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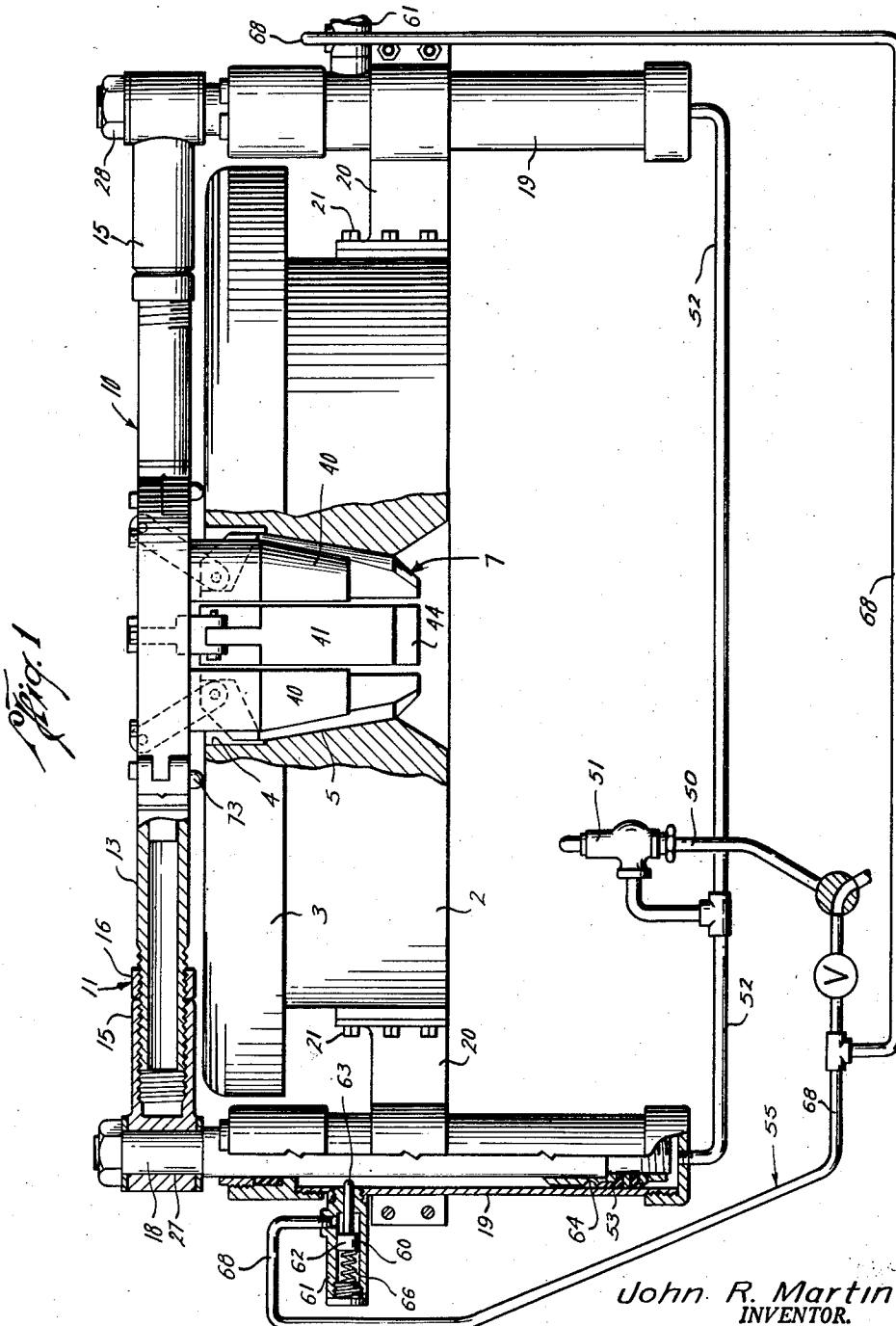
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POWER OPERATED SLIP MECHANISM

