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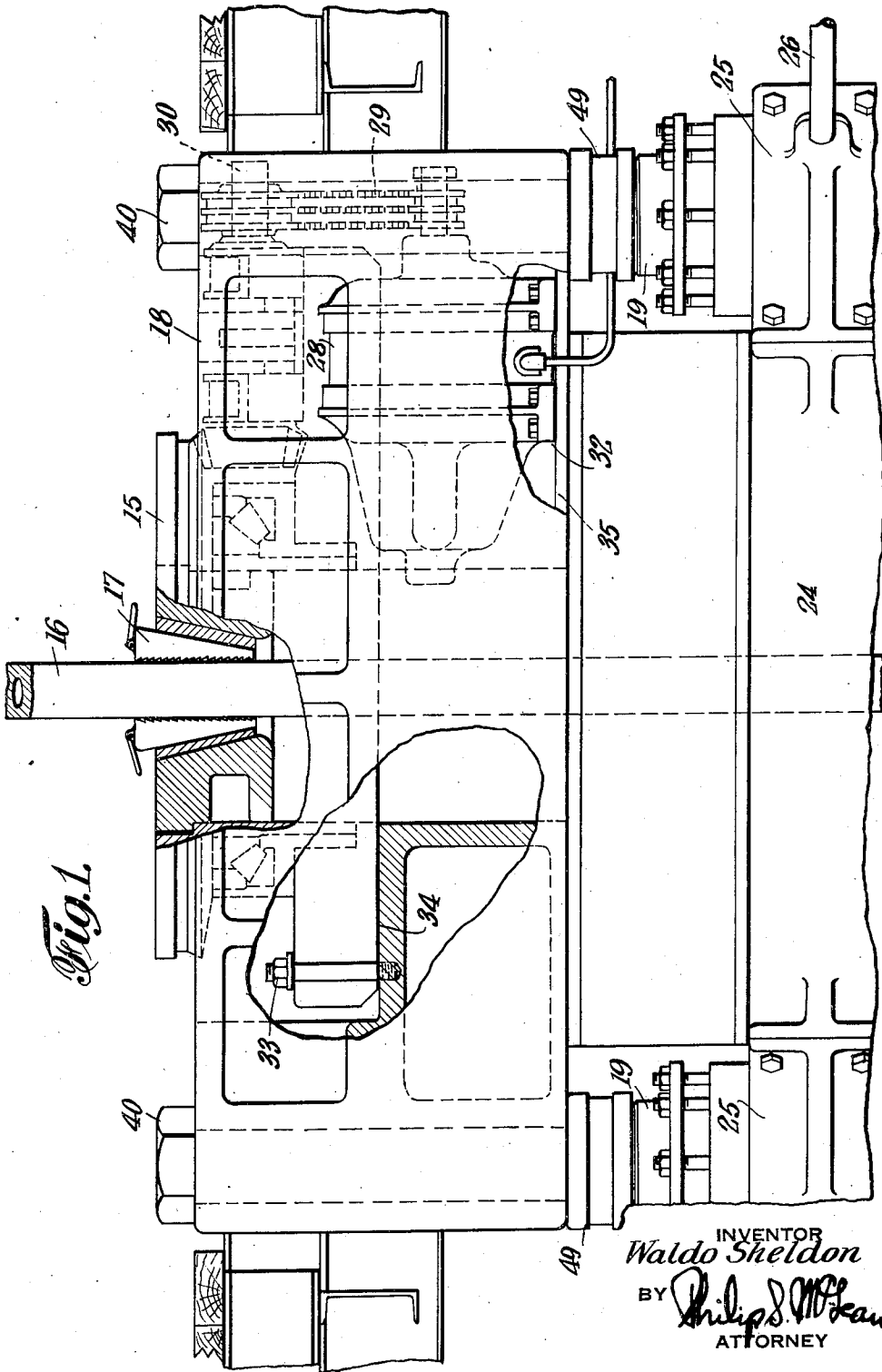
W. SHELDON

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DRILLING MACHINERY

Filed Jan. 8, 1932

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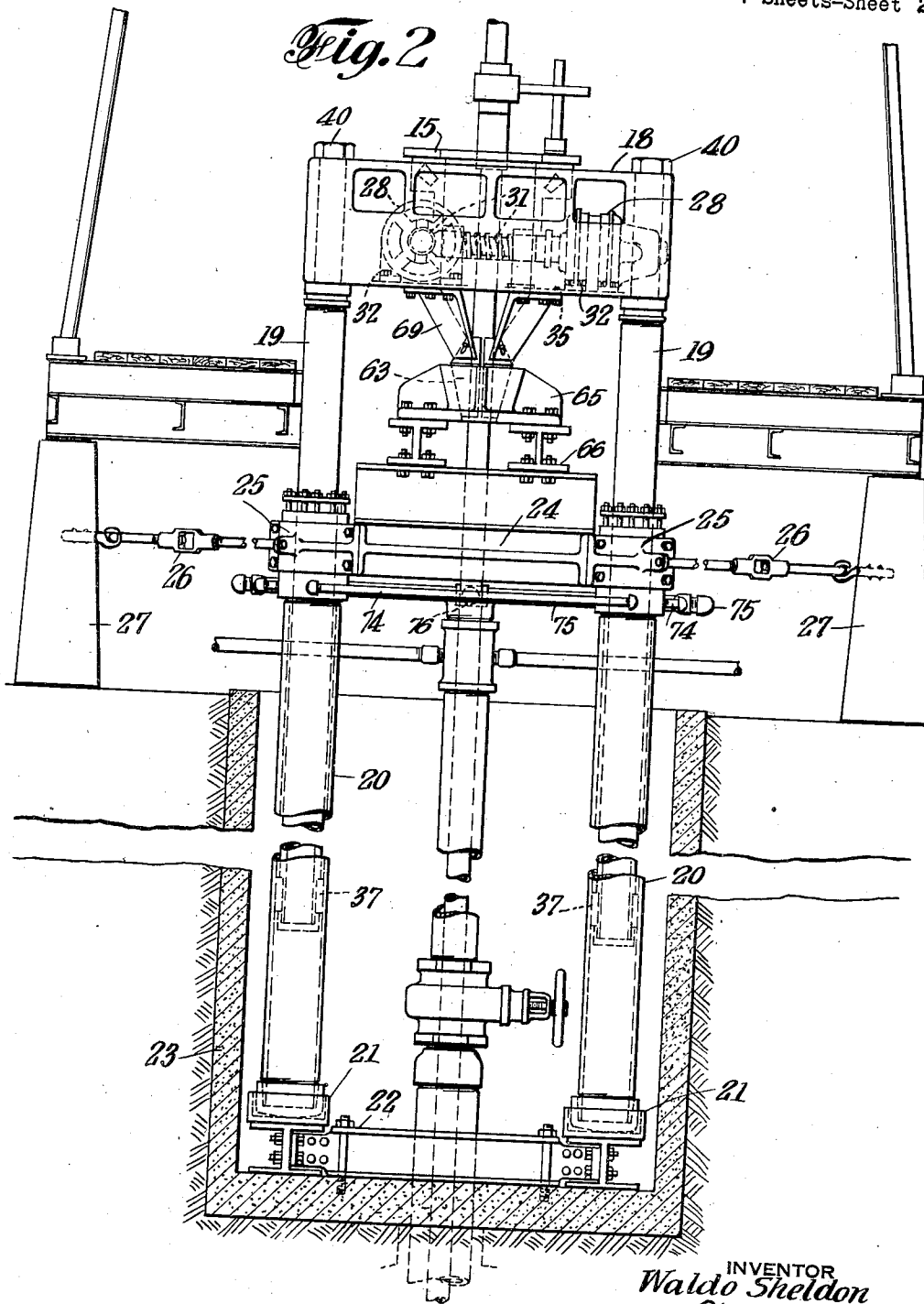
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Fig. 2



