Jan. 19, 1937. W. A. ABEGG 2,068,217

AUTOMATIC DRILLING SPIDER

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Fig. 1

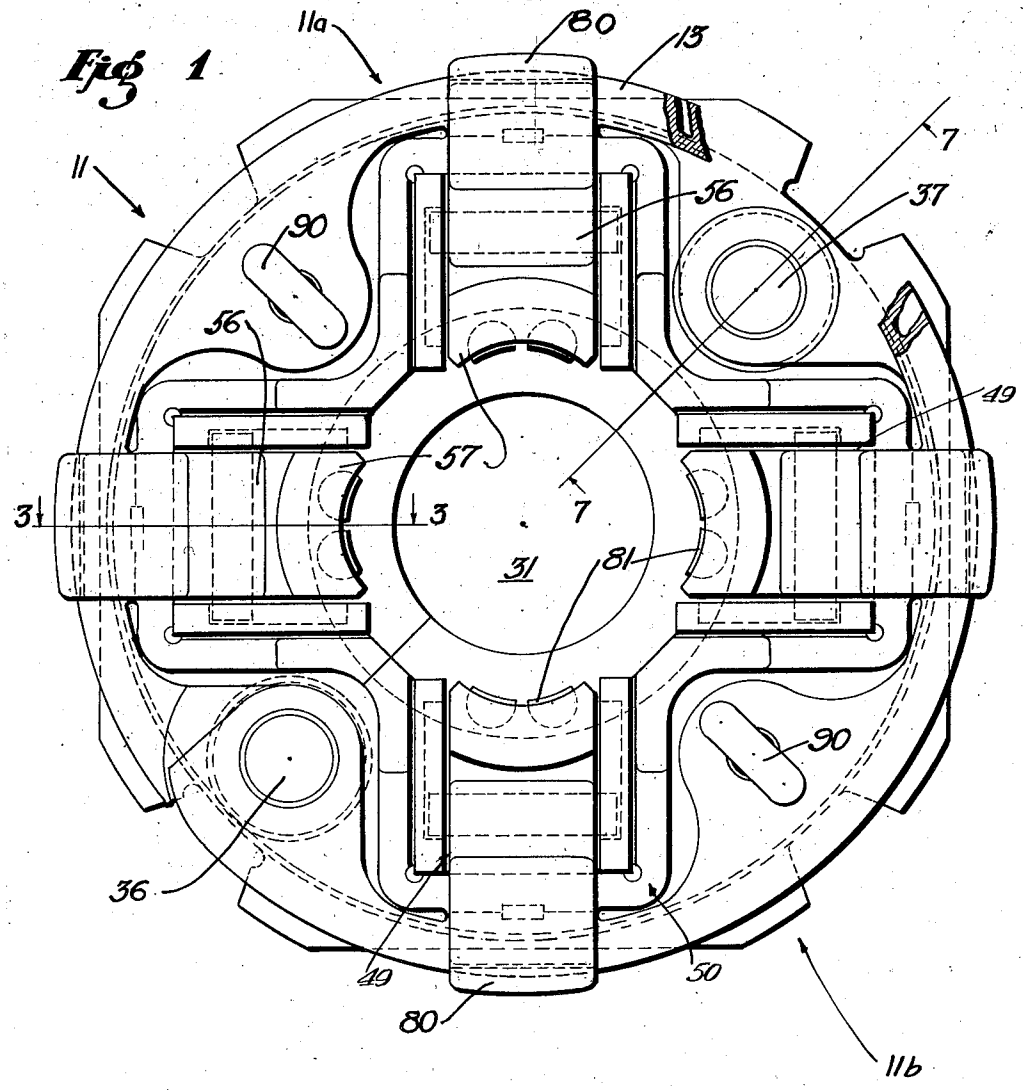
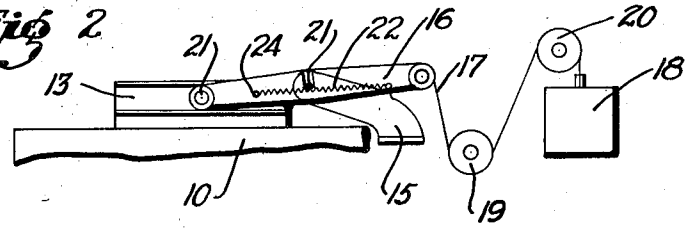