Filed Sept. 28, 1951

5 Sheets-Sheet 1



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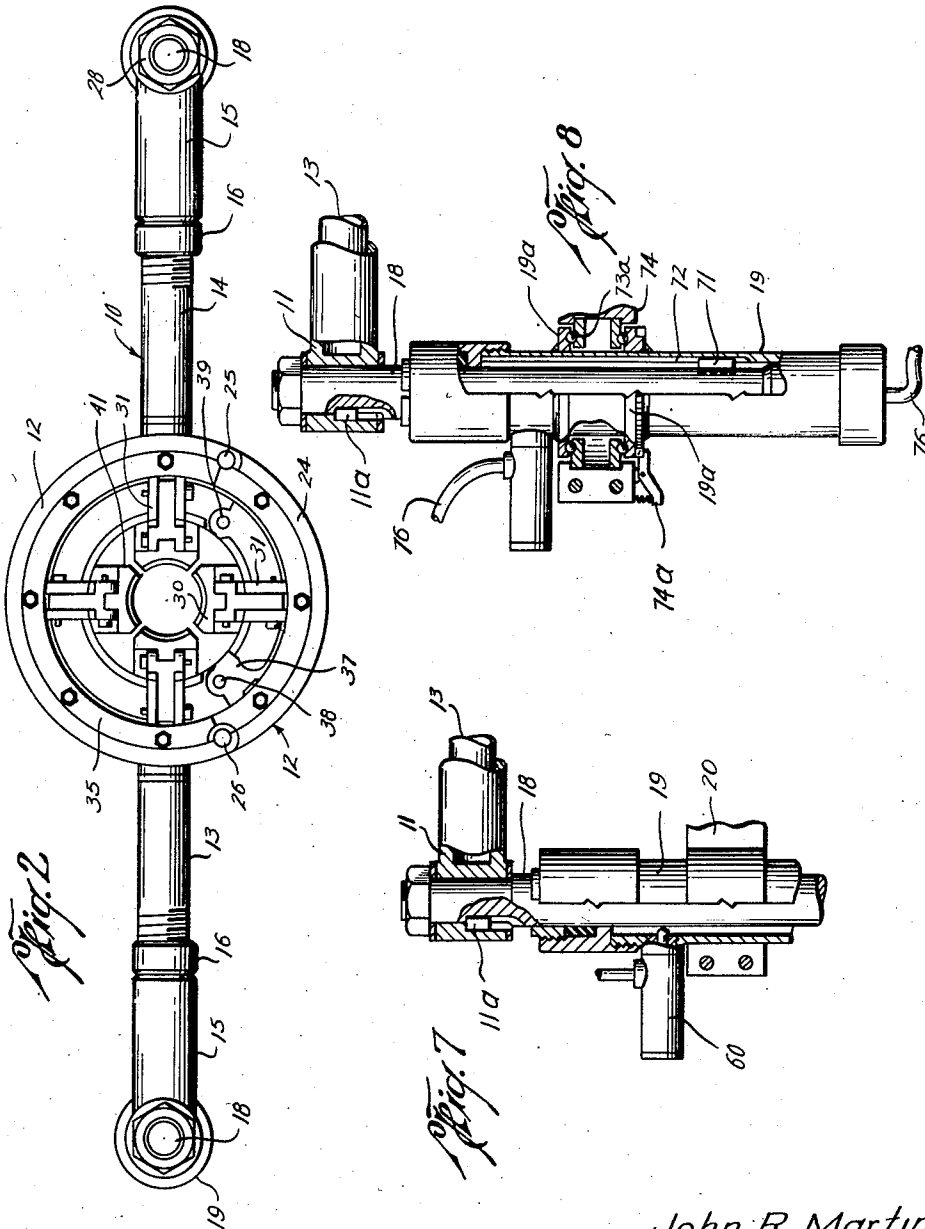
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5 Sheets-Sheet 2