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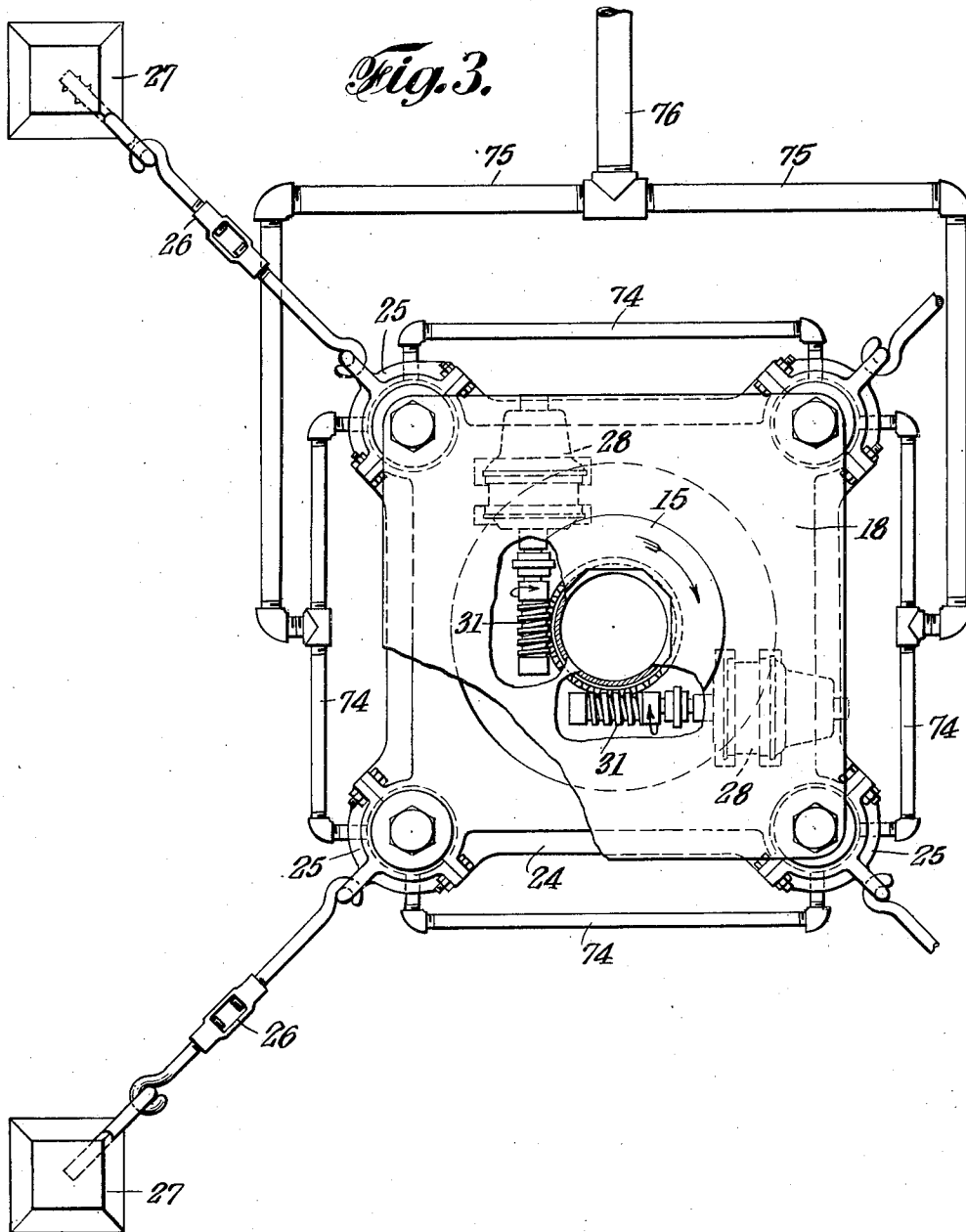
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DRILLING MACHINERY