Fig. 2



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Fig 3

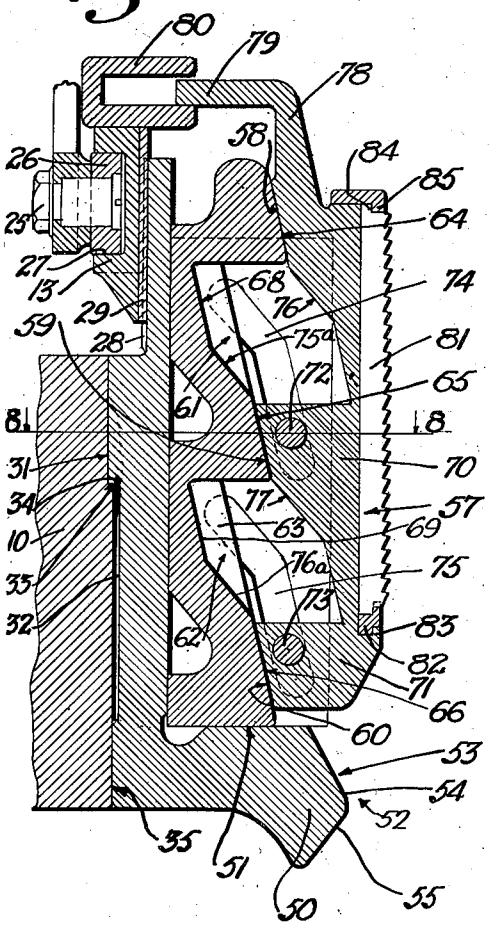
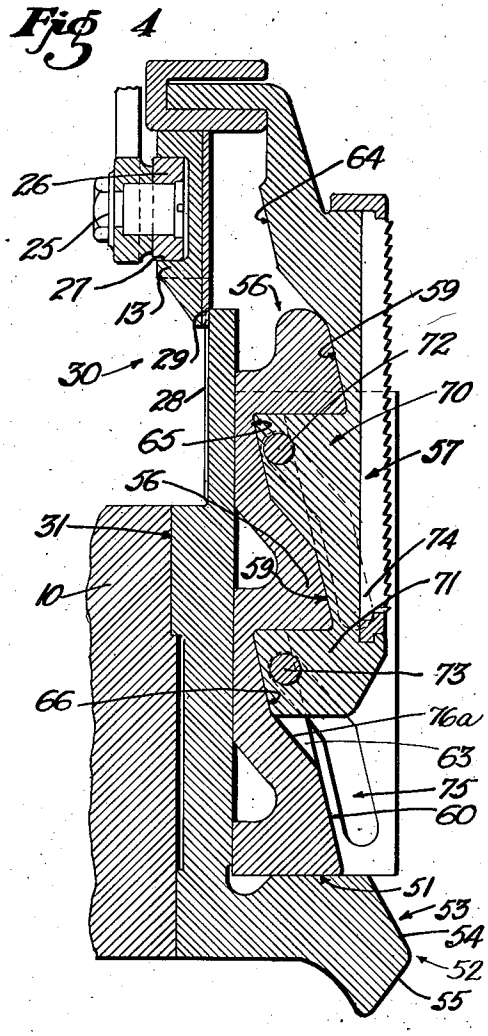