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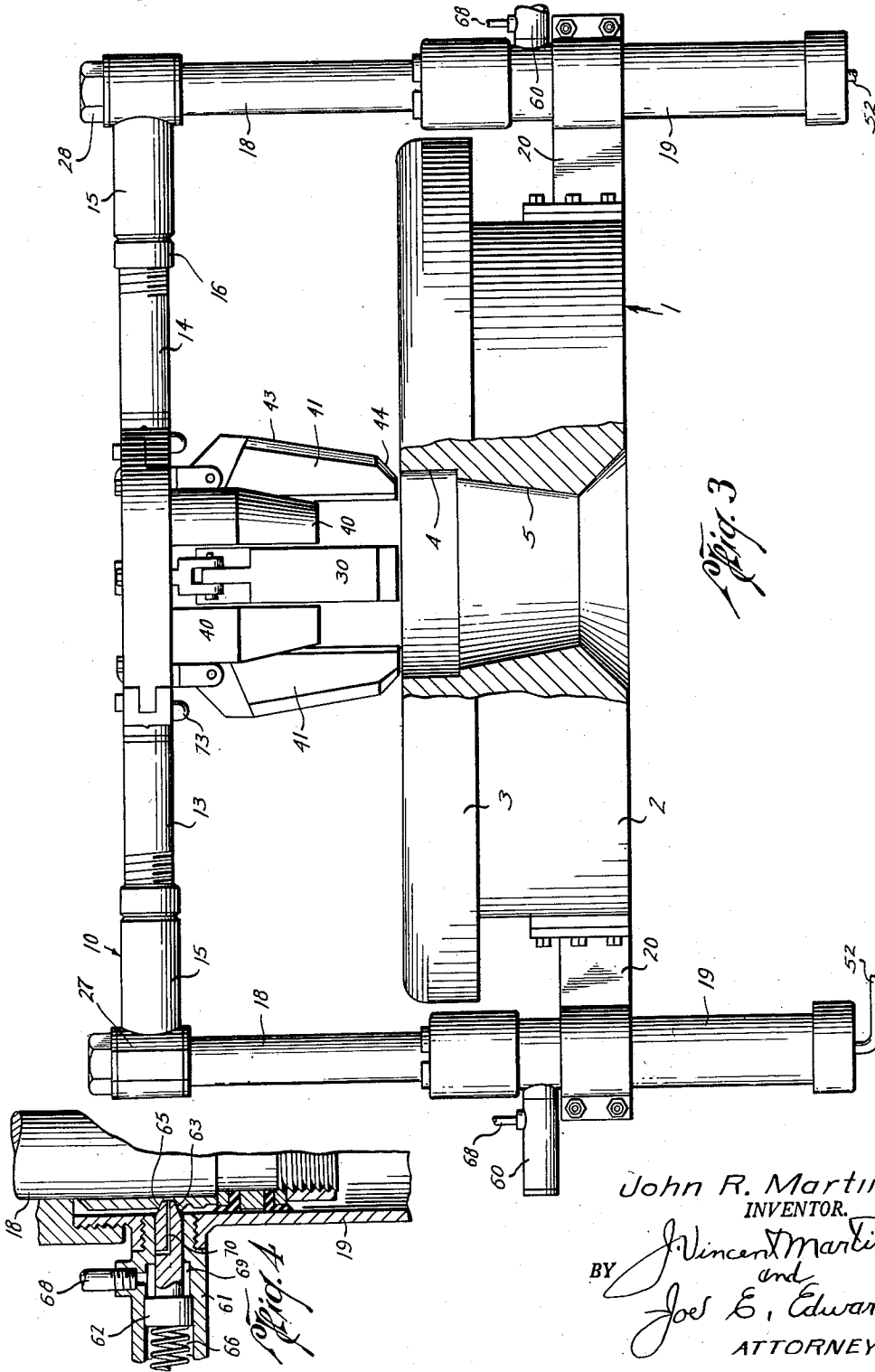
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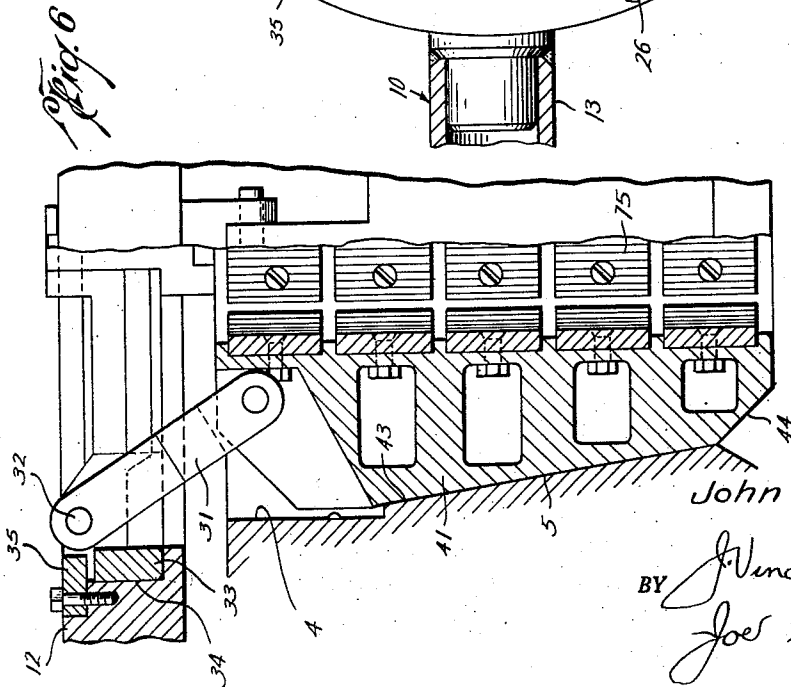
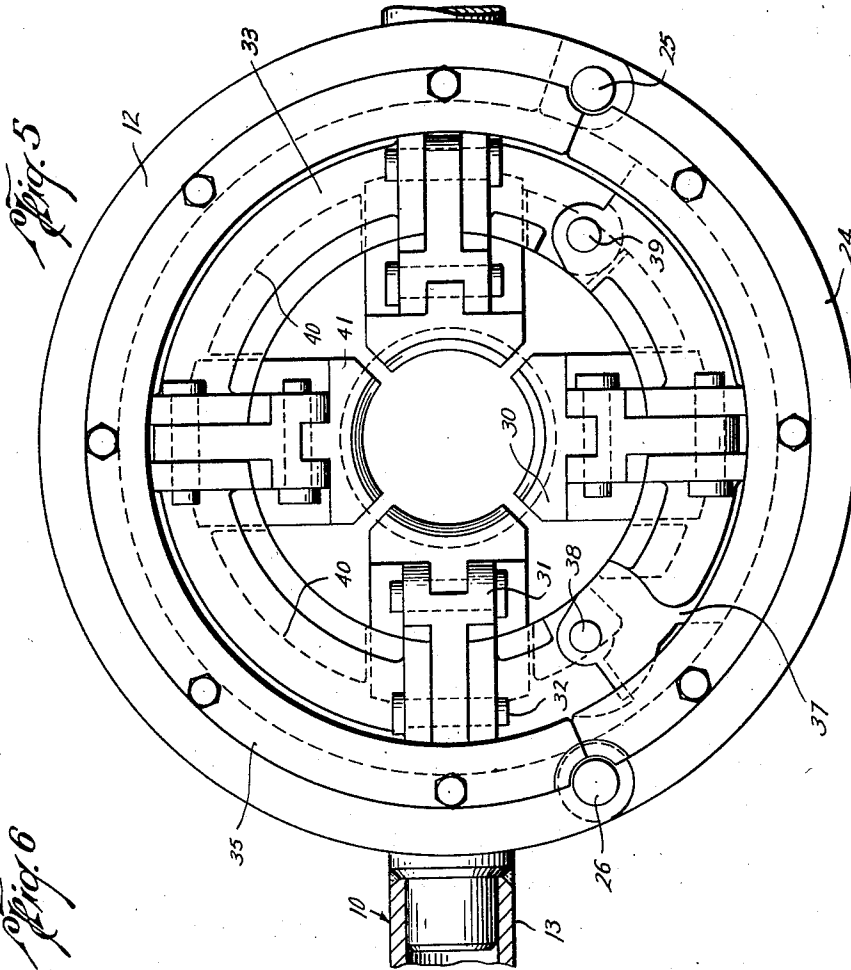
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5 Sheets-Sheet 4