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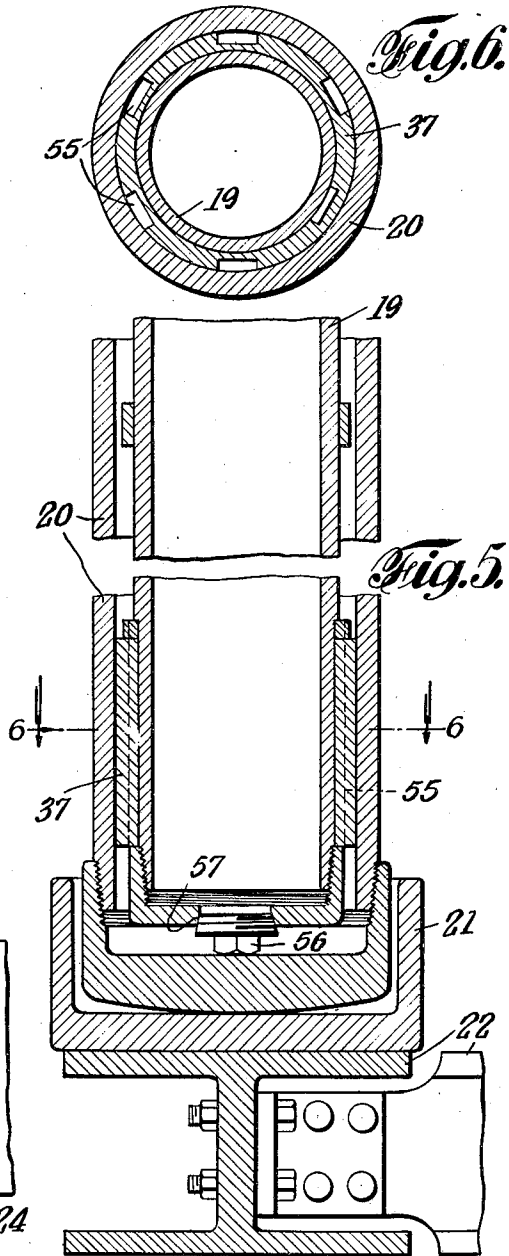
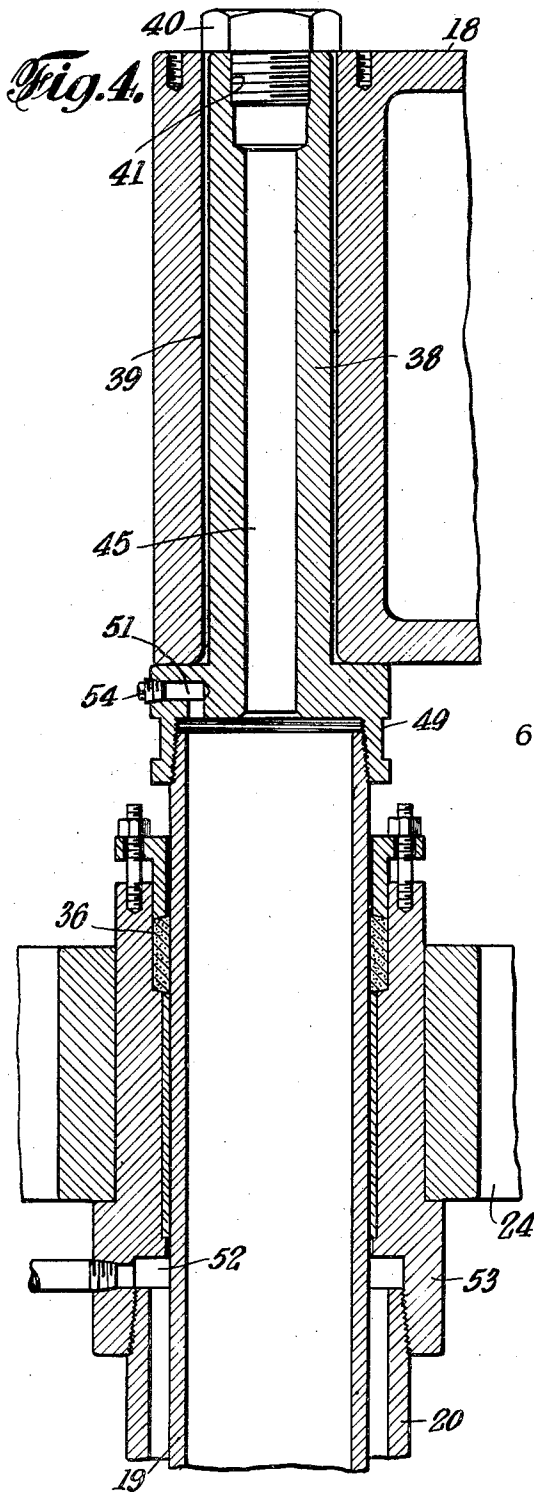
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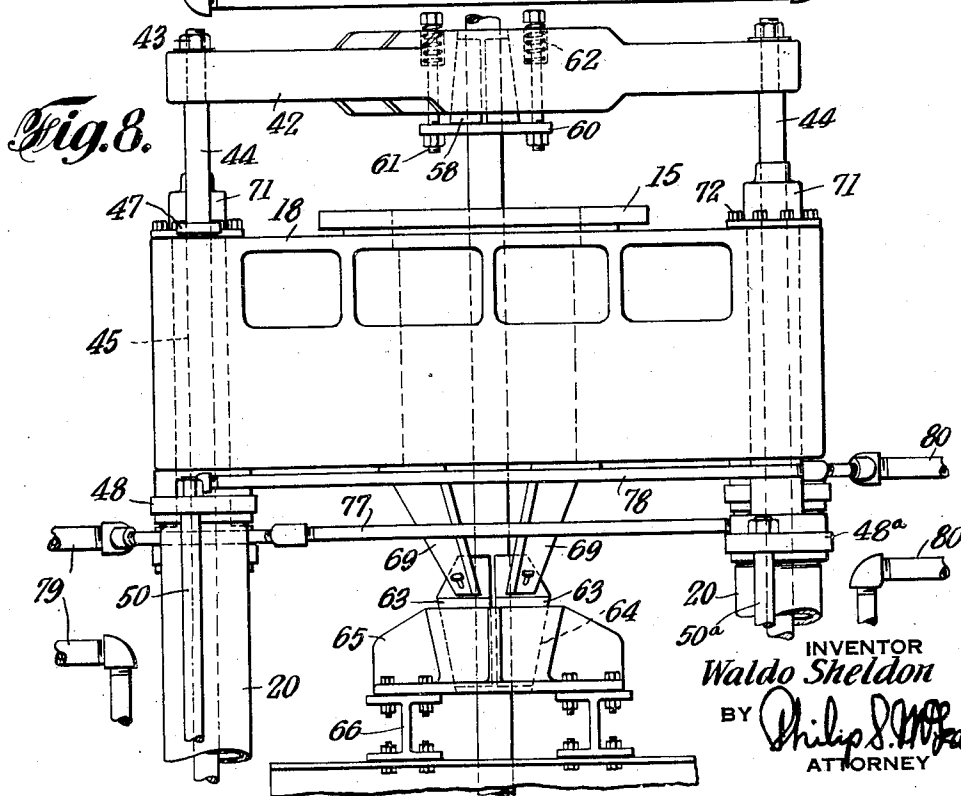
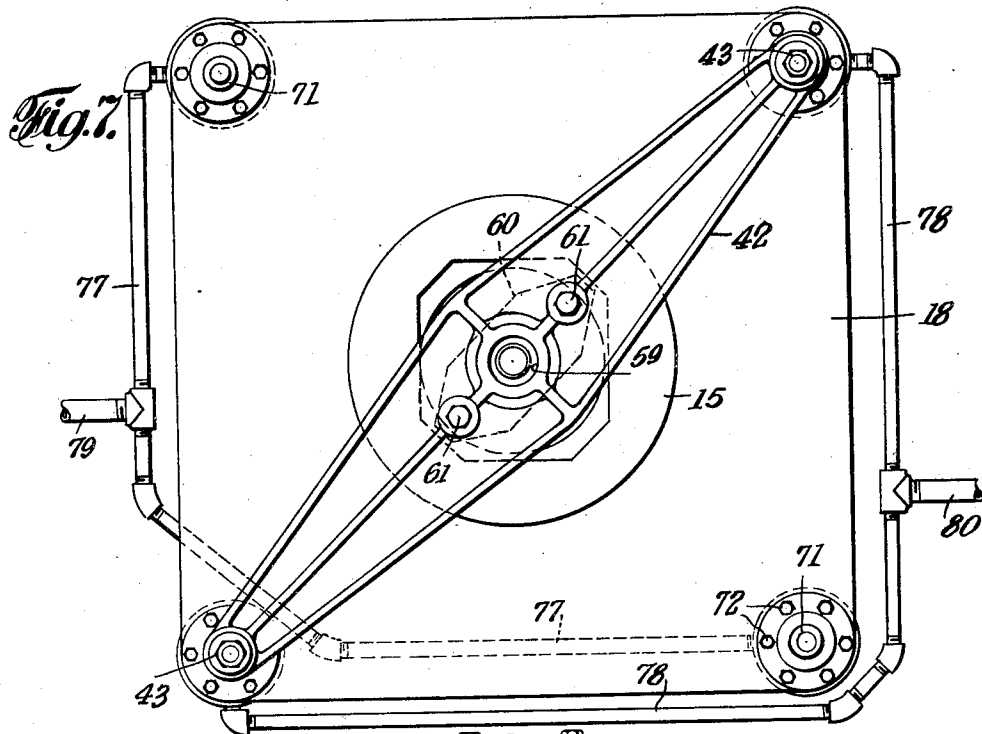
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DRILLING MACHINERY

