive means mounted within the rotary table, up-and-down thrust slips mounted within the drive means, means carried by the drive means and automatically operable upon the vertical movement of the drill stem for actuating the slips to hold the drill stem from further vertical movement relative to the rotary table.

9. In an apparatus of the class described, the combination of a drill stem, a rotary table, drive means mounted within the rotary table, up-and-down thrust slips mounted within the drive means, means carried by the drive means and automatically operable upon the vertical movement of the drill stem for actuating the slips to hold the drill stem from further vertical movement relative to the rotary table, and means for holding the driving means within the rotary table.

10. In an apparatus of the class described, the combination of a drill stem, a rotary table, a split table bushing mounted within the rotary table, up-and-down thrust slips mounted within the bushing, means automatically operable upon the vertical movement of the drill stem for actuating the slips selectively to hold the drill stem from further vertical movement relative to the rotary table.

11. In an apparatus of the class described, the combination of a drill stem, a rotary table, a split table bushing mounted within the rotary table, up-and-down thrust slips mounted within the bushing, means automatically operable upon the vertical movement of the drill stem for actuating the slips selectively to hold the drill stem from further vertical movement relative to the rotary table, means loosely connecting the portions of the split table bushing, and means for actuating the latter said means to firmly couple the portions of said bushings together.

12. In an apparatus of the class described, the combination of a drill stem, a rotary table, a split table bushing mounted within the rotary table, slips mounted within the bushing to grip the drill stem, means loosely connecting the portions of the split table bushing as a removable unit, and means for actuating the latter said means to firmly couple the portions of said bushing together.

13. In an apparatus of the class described, the combination of a drill stem, a rotary table, a table bushing mounted within the rotary table, up-and-down thrust slips mounted within the bushings, means automatically operable upon vertical movement of the drill stem for actuating the slips selectively to hold the drill stem from further vertical movement relative to the rotary table, and means operably connecting the up-and-down thrust slips and the automatically operable means for normally holding the slips out of drill stem engaging position.

14. In a device of the class described, the combination of a rotary table, a drill stem bushing mounted within the table, slips carried by the bushing for holding the drill stem from vertical movement relative to the table in either direction, and means for automatically actuating the slips into operative engagement with the drill stem on movement of the drill stem in either direction.

15. In a drilling apparatus, the combination of a rotary table, a split table bushing mounted therein, gripping means mounted within the bushing to engage a drill stem, means extending longitudinally of the bushing and selectively operable to clamp the portions of said bushing together as a unit.

16. In a drilling apparatus, the combination of a rotary table, a split table bushing mounted therein, gripping means mounted within the bushing to engage the drill stem, interlocking projections and recesses formed on the abutting faces of the bushing portions to maintain axial alignment of the bushing portions, and means to connect the portions of said bushing together as a unit.

17. In a drilling apparatus, the combination of a rotary table, a split table bushing mounted therein, gripping means mounted within the bushing to engage a drill stem, rotatable means on the

bushing being selectively operable to clamp the portions of the bushing together as a unit.

18. In a drilling apparatus of the class described, the combination of a rotary table having a vertically extending opening, opposed split co-operating table bushing members adapted to seat within the vertical opening, a drill stem positioned axially of the opening, the bushing members having an inner tapered seat, slips positioned on the tapered seat and engaging the drill stem to support the same, the wedging action of the said slips normally forcing the table bushing members outwardly into contact with the wall of the table opening, means for clamping the bushings together and away from tight engagement with the walls of the table opening in the absence of any wedging action by the slips, means to force the slips into positive engagement with the drill stem after the bushing members are clamped together as a unit so as to permit free withdrawal of the bushing unit from the opening upon the upward movement of the drill stem.

19. In an apparatus of the class described, the combination of a rotary table having a vertically extending opening therethrough, opposed split co-engaging table bushing members adapted to seat within the vertical opening, a drill stem positioned axially of the table opening, the bushing members having an inner tapered seat, slips positioned on the tapered seat and engaging the drill stem to support the same, the wedging action of the slips normally forcing the table bushing members outwardly into contact with the wall of the table bore, and means extending longitudinally of the bushing members and operable to clamp the bushing members together and away from tight engagement with the walls of the table opening in the absence of any wedging action by the slips, means to force the slips into positive engagement with the drill stem after the bushings are clamped together as a unit to permit free withdrawal of the bushing unit from the table opening upon upward movement of the drill stem.

20. In an apparatus of the class described, the combination of a rotary table having a vertically extending opening, a table bushing mounted within the table opening, an annular slip carrier slidably mounted axially within the opening formed in the upper portion of the table bushing, wedge slips positioned within the table bushing to engage a drill stem, means connecting the slips and the annular slip carrier, and manually operated means for actuating the slip carrier to move the slips in or out of engagement with the drill stem.

21. In an apparatus of the class described, the combination of a rotary table having a vertically extending opening, a table bushing mounted within the table opening, an annular slip carrier slidably mounted axially within an opening formed in the upper portion of the table bushing, wedge slips positioned within the table bushing to engage a drill stem, actuating means for the slip carrier including a pivotally mounted shifter member having a rotative connection with the slip carrier and which means are operable to actuate the slip carrier to move the slips into and out of engagement with the drill stem.