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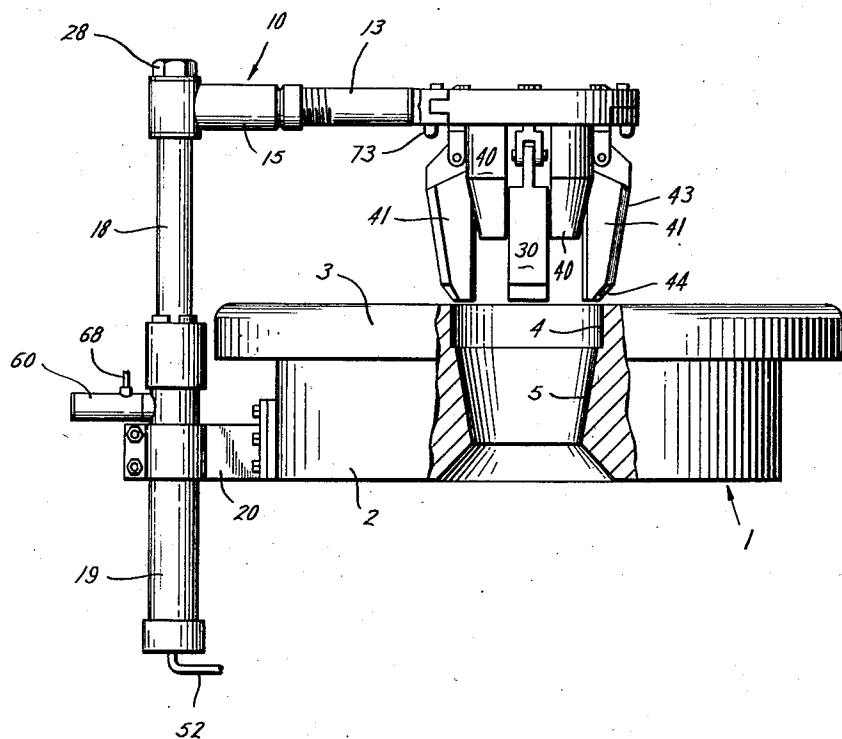
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POWER OPERATED SLIP MECHANISM

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Application September 28, 1951, Serial No. 248,745

8 Claims. (Cl. 255—23)

This invention relates to a power operated slip mechanism for use with the rotary machine employed in the rotary method of drilling wells. This application is filed as a continuation-in-part of my co-pending application, Serial No. 673,866, filed June 1, 1946, which application is now abandoned.

Considerable difficulty is encountered in manipulating the supporting slips for suspending the strings of pipe and particularly the rotary drill stem in the rotary method of drilling, first because of the tremendous weight of the pipe in the deeper wells, and second because very often rotary motion is imparted to the pipe while it is suspended by the slips.

The present invention contemplates a slip assembly which can be connected to the stationary part of the rotary machine and then manipulated by hydraulic pressure so as to raise and lower the slips in releasing and gripping the string of pipe, whereby an alignment between the slip assembly and the rotary table is maintained regardless of shifting movement of the table.

It is one of the objects of the present invention to provide a slip mechanism connected to the base of the rotary machine in such a manner that it may be adjusted in order to be centered over the slip bowl in the center of the rotary table.

Another object of the invention is to provide a slip supporting frame which can be raised and lowered hydraulically and which supports guide members for the slip jaws so as to space them uniformly and support the slips in event of rotation of the rotary table.

Still another object is to provide a slip mechanism which can be raised and lowered hydraulically and latched in raised position in such a manner that should an accidental weight or force strike the frame, that it would be released to move to its lowermost position against the rotary table.

Still another object of the invention is to provide a slip mechanism which can be raised and lowered hydraulically, but which will release upon the application of an excessive force which will act to release the pressure liquid used in elevating the assembly.