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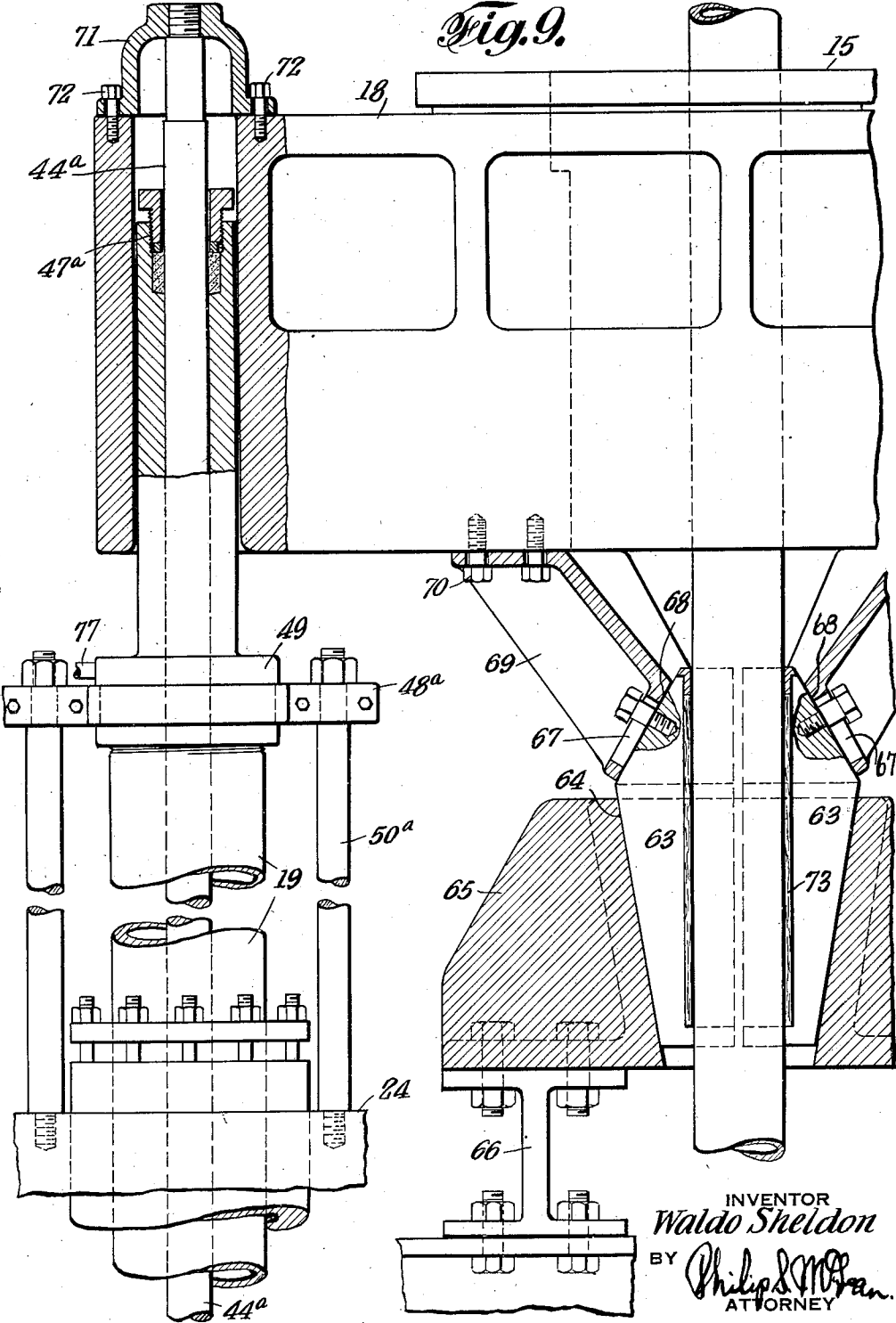
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DRILLING MACHINERY