Fig 4



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Fig 5

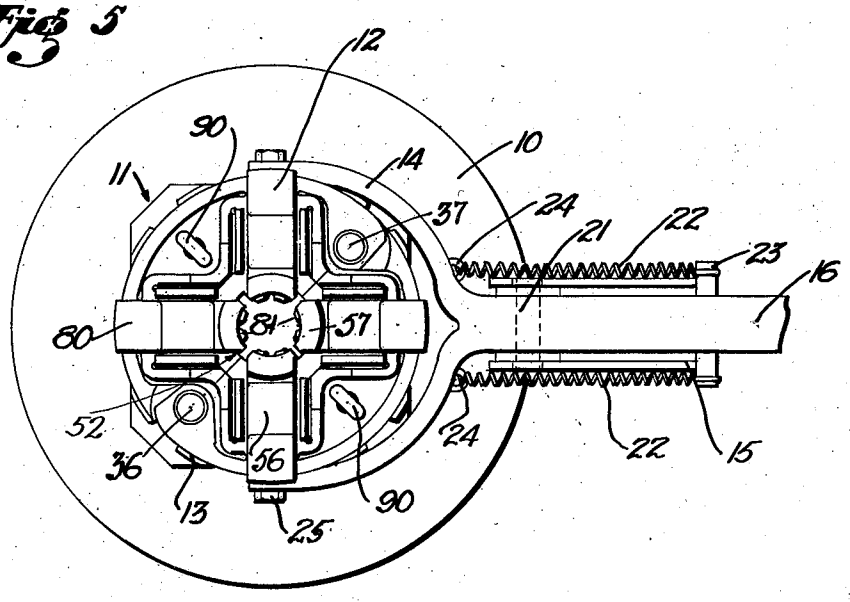
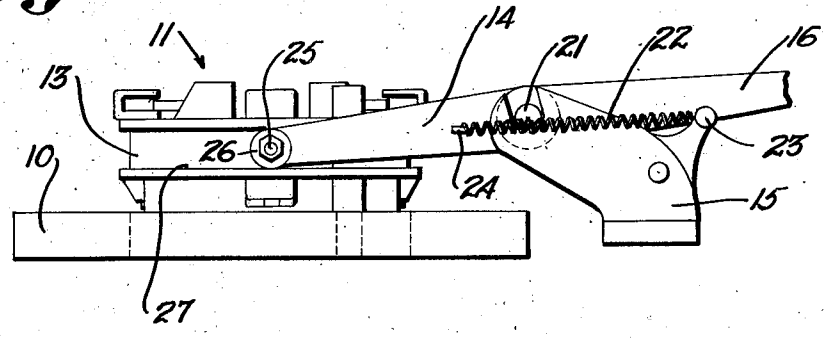


Fig 6



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AUTOMATIC DRILLING SPIDER

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Fig 7

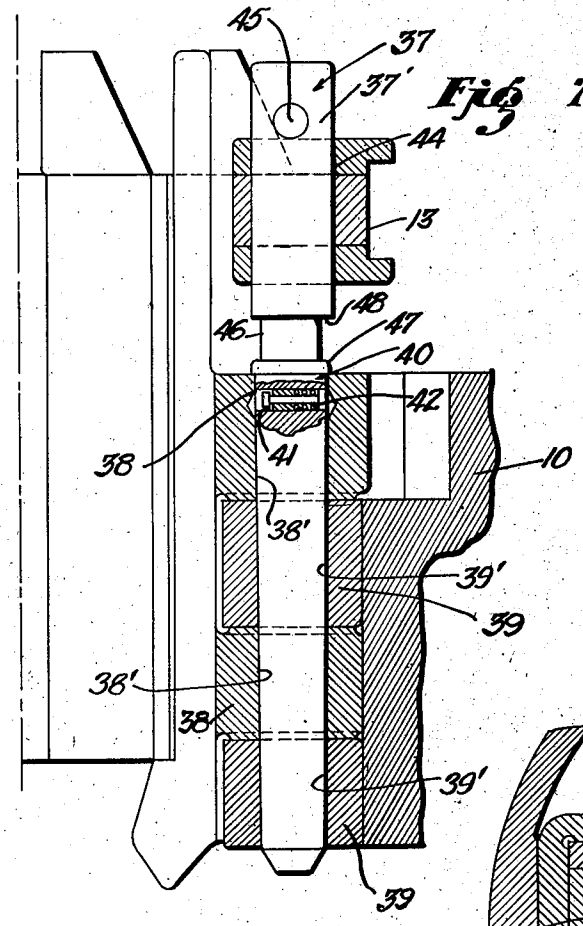
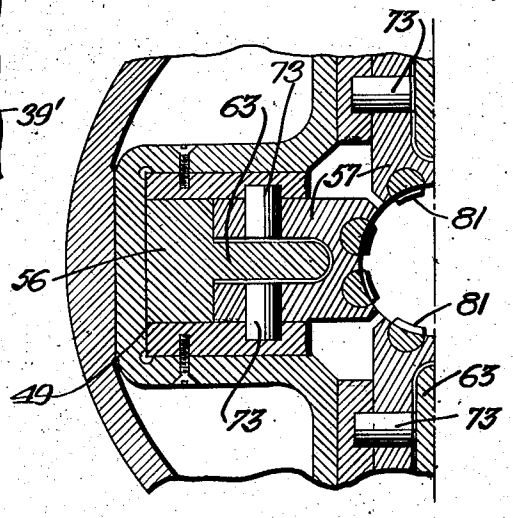