Still another object of the invention is to provide a power operated slip assembly having circumferentially spaced pipe supporting jaws with guide members therebetween so that the jaws will be restrained against twisting or rotary movement in event the pipe being supported is caused to rotate.

Still another object of the invention is to provide a releasable latch for power operated slip mechanisms which can be retracted to release the mechanism for lowering movement or which can be released in event of an accidental force being applied thereto.

Still another object of the invention is to provide a power operated slip assembly wherein the frame and the slip supporting ring provide a hinged gate including one of the slips, the gate being swung out of the assembly to permit passage of the assembly about the pipe.

Still another object of the invention is to provide a

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power operated slip mechanism which can be positioned over the rotary table for operation by pistons within diametrically oppositely disposed hydraulic cylinders, but which is releasable from one of said pistons so as to be moved to a lateral position away from the top of the rotary table.

A further object is to provide a mechanism of the character described, wherein the slip assembly is supported by an arm with means for swingably mounting the slip assembly with respect to the rotary table; said swingable mounting being either through the connection between the supporting arm and the piston, the rotatable connection between the operating piston and its cylinder, or through a rotation of the outer cylinder of the mechanism.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a side elevation showing the slip mechanism affixed to a rotary machine and lowered into operating position with certain parts shown in section;

Fig. 2 is a top plan view looking down on the slip assembly and supporting frame of Fig. 1;

Fig. 3 is a view similar to the elevation of Fig. 1 except that the slip supporting frame is shown in raised or inoperative position;

Fig. 4 is a broken detailed sectional view illustrating the releasing latch for retaining the mechanism in elevated position;

Fig. 5 is a top plan view looking down on the slip jaw supporting ring and slips;

Fig. 6 is a sectional view through one of the slips and illustrating the operating linkage therefor.

Fig. 7 is a fragmentary view illustrating the support pipe non-rotatably keyed to the upper end of the operating piston;

Fig. 8 illustrates another modification of the invention wherein the support pipe and piston are non-rotatable with respect to the cylinder, with the cylinder rotatably mounted in its supporting bracket; and

Fig. 9 is a view similar to Fig. 3 illustrating the slips supported with a single arm.

In Fig. 1 the rotary machine 1 comprising the base 2 and the rotary table 3 which is rotatable in said base is mounted upon a suitable foundation or support, and is arranged over the hole which is to be drilled and has the upper or rotary table portion 3 in position for rotation in the turning of the drill pipe. The driving mechanism for the table portion 3 is not shown.

This rotary machine 1 has an opening 4 therein which also includes a tapered bowl portion 5 which is a part of, and which rotates with, the rotary table 3. This opening usually receives a drive bushing for gripping the drill stem to impart rotation thereto, but when the pipe is to be removed from or lowered into the well bore, the drive bushing is removed, leaving the tapered bowl 5 open in position to receive the slip jaws 7 which form part of the power operated slip mechanism.

This mechanism includes the slip assembly 10 which is made up of a frame 11 which is in the form of a support ring 12 having the support pipes 13 and 14 extending therefrom on the opposite ends of a diameter.

These pipes 13 and 14 are threadably adjustable in the nipples 15 and are arranged to be locked in desired adjusted position by a locking collar 16. The nipples 15 are shown in Fig. 1 as being supported upon the piston rods 18, one of which is mounted for sliding movement in each of the diametrically opposed cylinders 19. These cylinders are in turn supported in a bracket 20 affixed at 21 to the stationary or base portion 2 of the rotary machine 1.

This arrangement positions the cylinders 19 relative to the rotary machine 1 so that there will be no relative lateral or other movement between the rotary machine

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1 and the cylinders. These cylinders 19 in turn are connected to a suitable hydraulic pressure system for transmitting movement to the pistons 18 so as to move the frame 11 of the entire slip mechanism.

The pipes 13 and 14 are connected to the supporting ring 12 which has pivot pin 25 on one side and a second pivot pin 26 on the other side so as to form a gate 24 constituting about one-third of the circular ring 12. With this arrangement the gate can be swung open so as to permit access to the center of the ring. This access is desired in order to move the supporting ring 12 about any pipe which might pass through the slip bowl 5 into the well bore and through the rotary table. The swinging movement of the frame 12 is accomplished by virtue of the fact that one of the nipples 15 is provided with a lateral slot or recess 27 which is arranged to move laterally and engage around the spindle or piston rod 18 as best seen in the left hand side of Fig. 1. The nut 28 can then be tightened so as to firmly secure the assembly in position. The lateral slot or recess is illustrated as formed in the nipple 15 on the left hand side of Figure 3, but such lateral slot may be formed in either one or both of said nipples; if formed in both of these elements, only one of the nipples would be disengaged from its respective piston so that the assembly would be swung laterally pivoting about the other piston.

The gate 24 can swing open and carry with it the slip jaw 30 which is suspended on a link 31 pivoted at 32 in a collar 33 Fig. 6. This collar is rotatably held in the recess 34 in the support ring 12 by a hold-down plate 35.

The collar 33 is formed with a gate portion 37 pivoted at 38 and 39 so as to swing the jaw 30 and the link 31 outwardly in opening up the assembly.