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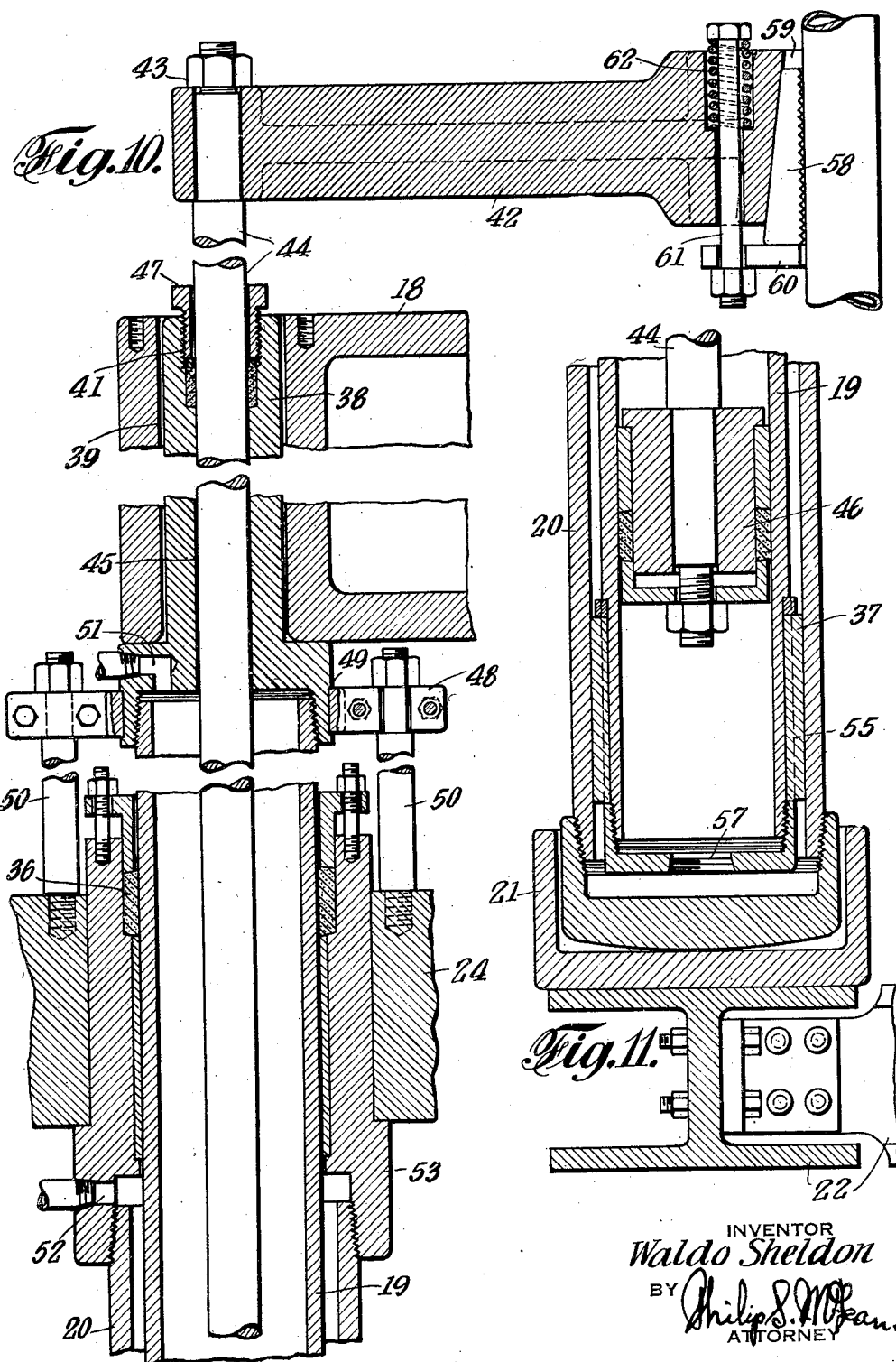


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UNITED STATES PATENT OFFICE

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DRILLING MACHINERY

Application filed January 8, 1932. Serial No. 585,473.

This invention relates to drilling machinery of the "rotary" type and particularly for drilling deep wells.

Special objects of the invention are to provide an improved and practical long stroke hydraulic feed and to combine the motive power with the rotary, so that the drive will remain constant irrespective of the operation of the hydraulic feed.

Further special objects of the invention are to combine in the machine provision for automatically setting and releasing slips for holding drill pipe or casing; means for effecting make-up and breaking out; means for braking pipe being forced out of a well by pressure in the well; means for snubbing pipe in and out of a well; and means for effecting a combined braking and holding or combined snubbing and holding action.

Other important objects and the many novel features of construction, combinations and relations of parts comprising the invention, will appear as the specification proceeds.

The drawings accompanying and forming part of the specification illustrate certain practical embodiments of the invention, but it is to be understood that the structure may be modified and changed in various ways all within the true intent and broad scope of the claims.

Fig. 1 of the drawings is a broken and partly sectional side elevation of a rotary drill embodying certain features of the invention.

Fig. 2 is a broken side elevation and partly sectional view on a smaller scale to show the power cylinders and illustrating certain modifications in the power drive and in the use of a spider and slips for holding the pipe.

Fig. 3 is a broken and partly sectional plan view of the apparatus shown in Fig. 2.

Figs. 4 and 5 are broken sectional views illustrating the upper and lower end portions respectively of the power cylinders.

Fig. 6 is a cross sectional detail as on the plane of line 6—6 of Fig. 5.

Fig. 7 is a broken plan view and Fig. 8 is a broken side elevation illustrating a combined snubbing and holding operation of the machine, utilizing two of the power cylinders for

holding purposes and the other two power cylinders for snubbing in or out.

Fig. 9 is an enlarged broken part sectional view illustrating particularly the operation of the two cylinders for the holding and braking control.

Fig. 10 is a generally similar view illustrating features of the other two cylinders employed for effecting the snubbing action.

Fig. 11 is a broken part sectional detail of the piston and lower end of the power cylinder as employed for the snubbing purpose.

In Fig. 1, a rotary of ordinary design is indicated at 15, driving a kelly or grief stem 16, through suitable slips 17.