Fig 8



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Patented Jan. 19, 1937 2,068,217

UNITED STATES PATENT OFFICE

2,068,217

AUTOMATIC DRILLING SPIDER

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Application August 19, 1935, Serial No. 36,847

3 Claims. (Cl. 24—263)

This invention relates to well drilling apparatus, and particularly pertains to automatic spiders for drill slips.

In carrying out rotary well drilling operations it is necessary that means be provided to grip the drill string as it is being lowered into the well or withdrawn therefrom, and to support the same against vertical movement with relation to the rotary table at such times. The usual method of accomplishing this result is to insert drill slips into a spider, sometimes called a "master bushing" or "table bushing", carried upon the rotary table, which slips are formed with serrated gripping faces to engage the surface of the drill string, or casing, and tapered back faces by which the slips will be wedged into engaging position and will hold the drill string firmly at such times. In the usual construction of drill slips the slips are individually lifted and lowered manually. They are of necessity of considerable weight, making them unwieldy to handle, and in view of the fact that they must be rapidly positioned in place and removed therefrom for the purpose of efficient drilling, it is awkward to operate them and may result in injury to the drilling crew and sometimes in the loss of a slip in the hole, which would delay drilling operations until its recovery. It is the principal object of the present invention, therefore, to provide a spider and drill slip structure for rotary tables in which the spider and the drill slips are at all times assembled, the slips being simultaneously and automatically advanced to a gripping position and retracted therefrom by the movement of a single operating member which may be easily manipulated to simultaneously advance and retract the slips.

The table bushing is made up of two sections. It has been found that due to the wedging action of the slips, a heavy outward pressure is placed upon the table bushing sections when pipe is being supported, this pressure being transmitted through the bushings to the rotary table, causing undue wear of the faces of the central table opening. It is therefore an additional object of the invention to provide a table bushing construction in which said spreading forces are taken up within the bushing itself, so those spreading forces are not transmitted to the table, and the wear on its surfaces are thus eliminated or very materially reduced.

The present invention contemplates the provision of a spider mounted upon a rotary table and being designed with vertical ways within which the separate slips are mounted for vertical sliding movement, the slips having operating means by which they are instantly moved in unison.

The invention is illustrated by way of example in the accompanying drawings in which:

Figure 1 is a view in plan showing the structure with which the present invention is concerned and with parts broken away to more clearly disclose the design thereof.

Fig. 2 is a view in diagram illustrating one method of operating the slips and of counterbalancing the operation.

Fig. 3 is an enlarged view in vertical section taken through the drill spider and a slip as shown on the line 3—3 of Fig. 1, and showing the slip in its lowermost position.

Fig. 4 is a view similar to Fig. 3 showing the slip in its resting position.

Fig. 5 is a view in plan showing the assembled structure on a rotary table.

Fig. 6 is a view in side elevation showing the structure of Fig. 5.