One of the important features of the invention is the arrangement of the guides 40 which are spaced between the adjacent slip jaws 41. These jaws are like the jaw 30 except that they are suspended from the collar 33 by the pivots 32 and they remain stationary with the collar 33.

These guides 40 are arcuate in shape as shown by the full and dotted lines in Fig. 5. They are slightly crescent shaped so as to fit between the adjacent edges of the slip jaws 41 and can be affixed to or formed as a part of the collar 33. They are immovably arranged as best seen in Fig. 3 so as to insure the vertical position of the slip jaws during operation of the device.

The backs 43 of the slip jaws are tapered to fit the bowl 15 and the lower ends are beveled at 44 to facilitate lowering of the slip jaws into the recess 4 in the rotary table 3.

The links 31 permit both vertical and lateral movement of the slips so that they will drop into position as seen in Fig. 1.

In order to operate the slip mechanism the hydraulic pressure system 55 is provided including the pipe or conduit 50 which is connected through a relief valve 51 to the manifold pipe 52 which is in turn connected to the base of each of the cylinders 19. The pistons 18 each have a suitable packing 53 thereon to form a seal with the inside of the cylinder so that the application of hydraulic pressure will serve to elevate the slip assembly when the slips are to be raised to the inoperative position of Fig. 3.

It will be understood that during the normal drilling and rotating operations that the slips are not used and that they may be swung laterally by releasing the nut 28 so that the frame and assembly will not be positioned over the rotary table at all. On the other hand, the parts may remain in the position shown in Fig. 3 while the drive bushing used when drilling is resumed will be slipped into the recess 4 and bowl 5.

In order to avoid maintaining hydraulic pressure in the cylinders 19, a latch 60 is shown in Fig. 1 on the left

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hand cylinder as including a housing 61 connected into the cylinder 19 and having a spring pressed plunger 62 therein whose forward end is beveled at 63 to engage in an annular recess 64 in an enlargement on the piston rod 18. Thus, when the piston is raised the parts will assume the position of Fig. 4 and the weight of the frame and assembly will rest upon the shoulder 65 on the piston and in this manner be supported on the plunger.

In event the elevators or some other object should strike the frame from above while it is thus elevated, the downward impact will be imparted to the piston rod 18 which will move said rod downwardly relative to the beveled surface 63 on the plunger 62 with the result that the plunger will be forced to the left as seen in Fig. 4 to overcome the compression on the spring 66; in this manner the plunger is retracted to release the piston and the frame may thus drop downwardly to the position of Fig. 1. If such an action should occur while the hydraulic pressure is within the cylinders the relief valve 51 is set to release the pressure at a predetermined point and the downward impact on the frame adds sufficient force to actuate the valve and release the pressure to thereby permit the device to move downwardly at a predetermined rate before it would be bent or broken.

In operation, when the device is to be lowered suitable pressure can be applied to the pipe 68 which is shown as connected into the housing 61 so as to apply a pressure in the chamber 69 to move the plunger 62 to the left.

The port 70 would thus move back into the chamber 69 as seen in Fig. 4 and release the pressure therein so that the spring 66 would snap the plunger back to its normal locking position. Since the plunger moves back to normal locking position upon an equalization of pressure across the plunger and since very little pressure is necessary to operate said plunger, no appreciable pressure will build up in the cylinder from this source; however, if a pressure buildup should occur, this may be easily relieved by unscrewing the closure in the end of the housing 61 to relieve such pressure prior to operation of the slip assembly.

Suitable bumpers 73 of resilient or other material may be provided to abut the rotary table as seen in Fig. 1 when the device moves to its lowermost position.

The slip jaws 30 and 41 may be of any desired types, Fig. 6, showing the knurled plates 75 thereon as being adapted to grip the periphery of the pipe so as to hold the pipe securely in position.

In installing the device, the brackets 20 and cylinders 19 will be affixed and the pipes 13 and 14 adjusted so as to center the ring over the rotary table. The nuts 16 will then lock the parts in place and unless and until there is some misalignment, the slips will be properly centered over the slip bowl for satisfactory operation. The assembly may or may not be swung laterally during operation as desired, but the gate 24 provides for such lateral swinging relative to any pipe in the hole, if such movement is desired.

As above indicated, the pipe is sometimes turned by the rotary table while it is suspended in the slips. In such position the slips are wedged in the slip bowl 5 by the weight of the pipe and will be compelled to turn with the rotary table and pipe. To permit such rotation the collar 33 will turn in the ring 12 because the ring is held non-rotatable as a part of the frame 11. The links 31 fit in slots in the collar as seen in Fig. 6 so that the links will be laterally supported by such ring.

As illustrated in Figs. 1 to 5, two cylinders are shown in diametrically opposed relationship with each cylinder having a piston secured to one of the support pipes 13 and 14. However, it is evident that the invention may be accomplished by providing only a single cylinder and single piston with a single support arm connected to the slip assembly; in such case, however, the various parts would have to be made considerably heavier in order to

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properly and efficiently support the slips. However, the operation would be identical and the single cylinder would be secured to the rotary table whereby any misalignment of the rotary table would be automatically compensated for, and thus the slips would always be in proper position with respect to said rotary table.