For feed control and other purposes, the rotary is mounted on a base, frame or head 18, carried by the rams or pistons 19 of the four power cylinders 20, as shown in Fig. 2. These power cylinders are illustrated as seating at the bottom in sockets 21 carried by a frame 22 set on suitable foundations in the cellar 23 of the well and as rigidly braced and held at their upper ends in a frame 24. For convenience of assembling and disassembling, the frame 24 is shown in Fig. 3 as having removable caps 25 at the four corners of the same for securing the cylinders and for bracing and positioning purposes these caps or corner portions of the frame are shown as connected by turnbuckles 26 with piers or anchorages 27, which may be the corner foundations of the derrick.

Power for driving the rotary is supplied, in the present disclosure, by an electric motor or motors 28, Figs. 1, 2 and 3, mounted on and carried by the same movable head, base or platform 18 which carries the rotary.

In the first view, a single motor is shown mounted on the movable platform carrying the rotary and connected with the rotary by a chain drive 29 to the pinion shaft 30 of the rotary.

The double or multiple motor drive illustrated in Figs. 2 and 3, has certain advantages, particularly as enabling the use of smaller motors, the balancing of the weight of one motor by the weight of another and the distribution or balancing of the driving torque. Thus as particularly shown in Fig.

3, when two or more motors are used they may be located at opposite sides of the table center, so as to balance each other in weight and in the case of worm drive to the table
 5 as shown at 31, to balance or distribute the torque. In the particular case shown, the shafts of the motors are at right angles and hence the thrust of one motor is at a right angle to the thrust of the other motor. This
 10 multiple motor drive also enables further balance being attained by rotating the motors in reverse directions, as indicated in Fig. 3.

The drive motor or motors, like the rotary,
 15 are removably mounted on the movable rotary platform, substantially as indicated at 32 and 33, and preferably the rotary is set down on a shelf 34 in the body of the platform, so as to bring the table substantially
 20 flush with the top of the platform and with the level of the derrick floor, Fig. 1, while the motor or motors is, or are, preferably mounted on a shelf or base 35 in the lower portion of the platform, so as to be below
 25 the rotary and below the top of the platform, leaving the space about the rotary entirely clear for usual drilling operations. This location of the power unit or units in the lower portion of the platform also is an aid
 30 in preserving a better balance of weight and power.

Details of the power cylinders are shown in Figs. 4, 5 and 6. The ram element 19 is
 35 shown in these views as a hollow cylinder operating in the power cylinder 20, through an "outside" packing 36, at the top and carrying at the bottom a guide bushing 37. This ram cylinder is shown as having a long tubular
 40 stud 38 extending up through a bore 39 in the movable base or rotary platform and rigidly held to the latter by a heavy overstanding bolt 40, threaded into the upper end of the stud at 41. This construction provides
 45 a solid connection between the rams and movable platform and enables ready assembly or disconnection of such parts. Furthermore, this construction enables changes being readily made to utilize the cylinders for special
 50 snubbing purposes.

Thus as shown in Figs. 7 to 10, the ram
 55 cylinders may be locked down stationary and pistons be operated in these then stationary cylinders to provide downward, as well as upward thrust for snubbing and holding purposes. In these views also, are illustrated the possibilities of dividing the cylinders in pairs or sets and using one pair for example for
 60 braking or holding pipe or casing and the other pair for snubbing pipe up or down.

Thus in Fig. 7, the upper left and lower
 65 right hand corner cylinders are coupled together and arranged to operate the platform for braking or holding the pipe and the lower left and upper right hand cylinders are coupled together and used for operating a special

snubbing head. This snubbing head is indicated at 42, as a heavy bar extending diagonally across the platform above the table and as removably secured at 43 on the upper
 70 ends of piston rods 44 operating up through the bores 45 of the hollow studs 38, Fig. 10, and connected at their lower ends with pistons 46 operating in the ram cylinders 19, Fig. 11. The removal of the hold-down bolts 40 from
 75 the upper ends of the hollow studs frees the platform from these two diagonally opposite ram cylinders and also enables the placing of special packing glands 47, Fig. 10, for the piston rods 44, in the seats 41, left vacant
 80 by the removal of the hold-down bolts. The ram cylinders are shown as held stationary by the split holding rings 48, engaged with the grooved heads 49 of the cylinders and secured by studs 50 of proper length to the
 85 stationary frame 24. Hydraulic or other power fluid is admitted and exhausted above and below the pistons by ports 51 in the upper heads of the ram cylinders and ports 52 in the stationary upper heads 53 of the
 90 power cylinders. When the power cylinders operate simply as rams for providing a simple hydraulic feed and the ram sleeves have movement in the power cylinders, as first described, the upper ports 51 in the ram cylinders are not used and may be
 95 plugged off as indicated at 54 in Fig. 4. Then only the ports 52 in the power cylinders are required, the fluid passing down from these ports and through channels or waterways 55, Figs. 5 and 6, provided in the guide bushing 37, to beneath the head of the ram sleeve,
 100 which then is closed off by a removable screw plug 56. This plug is taken out when the ram sleeve is used as a stationary power cylinder, leaving a port as shown at 57, Fig. 11, for passage of power fluid to the lower side of the piston.

The snubbing head 42 as shown in Figs. 8 and 10, is constructed to carry pipe slips or other gripping devices 58, which may be
 110 faced to work either upwardly or downwardly. In the views referred to, these slips seat in an upwardly convergent socket 59 in the snubbing head, so as to grip and hold the pipe on the down stroke of the head and said
 115 slips are shown as sustained by a plate or ring 60, carried by bolts 61, yieldingly supported by springs 62, so that upon upward movement of the head, the slips may drop down out of holding engagement with the pipe and thus slide up freely over the pipe. This construction enables an automatic release of the
 120 slips upon reversal of movement of the snubbing head

When two of the diagonally opposite cylinders are used for snubbing purposes, as described, the other two diagonally opposite cylinders may be used for holding the pipe at such times as the snubbing cylinders let go, by providing the special holding slips 130

shown at 63 in Figs. 2, 8 and 9 seating in the contracting socket 64 in a holding spider 65 carried by base 66 adapted to be mounted on the stationary framing or head 24, said slips having a sliding slotted suspension connection 67 with the upwardly convergent socket faces 68 of brackets 69 removably attached at 70 to the underside of the movable platform, Fig. 9. This sliding connection is sufficient to permit the slips opening up far enough to pass collars and tool joints on the pipe. In this instance, as shown in Fig. 9, the ram cylinders which are used for effecting operation of the holding slips, are anchored stationary by holding rings 48a and anchor bolts 50a and the piston rods 44a operating in these particular two cylinders, are connected with the movable platform by caps or bolt heads 71 screwed onto the upper ends of such piston rods and removably bolted to the top of the platform at 72.