Fig. 7 is an enlarged view in section showing the coupling pin on the line 7—7 of Fig. 1.

Fig. 8 is an enlarged view in transverse section on the line 8—8 of Fig. 3.

Referring more particularly to Figs. 5 and 6 in the drawings a rotary table 10 is indicated. This table is of conventional type having a central opening therethrough to receive a drill slip spider or table bushing generally indicated at 11 in the drawings and within which structure a plurality of vertically moving drill slips 12 are mounted. These slips are simultaneously actuated by a lift ring 13 which is engaged by a lifting yoke 14 mounted upon a bracket 15 alongside the rotary table and the outer end of which yoke is fitted with a lever arm 16. This lever arm may be manually moved by imposing a weight on its end, and, as particularly shown in Fig. 2 of the drawings, a cable 17 may be attached to the free end of the lever arm 16 to connect this lever arm with a counterweight 18 attached to the end of the cable. The cable may be led around a plurality of pulleys 19 and 20 for convenience, and will thus make it possible to quite easily swing the lever arm to simultaneously lift the slips 12. The lever arm 16 is fitted with a fulcrum pin 21 carried in slotted bearing seats of the bracket 15. Springs 22 are attached to the fastening arms 23 of the bracket and are connected by pins 24 to the yoke 14. The position of connection of the opposite ends of the springs to the member 23 and the pins 24 is such as to insure that when the lever and yoke swing beyond dead center in either direction, the spring will tend to tempo-

rarily hold the yoke and the lift ring in that particular position, and is not liable to be displaced accidentally in the operation of the machine. The forward ends of the arms of the yoke 14 carry trunnion pins 25 upon which are mounted rollers 26. These rollers extend into an annular groove 27 and lifting ring 13 and make it possible to exert a lifting or lowering pressure upon the ring irrespective of whether or not the rotary table is in movement. The ring 13 is provided with guide pins 28 which extend through bosses 29 on the ring 13. The upwardly extending portion 30 of the spider projects above the plane of the top of the rotary table 10. The body portion of the spider extends downwardly into an opening 31 formed through the rotary table. A counterbore 32 occurs at the top of the opening 31 and forms a shoulder 33 upon which an annular shoulder 34 of the spider rests. The body of the spider 11 extends downwardly through the opening 31 and is relieved for a major portion of its length to prevent binding or wedging between the parts. An annular portion 35 occurs around the perimeter of the spider at its lower end to fit snugly within the bore 31 and to thus secure the spider or table bushing firmly in place. The spider is made in two segmental halves, generally indicated as 11*a* and 11*b*. These halves are pivoted upon a vertical hinge pin 36 shown in the lower left hand corner of Fig. 1 of the drawings. The two spider halves may, therefore, be withdrawn from the rotary table and removed from an embracing position around the drill stem. The free ends of member 11*a* and 11*b* are temporarily locked together by a tapered lock pin 37, which, as shown in Fig. 7 of the drawings, extends downwardly through taper pin-holes 38′, 39′ in intermeshing bosses or end formations 38 and 39, respectively, of the two spider sections. Pins 36 and 37 rigidly interconnect the bushing parts 11*a* and 11*b*, when in the condition of Figs. 1 and 7. In order to secure the lock pin 37 in position a lock plunger 40 is mounted to reciprocate in a bore 41 formed diametrically across the lock plunger. A spring 42 yieldably urges the lock pin 40 outwardly to set within the recess 43 formed in the boss 38. The pin 37 has an upper portion 37′ which extends through a bore 44 in the lifting ring 13 and tends to guide the ring in its vertical movement. A stop pin 45 extends transversely of the portion of the pin 37 projecting above the lifting ring to limit the upward movement of the ring.