22. In an apparatus of the class described, the combination of a rotary machine, a split table bushing mounted within the rotary table, two sets of opposed connected slips mounted within the bushing for holding the drill stem from vertical displacement relative to the rotary table, means engaging the drill stem for automatically actuating the slips on movement of the drill stem, and means operable to disengage said last named means from the drill stem to render the automatic function inoperative.

23. In a well drilling apparatus, the combination of a rotary machine having a rotary table, a split table bushing mounted in the rotary table, slips mounted within the bushing for holding the drill stem from vertical displacement relative to the rotary table, means for automatically setting the slips on movement of the drill stem in one direction but allowing free movement in the opposite direction, and manually operable to disengage the last named means from the drill stem to render the automatic function inoperative.

24. In a device of the class described, the combination of a rotary table, a drill stem bushing mounted within the rotary table, slips mounted within the bushing for holding the drill stem from downward movement relative thereto, a second set of slips mounted within the bushing for holding the drill stem from upward vertical movement relative thereto, control means mounted on the bushing, means connecting the control means and the slips, means for actuating the control to set the slips, which means are automatically operable on movement of the drill stem for actuating the control means, and means manually operable to render the control means inoperative.

25. In an apparatus of the class described, the combination of a drill stem, a rotary table, drive means mounted within the rotary table, up-and-down thrust slips mounted within the drive means, means carried by the drive means and vertically operable upon the vertical movement of the drill stem in either direction for actuating the slips to hold the drill stem from further vertical displacement relative to the rotary table, and means manually operable for rendering the automatic slip means inoperative to set the slips.

26. In an apparatus of the class described, the combination of a drill stem, a rotary table, drive means mounted within the rotary table, up-and-down thrust slips mounted within the drive means, means carried by the drive means and automatically operable upon the vertical movement of the drill stem for actuating the slips to hold the drill stem from further vertical displacement relative to the rotary table, means for holding the driving means within the rotary table, and means manually operable for rendering the automatic slip actuating means inoperative to seat the slips.

27. In an apparatus of the class described, the combination of a drill stem, a rotary table, a split table bushing mounted within the rotary table, up-and-down thrust slips mounted within the bushing, means automatically operable upon the vertical movement of the drill stem for actuating the slips selectively to hold the drill stem from further vertical movement relative to the rotary table, and means manually operable for rendering the automatic slip seating means inoperative when it is desired to move the drill stem through the slips.

28. In a slip-handling device, the combination of a body, a split drill stem bushing mounted within the body, slips carried by the bushing for holding the drill stem from vertical movement relative to the body in either direction, means for automatically actuating the slips into operative engagement with the drill stem on movement of the drill stem in either direction, and means operable to render the automatic slip actuating means inoperative when it is desired to move the drill stem through the body.

29. In a tube gripping device, the combination of a body having a tapered opening providing a

slip-engaging seat, a well tube positioned within said opening, slips mounted within the body on the tapered seat to engage the tube, a first means to automatically actuate said slips into engagement with the well tube upon vertical movement of the tube, and a second means to manually operate the slips, said second means including means to render the first means inoperative when under control of the operator, said first means becoming automatically operable in the event the manual control of the second means is abandoned.

30. In a tube gripping device, the combination of a housing having a tapered opening providing a slip-engaging seat, a slip carrier slidably mounted axially within a bore formed in said housing, a well tube positioned within said opening and extending through an opening in the slip carrier, depending slips on said carrier mounted within said housing on the tapered seat to engage the tube, manually controlled means operable to actuate the slip carrier and move the slips into and out of engagement with the well tube, members mounted on the slip carrier, means for yieldably urging the said members normally into contact with the tube to effect automatic actuation of the slips upon vertical movement of the well tube, and manually operable means for retracting the members when it is desired to manually actuate the slips.

31. In a traveling spider for handling well pipe, the combination of a body having a portion extending outwardly to form a yoke, an inverted tapered opening in the body, slips mounted within the opening to engage a well pipe passed through the opening, and means remotely positioned with respect to the spider for actuating the slips into engagement with the well pipe from a point remotely situated from the spider.

32. In a traveling spider for handling well pipe, the combination of a body having outwardly extending portions forming a yoke, guide bushings mounted within an opening formed in the body for positioning the spider axially with relation to the well pipe, the body having an inverted tapered opening, slips mounted within the opening to engage the well pipe passed through the opening, means to actuate the slips, and means remotely situated with reference to the spider for actuating the latter said means from a point remote from the spider.

33. In a well drilling apparatus, the combination of a casing, a drill stem within said casing, means for rotating the drill stem, the latter said means including a bushing, means including two sets of oppositely disposed slips within the bushing for holding the drill stem from vertical movement in either direction relative thereto and the effectiveness of the holding means being substantially the same in either direction and being the function of the axial load being transmitted from the drill stem.

34. In a device of the class described, the combination of a rotary machine, a drill stem bushing mounted within the table, two sets of slips having opposed tapered surfaces carried by the bushing for holding the drill stem from vertical movement relative to the table in either direction, and means for actuating the slips in position to engage the drill stem.

LEWIS EMANUEL ZERBE.
EDWARD TIMBS.