By proper control of admission to and exhaust from the two sets of cylinders, the snubbing and holding actions may be controlled to effect the desired results. Thus with upward pressure on the pistons connected with the platform, the holding slips in the spider may be released and if at such time downward pressure is applied to the pistons connected with the snubbing head, the pipe may be snubbed in against pressure in the well.

At the end of the downward snubbing stroke, downward pressure may be applied to the platform to set the holding slips into holding engagement with the pipe and while the pipe is so held, the snubbing head may be run up to the top of its stroke to take a fresh hold on the pipe. By turning the snubbing head over from the position shown in Fig. 10, it will be evident that the slips may be caused to grip the pipe on the upstroke and to automatically let go of it on the downstroke. Hence the pipe may be snubbed in or out of the well, or held from dropping with the snubbing head turned over.

The slips in the stationary spider may be used either for braking or for holding purposes or for both braking and holding. Thus as indicated in Fig. 9, these slips may be lined with a braking material 73, adapted to stand the wear of continued applications of braking force.

The necessary pipe and control valves are not shown in detail, but sufficient is shown in Fig. 3 to illustrate the fact that pressure in the cylinders should be equalized, as by connecting them all together in a single circuit by yokes of piping 74 and by connecting the branches 75 from the supply main 76 into two opposite portions or yokes in this circuit.

Where the cylinders are controlled in pairs, as in Figs. 7 and 8, separate systems of piping are required. These are shown generally, in the views referred to, as yokes of piping

77 connecting two diagonally opposite cylinders and other yokes of piping 78 connecting the other two diagonally opposite cylinders and separately connected with the mains at 79, 80, suitable valves being interposed in the lines to effect the desired control operation.

The four power cylinders brace and support the rotary platform, being widely spaced for this purpose and for the purpose of providing plenty of room for operations in the cellar. The driving motors are concealed within and protected by the platform structure, but are readily removable, as is also the rotary itself. The worm drive from the motors provides an effective gear reduction and is self-locking to hold the table stationary, when desired. The motors preferably are reversible, so that the table may be turned in opposite directions for making up and breaking out. For such operations, a spider may be employed as indicated in Fig. 2, for holding a lower section of pipe, while the upper section is being rotated by the table or by tongs or other tools. The power cylinders may be used simply as hydraulic rams to regulate the drill feed or by anchoring the ram cylinders and operating pistons therein both downward and upward pressure may be applied, or by connecting and controlling the power cylinders in pairs, combinations of upward and downward pressure applying forces may be utilized.

The invention is of broad application and the structure is susceptible of modification, so the claims should be construed accordingly, the language employed being used in a descriptive rather than in a limiting sense, except possibly for limitations required by the state of the prior art.

The contracting socket 68 provided by the brackets 69 at the underside of the table platform is designed to set the slips firmly in holding engagement with the pipe, so as to augment the pipe gripping action effected by the contracting socket 64 of the spider 65. Ordinarily therefore, the weight of the table supporting structure may be sufficient to hold the pipe without applying downward pressure through the power cylinders. By applying a lifting force, the grip of the slips may be either partly or entirely released and by lifting the slips far enough for them to slide downwardly and outwardly in the slots 67, they will open up to pass tool joints or collars or the like, on the drill string. Toothed slips may be used in place of the slips lined with heat resisting braking material shown in Fig. 9.

The frame 24 which ties the four cylinders together provides a stationary platform which may be utilized when required as a stationary support for the spider 65. In such case, the table platform is lifted by the hydraulic cylinders sufficiently to provide the necessary

space beneath the platform to take the spider and its adjuncts. When not required, the spider may be quickly removed and the table support may then lower again down to the level of the derrick floor. The stationary frame or platform 24 is rigidly braced to the four corner posts of the derrick by the turn buckles 26, but is so made up that it can be quickly taken down upon removal of the corner caps 25 which secure the hydraulic cylinders to such frame. The turn buckles serve as a readily adjustable means for bracing and centering the hydraulic assembly. The caps 40, Fig. 4, may be quickly interchanged for the caps 71, Fig. 9 and the stuffing boxes 47a and 47, Figs. 9 and 10 be used, in accordance with various snubbing and holding operations. The four hydraulic cylinders provide a wide, solid foundation for the rotary table base. The use of two or more motors is desirable for the further reasons that they may be of different characteristics, one intended primarily for ordinary drilling operations and the other intended primarily for heavier slower operations, such as the making up and breaking out pipe and suitable clutches may be provided, so that different motors may be cut in or out at will. The motors also may be specially wound so as to give the proper power or torque for ordinary drilling operations and much greater torque with slower rotation for making up and breaking out pipe.

What is claimed is:

1. In combination, hydraulic power cylinders, a supporting head operated thereby, a rotary drilling machine mounted on said head and set in the head with the rotary table of the same above the top of the head and a drive motor for the table set down in the head below the top of the same and connected in driving relation with the table.

2. In well drilling apparatus, the combination of a snubbing head, hydraulic power mechanism for actuating said snubbing head, a holding and braking head independently of said snubbing head, and hydraulic power mechanism for operating said holding and braking head independently of or in conjunction with said snubbing head to enable coordinated holding and snubbing operations on the drill pipe.

3. In well drilling apparatus, the combination of a pair of snubbing cylinders, a pipe snubbing head operated from said cylinders, a pair of holding cylinders operable independently of said snubbing cylinders, a pipe holding head operated from said holding cylinders and positioned to operate on the same line of drill pipe as the snubbing head and means for controlling said snubbing cylinders and holding cylinders to effect coordinated holding and snubbing operations on the drill pipe.

4. In well drilling, the combination of four

power cylinders in quadrangular arrangement, a pipe snubbing head operated from two of the diagonally opposite power cylinders and a pipe holding head operating from the other two diagonally opposite holding cylinders.