As illustrated in Figs. 1 to 6, each support pipe 13 or 14 is secured to the upper end of its piston 18 by a pivotal mounting so that when one of the pipes has its nipple 15 disengaged from its piston lateral swinging of the slips may be accomplished, with this swinging being effected by a rotation of the support arm on the piston. The purposes of the invention could be accomplished by keying each nipple 15 by means of a key 11a to the upper end of the piston 18, as shown in Fig. 7. In such case a swinging movement of the arm is possible because the piston 18 will merely rotate within the cylinder 19.

Still another modification whereby each support pipe is swingably mounted is illustrated in Fig. 8. In this instance, the nipple 15 is connected by the key 11a to the upper end of the piston 18. The piston 18 is non-rotatable within the cylinder 19 by means of a key 71 and slot 72. Instead of being clamped within the bracket 20, the cylinder 19 is rotatably mounted on bearings 73a within a bracket 74, which bracket is secured to the base portion 2 of the rotary table. The cylinder may be provided with bearing flanges 19a which engage the upper and lower surfaces of the bracket 74 to prevent sliding movement of the cylinder with respect to the bracket. A suitable spring-pressed detent 74a may normally lock the cylinder against rotation.

In the form of the particular mounting shown in Fig. 8 it is evident that release of the detent 74a will permit the entire cylinder 19 to be rotated, and since the piston and support nipple are keyed to the cylinder, these parts will rotate therewith to swing the slips laterally of the rotary table. In this form the connections between the hydraulic pressure system 55 and the cylinder 19 are made by flexible hose 76.

It is believed that the operation will be obvious from the foregoing description, but broadly the invention contemplates a power operated slip mechanism which may be affixed and adjusted relative to a rotary machine and wherein the slip jaws are guided to insure proper alignment thereof.

The invention claimed is:

1. A slip mechanism for supporting pipe for use with a rotary machine having a base, a rotary table and a slip bowl in said table, said mechanism including, a slip assembly comprising, a frame, a collar rotatable in said frame, a gate in said frame and collar for adapting said assembly to encircle pipe, a plurality of slip jaws pivotally suspended from said collar, guide members on said collar disposed between adjacent jaws, a pair of cylinders adapted to be mounted on diametrically opposite sides of the base of the rotary machine, pistons in said cylinders, said frame being pivotally connected to one of said pistons and releasably connected to the other of said pistons so that said assembly may be moved from over the rotary table of said machine through which said pipe extends, a pressure fluid system connected to said cylinders for actuating said pistons for moving said assembly downward to bring said jaws into contact with the bowl of said table and into gripping contact with said pipe, and for raising said assembly for releasing said pipe, a latch on at least one cylinder for latching said pistons in raised position and for releasing said pistons for downward movement in operation and when an excessive weight is applied to said frame, and a relief valve in said system for dampening the descent of said assembly.

2. A slip mechanism for supporting pipe for use with a rotary machine having a base, a rotary table and a slip bowl in said table, said mechanism including a slip assembly comprising, a frame, a collar rotatable in said frame, a gate in said frame and collar for adapting said

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assembly to encircle pipe, a plurality of slip jaws pivotally suspended from said collar, a pair of cylinders adapted to be mounted on diametrically opposite sides of the base of the rotary machine, pistons in said cylinders, said frame being pivotally connected to one of said pistons and releasably connected to the other of said pistons so that said assembly may be moved from over the rotary table of said machine, and a pressure fluid system connected to said cylinders for actuating said pistons for moving said assembly downward to bring said jaws into contact with the bowl of said table and into gripping contact with said pipe and for raising said assembly for releasing said pipe.

3. A slip mechanism for supporting pipe for use with a rotary machine having a base, a rotary table and a slip bowl in said table, said mechanism including a slip assembly comprising, a frame, a collar rotatable in said frame, a gate in said frame and collar for adapting said assembly to encircle pipe, a plurality of slip jaws pivotally suspended from said collar, cylinder means having piston means therein to which said frame is connected, said cylinder means being mounted on the base of the rotary machine so as to support said frame thereabove with the axis of said collar substantially co-axial with the vertical axis of the bowl of said machine, said frame being pivotally connected to said piston means so that said assembly may be moved from over the rotary table of said machine, and a pressure fluid system connected to said cylinder means for actuating said piston means for moving said assembly downward to bring said jaws into contact with the bowl of said table and into gripping contact with said pipe and for raising said assembly for releasing said pipe, a latch means mounted in the cylinder means and engageable with the piston means for latching the piston means in its raised position, said latch means and piston means having cooperating portions which are inclined relative to the axis of the piston so that the latch means is releasable by a predetermined downward force applied to the slip assembly and piston means whereby said assembly and piston means may be moved downwardly by said applied force, and a relief valve in the pressure system operable when the predetermined force is applied to the assembly and piston means for controlling the rate of downward movement of the piston means as a result of applied force.