As particularly shown in Fig. 7 of the drawings an annular groove 46 is formed around the body of the lock pin at a point above the upper face of the spider. Directly below this groove an annular collar 47 is formed on the pin to limit the downward movement of the pin. The groove 46 provides a downwardly presented shoulder 48 beneath which a prying member could be positioned in the event that the pin 37 should stick in the bores of the bosses 38 and 39 of the spider sections. The spider sections are each formed with a pair of vertical guideways 49. These guideways are of channel section and are suitably reinforced by a rib 50 extending around their perimeters. The guideways extend radially of the assembled spider structure and of the rotary axis of the table 10. The guide channels 49, as particularly shown in Figs. 3 and 4 of the drawings, have a vertical wall and a lower horizontal wall. The lower wall is formed by an inwardly extending floor portion 51 through which a center opening 52 occurs. The center opening is bound by a downwardly and inwardly extending guide flange 53 which has an upwardly presented inclined face 54 and a downwardly presented inclined face 55 by which the opening 52 is defined. Due to this arrangement it is possible to easily guide the drill stem and its collar through the spider and the rotary table and to tend to center the drill string for operation. Mounted within each of the guideways 49 is a spider wedge block 56. These wedge blocks fit within the guide channels 59, but present a series of inner vertically inclined faces over which drill slips 57 may move as they shift radially from a non-wedging to wedging positions, and vice versa. The faces, as shown in Figs. 3 and 4 of the drawings, are three in number: an uppermost inclined face 58, an intermediate inclined face 59, and a lowermost inclined face 60. The faces 59 and 60 are relieved throughout the portion of their upper length as indicated at 61 and 62 of the drawings. Extending vertically of the relieved portions of the faces is a reinforcing rib 63 which tends to strengthen the wedge blocks and to resist the heavy stresses and strains to which they are imposed. The drill slips 57 are formed with faces 64, 65, and 66 which agree in angularity with the faces 58, 59, and 60 of the wedge blocks, and vertically of which said drill slips slide. The recesses 61 and 62 are formed with inclined faces 68 and 69 which are in planes parallel to the faces 65 and 66 of the drill slips. This makes it possible for the projecting portions 70 and 71 of the slips, and upon which the inclined faces 65 and 66 occur, to move into the recesses 61 and 62 when the drill slips are in their uppermost and retracted positions. Outward movement of the drill slips is limited by pins 72 and 73 which are carried by the projecting portions 70 and 71 of each slip. These pins extend horizontally from opposite sides of each of the drill slips 57 and project into guide slots 74 and 75 occurring in the opposite parallel side walls of each of the guide channels 49. The guide slots, as clearly shown in Figs. 3 and 4 of the drawings, have a lower length which extends parallel to the faces 59 and 60 of the guide blocks and upper length extending parallel to inclined faces 76 and 77. The inclined face 75*a* forms a continuing face from the face 59 of the guide block to the face 68. The inclined face 76*a* forms a continuing face from the face 60 of the guide block to the face 69. Due to this arrangement the pins and their guide slots cooperate in maintaining the drill slips in sliding contact with the various faces along which they move in their operation. The individual drill slips 57 are each provided with a lifting finger 78 one of which extends upwardly from each of the slips and each of which terminates in an outwardly extending flange 79. These flanges project horizontally and radially of the assembled structure and extend into channel shaped saddles 80 carried by the lifting ring 13. It will thus be evident that as the lifting ring 13 is raised or lowered its saddles will engage flange 79 on each of the lifting fingers and will correspondingly raise and lower a drill slip while the flange 79 moves vertically and reciprocates horizontally with relation to its saddle 80. The gripping face of the drill slips may be formed as desired, but it has been considered preferable to construct it with a plurality of removable inserts 81 characterized as having their gripping faces serrated and as having a substantially semi-cylindrical vertical back face which seats within a vertically extending

groove of arcuate cross section. As shown in Figs. 3 and 4 of the drawings, it will be seen that the lower ends of the inserts are formed with toes **82** which hook over a locking flange **83**, and with their upper ends are formed toes **84** which are engaged by a retaining angle **85**. It is to be understood that various designs of wedge blocks and drill slips may be made, and that, if desired, the spider sections may be articulately connected and assembled in other manners than shown in the drawings, without departing from the spirit of the invention.