5. In well drilling, the combination of four power cylinders in quadrangular relation, a supporting platform, a rotary table mounted on said platform, power means for operating said rotary table mounted on the platform, connections from two of the power cylinders for raising and lowering said platform, a snubbing head, and connections from the other two power cylinders for actuating said snubbing head.

6. In well drilling, the combination of four power cylinders in quadrangular relation, a supporting platform, a rotary table mounted on said platform, power means for operating said rotary table mounted on the platform, connections from two of the power cylinders for raising and lowering said platform, a snubbing head, connections from the other two power cylinders for actuating said snubbing head, a spider, pipe gripping clamps associated with said spider and means carried by the vertically movable platform for operating said pipe holding clamps.

7. In well drilling, a rotary drilling machine, downwardly acting pipe gripping snubbing clamps above and upwardly acting holding and braking pipe gripping clamps below the table of said rotary drilling machine and power devices for separately operating said pipe gripping snubbing clamps above and said holding clamps below the rotary table.

8. In well drilling, a rotary drilling machine, downwardly acting pipe gripping snubbing clamps above and upwardly acting holding and braking pipe gripping clamps below the table of said rotary drilling machine, power devices for separately operating said pipe gripping snubbing clamps above and said holding clamps below the rotary table and including long stroke power cylinders having connections with the clamp above the table for snubbing purposes.

9. In well drilling apparatus, the combination of power cylinders, ram cylinders operable therein, pistons operable in the ram cylinders, means for securing the ram cylinders immovable in the power cylinders, pipe gripping means connected with the pistons and means for controlling flow of power fluid to the pistons operating in the ram cylinders.

10. In well drilling apparatus, the combination of power cylinders, ram cylinders operable therein, pistons operable in the ram cylinders, means for securing the ram cylinders immovable in the power cylinders, pipe gripping means connected with the pistons, means for controlling flow of power fluid to the pistons operating in the ram cylinders,

other power cylinders, pipe holding means and means operating in said other power cylinders and connected to operate said pipe holding means.

11. In well drilling, the combination of power cylinders, ram cylinders in said power cylinders and having tubular projecting studs, a supporting head engaged by said tubular studs, pistons operating in the ram cylinders and having piston rods operating up through the hollow studs of the ram cylinders and a pipe gripping head connected with said piston rods.

12. In well drilling, the combination of four power cylinders in quadrangular relation, rams operating in two of the diagonally opposite power cylinders, a pipe holding head connected with and operated by said rams, ram cylinders in the other two diagonally opposite power cylinders, pistons operating up through said ram cylinders and a pipe snubbing head actuated by said pistons.

13. In well drilling apparatus, the combination of power cylinders, a platform carried by said power cylinders, a rotary table mounted on said platform, a motor for driving said rotary table also mounted on said platform and movable with the rotary table in the operation of the power cylinders, pipe gripping means separate from the rotary table and power cylinders for vertically shifting said separate pipe gripping means independently of movement imparted to the rotary table by the first mentioned power cylinders.

14. In well drilling apparatus, the combination of a vertically movable non-rotating platform, power mechanism for raising and lowering the same, a rotary table mounted on said platform and vertically shiftable therewith, pipe holding means carried by said vertically shiftable table, power means for operating said rotary table mounted on said platform, pipe gripping means beneath said platform and including a stationary holding socket, pipe slips in said socket and bracket means attached to the vertically movable non-rotating platform and connected with the slips for effecting control of the latter by vertical shifting movements of the non-rotating table carrying platform.

15. In well drilling apparatus, the combination of upwardly acting pipe holding and braking clamp means, downwardly acting pipe snubbing clamp means and separate power devices for said snubbing and pipe holding clamp means selectively operable for effecting conjoint pipe snubbing and pipe holding and braking operations.

16. In well drilling apparatus, the combination of a hollow head having supporting shelves at different levels therein, hydraulic power cylinders connected with said hollow head for raising and lowering the same, a rotary machine mounted within the hollow head

on one of said supporting shelves and having a rotary table exposed above the top of the movable platform and a motor for driving the rotary mounted within the hollow head on the other supporting shelf and having driving connections within the hollow head extending to the rotary.

17. In apparatus of the character disclosed, the combination of a rotary machine, including a rotary table, a vertically movable platform having a seat within the same on which said rotary machine is mounted with the table approximately at the level of the top of the platform, a second seat within the platform, a driving motor disposed within the platform and mounted on said second seat, drive connections within the platform extending from said motor to that part of the rotary machine within the platform and hydraulic power cylinders connected with said platform for raising and lowering the same as a complete self-contained rotary and power unit.

18. In apparatus of the character disclosed, the combination of a rotary machine, including a rotary table, a vertically movable platform having a seat within the same on which said rotary machine is mounted with the table approximately at the level of the top of the platform, a second seat within the platform, a driving motor disposed within the platform and mounted on said second seat, drive connections within the platform extending from said motor to that part of the rotary machine within the platform and hydraulic power cylinders connected with said platform for raising and lowering the same as a complete self-contained rotary and power unit, a relatively stationary platform beneath said movable platform and cooperating pipe gripping clamp means between said relatively stationary and movable platforms and controlled thereby.

19. In apparatus of the character disclosed, the combination of power cylinders, a base supporting the lower ends of the cylinders in definitely spaced relation, a frame for supporting the upper ends of the cylinders in correspondingly spaced relation and comprising a central frame structure socketed to receive the cylinders and having removable caps cooperating with the sockets to secure the cylinders therein, turn buckle mechanism connected with said upper spacing frame for effecting and maintaining alignment of the cylinders, a vertically movable head connected with the power cylinders and a rotary machine carried by said vertically movable head.

20. In apparatus of the character disclosed, the combination of power cylinders, a base supporting the lower ends of the cylinders in definitely spaced relation, a frame for supporting the upper ends of the cylinders in correspondingly spaced relation and com-

prising a central frame structure socketed to receive the cylinders and having removable caps cooperating with the sockets to secure the cylinders therein, turn buckle mechanism 5 connected with said upper spacing frame for effecting and maintaining alignment of the cylinders, a vertically movable head connected with the power cylinders, a rotary machine carried by said vertically movable 10 head, and a driving motor for the rotary machine mounted in the vertically movable head and connected in driving relation with the rotary machine.

15 In testimony whereof I affix my signature.
WALDO SHELDON.

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