4. A slip mechanism as set forth in claim 3, wherein the latch means is a spring-pressed plunger engageable with a recess in the surface of the piston.

5. The combination with a rotary machine employed in the rotary method of drilling and having a stationary base member and a rotatable bowl part, of a slip mechanism for supporting pipe, said mechanism including a slip assembly comprising, a horizontally disposed frame, a collar rotatable in said frame, a gate in said frame and collar for adapting said assembly to encircle pipe, a plurality of slip jaws pivotally suspended from said collar, a vertical cylinder having piston means therein and disposed at one side of the rotary machine, means for mounting said cylinder directly upon the stationary base member of said rotary machine, a horizontal supporting arm connecting the frame of the slip assembly to the piston means and adapted to extend radially of the rotary machine to support the frame thereabove with the axis of said collar substantially co-axial with the vertical axis of the bowl of said machine, means mounting the supporting arm and frame for horizontal swinging movement about the axis of the cylinder and piston means comprising a keyed connection between the supporting arm and the piston means and a rotatable connection between said piston means and its cylinder so that the slip assembly may be moved from over the rotary table of said machine solely by said horizontal swinging movement, and a pressure fluid system connected to said cylinder for actuating the piston means therein for moving said assembly down-

ward to bring the slip jaws into contact with the bowl of said rotary table and into gripping contact with said pipe and for raising said assembly for releasing said pipe.

6. The combination with a rotary machine employed in the rotary method of drilling and having a stationary base member and a rotatable bowl part, of a slip mechanism for supporting pipe, said mechanism including a slip assembly comprising, a horizontally disposed frame, a collar rotatable in said frame, a gate in said frame and collar for adapting said assembly to encircle pipe, a plurality of slip jaws pivotally suspended from said collar, a vertical cylinder having piston means therein and disposed at one side of the rotary machine, means for mounting said cylinder directly upon the stationary base member of said rotary machine, a horizontal supporting arm connecting the frame of the slip assembly to the piston means and adapted to extend radially of the rotary machine to support the frame thereabove with the axis of said collar substantially co-axial with the vertical axis of the bowl of said machine, means mounting the supporting arm and frame for horizontal swinging movement about the axis of the cylinder and piston means comprising a keyed connection between the supporting arm and piston means, a keyed connection between the piston means and the cylinder, and means for rotatably mounting the cylinder within its mounting means upon the stationary base of the rotary machine so that the slip assembly may be moved from over the rotary table of said machine solely by said horizontal swinging movement, and a pressure fluid system connected to said cylinder for actuating the piston means therein for moving said assembly downward to bring the slip jaws into contact with the bowl of said rotary table and into gripping contact with said pipe and for raising said assembly for releasing said pipe.

7. The combination with a rotary machine employed in the rotary method of drilling and having a stationary base member and a rotatable bowl part, of a slip mechanism for supporting pipe, said mechanism including a slip assembly comprising, a horizontally disposed frame, a collar rotatable in said frame, a gate in said frame and collar for adapting said assembly to encircle pipe, a plurality of slip jaws pivotally suspended from said collar, a vertical cylinder having piston means therein and disposed at one side of the rotary machine, means for mounting said cylinder directly upon the stationary base member of said rotary machine comprising a laterally projecting bracket extending outwardly from the base member of the rotary machine and bearing means between the bracket and cylinder whereby said cylinder is rotatable therein, a horizontal supporting arm connecting the frame of the slip assembly to the piston means and adapted to extend radially of the rotary machine to support the frame thereabove with the axis of said collar substan-

tially co-axial with the vertical axis of the bowl of said machine, means mounting the supporting arm and frame for horizontal swinging movement about the axis of the cylinder and piston means comprising a keyed connection between the supporting arm and the piston means and a rotatable connection between said piston means and its cylinder so that the slip assembly may be moved from over the rotary table of said machine solely by said horizontal swinging movement, and a pressure fluid system connected to said cylinder for actuating the piston means therein for moving said assembly downward to bring the slip jaws into contact with the bowl of said rotary table and into gripping contact with said pipe and for raising said assembly for releasing said pipe.

8. A slip mechanism for supporting pipe, for use with a rotary machine having a base, a rotary table and a slip bowl in said table, said mechanism including a slip assembly comprising, a frame, a collar rotatable in said frame, a gate in said frame and collar for adapting said assembly to encircle pipe, a plurality of slip jaws pivotally suspended from said collar, guide members on said collar disposed between adjacent jaws, a cylinder adapted to be mounted in vertical position on the base of the rotary machine, a piston in said cylinder, means mounting the frame on the piston and providing for swinging movement of the frame about the central axis of the cylinder so that said assembly may be moved from over the rotary table of said machine through which said pipe extends, a pressure fluid system connected to said cylinder for actuating said piston for moving said assembly downward to bring said jaws into contact with the bowl of said table and into gripping contact with said pipe, and for raising said assembly for releasing said pipe, a latch on said cylinder for latching said piston in raised position and for releasing said piston for downward movement in operation and when an excessive weight is applied to said frame, and a relief valve in said system for dampening the descent of said assembly.

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