In operation of the present invention the structure may be assembled as here disclosed, it being understood that the lifting ring is also formed in two sections which are hinged upon the pins **36** and **37** so that the entire spider with the ring sections and slips may be readily placed in an assembled position around to fit within the bore **31** of the rotary table. After this has been done, the lever **16** with its yoke **14** may be moved to swing the yoke **14** upwardly, thus lifting the ring **13** and simultaneously lifting and radially retracting all of the drill slips **57**. Sections of drill string may then be lowered through the center opening **52** of the assembled slip structure and the rotary table. When it is desired to set the drill string against vertical movement, the lever **16** may be lifted so that the lifting ring will be moved downwardly and the drill slips **57** will move downwardly and inwardly to wedging and gripping position. As this action takes place, the complementary inclined faces of the wedge blocks and the drill slips will act to direct and determine the inward movement of the drill slips and will cause a wedging action to occur around the drill pipe. The guide pins **72** and **73** will move along the slots **74** and **75** and will also tend to guide the slips, as well as limit their outward movement to a wedging position. The slips in riding down the tapered surfaces of blocks **56** and wedgingly gripping a pipe or casing, set up lateral or horizontal forces which, in some cases, are very large. These lateral forces are of course transmitted to the halves of the table bushing, but the pins **36** and **37** take those lateral forces or spreading pressures, and thus prevent these pressures from being imposed upon the rotary table, to very real advantage. As previously stated, it may facilitate matters to counterbalance the lever **16** so that weight **18** will substantially agree with the aggregate weight of the lifting ring and the wedging slips, and so that the lever **16** may be moved with relatively small effort. In order to facilitate in manipulating the assembled structure eyebolts **90** are mounted in the upper face of each of the spider sections to be engaged by spider hooks, or cables, connected with the draw-works of the well rig.

Attention is directed to the fact that due to the backing provided the wedge members for the slips it is possible to design the structures having sliding planes of angles more nearly vertical than commonly used. This prevents excessive wear on the parts, makes it possible to obtain suitable gripping action without imposing undue strain on the gripping teeth of the slips, and prevents the parts from becoming readily broken and the teeth from being dulled.

It will thus be seen, therefore, that the invention here disclosed comprises desirable means for maintaining an entire set of drill slips in a permanently assembled position whereby they may be easily installed upon a rotary table and whereby the drill slips may be collectively operated to grip or release a pipe or casing extending through the rotary table.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes may be made in combination, construction, and arrangement of parts by those skilled in the art, without departing from the spirit of my invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a rotary well drilling apparatus an automatic drill spider comprising a spider member adapted to be operatively positioned with relation to a rotary table, a plurality of drill slips vertically slidable with relation to said spider member, a lifting ring engaging each of the drill slips to move the same, operating means engaging the lifting ring to raise and lower it, said spider and ring each being formed in two complementary sections whereby said members may be disposed in an embracing position around a drill string or the like to be gripped, and means articulately connecting contiguous ends of said spider and ring sections.

2. In a rotary well drilling apparatus an automatic drill spider comprising a spider member adapted to be operatively positioned with relation to a rotary table, a plurality of drill slips vertically slidable with relation to said spider member, a lifting ring engaging each of the drill slips to move the same, operating means engaging the lifting ring to raise and lower it, said spider and ring each being formed in two complementary sections whereby said members may be disposed in an embracing position around a drill string or the like to be gripped, means articulately connecting contiguous ends of said spider and ring sections, and means for locking the opposite ends of said spider and ring sections in their operative position.

3. In a rotary well drilling apparatus an automatic drill spider comprising a spider member adapted to be operatively positioned with relation to a rotary table, a plurality of drill slips vertically slidable with relation to said spider member, a lifting ring engaging each of the drill slips to move the same, operating means engaging the lifting ring to raise and lower it, said spider and ring each being formed in two complementary sections whereby said members may be disposed in an embracing position around a drill string or the like to be gripped, means articulately connecting contiguous ends of said spider and ring sections, and guide means whereby the ring sections and their complementary spider sections will swing in unison and may be simultaneously manipulated.

WALTER A. ABEGG.