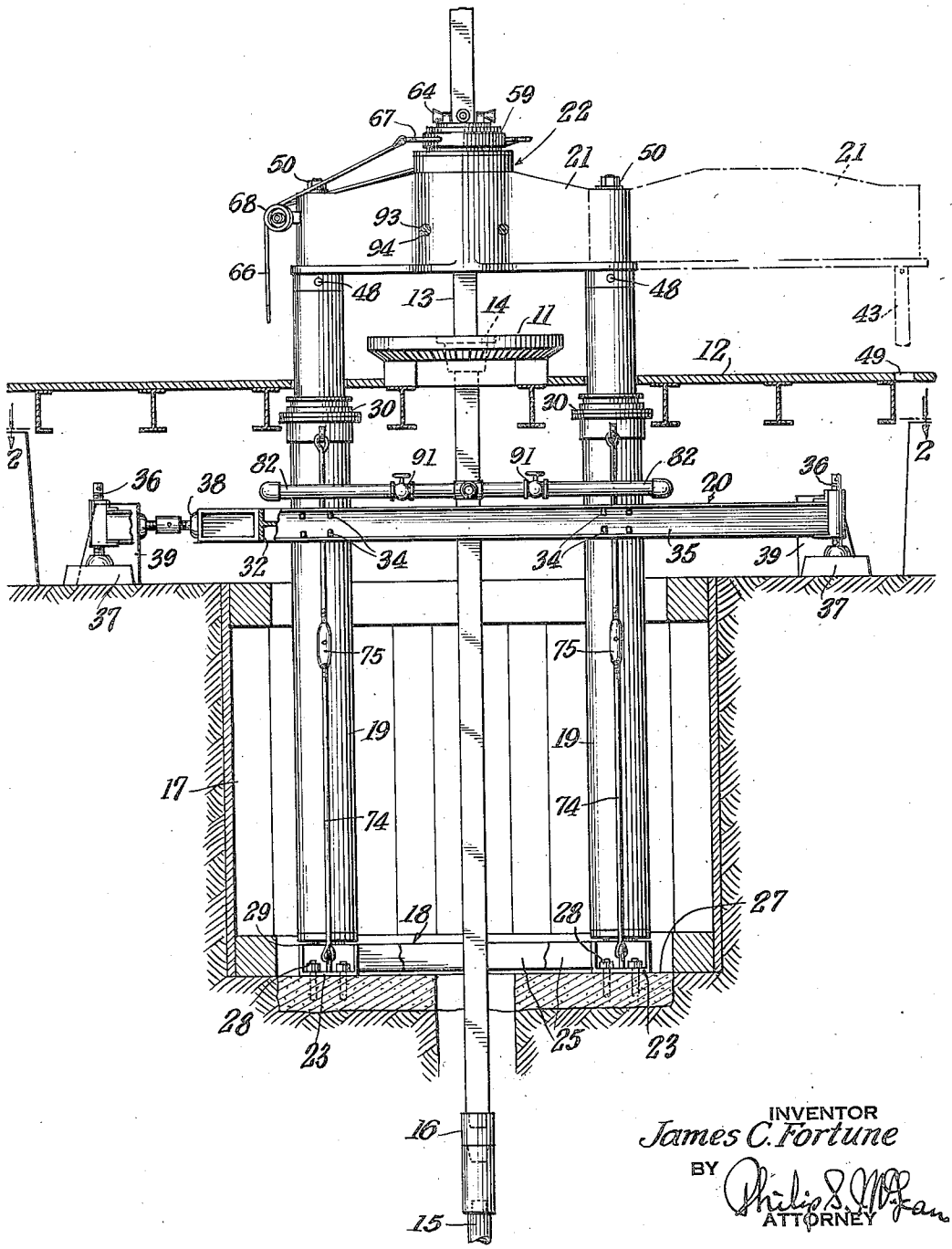
Sept. 27, 1932. J. C. FORTUNE 1,879,929

HYDRAULIC FEED FOR ROTARY DRILLING

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Fig. 1.



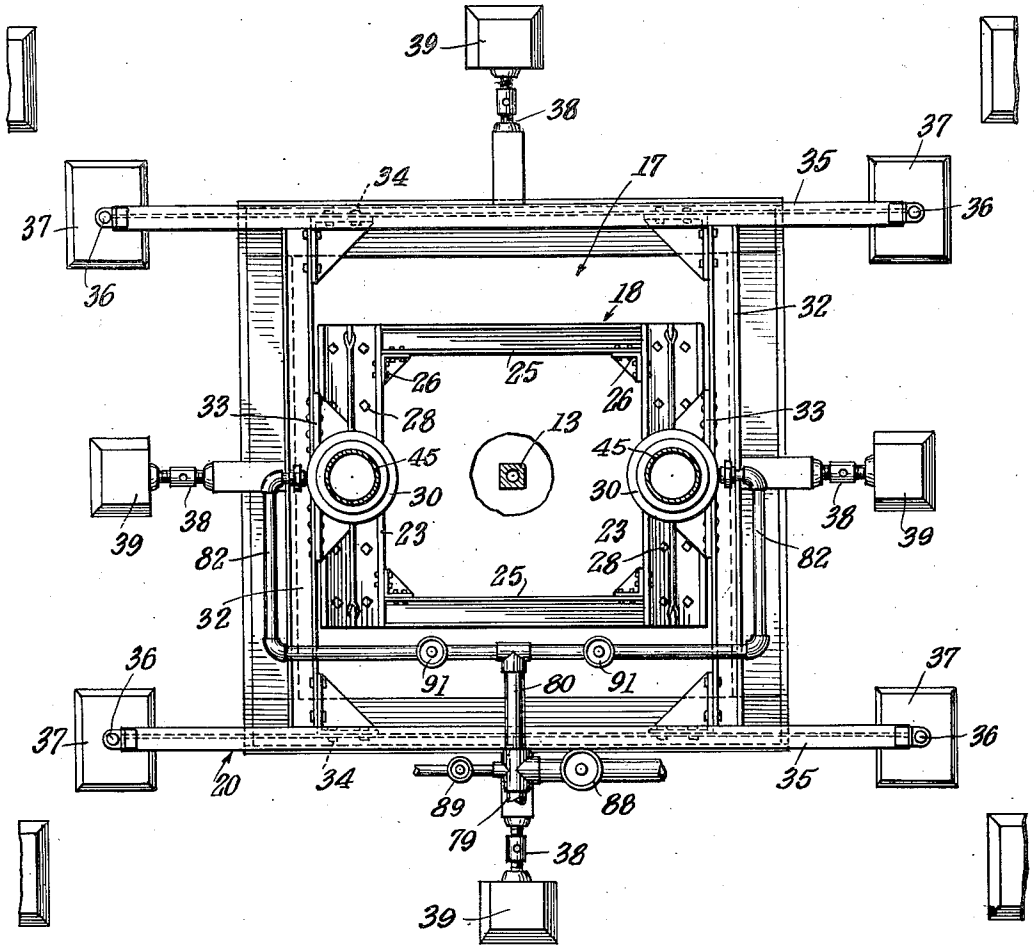
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HYDRAULIC FEED FOR ROTARY DRILLING

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Fig. 2.



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HYDRAULIC FEED FOR ROTARY DRILLING

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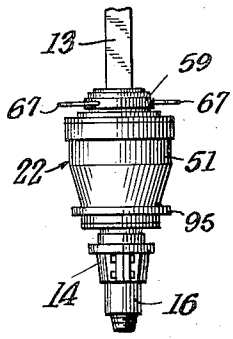
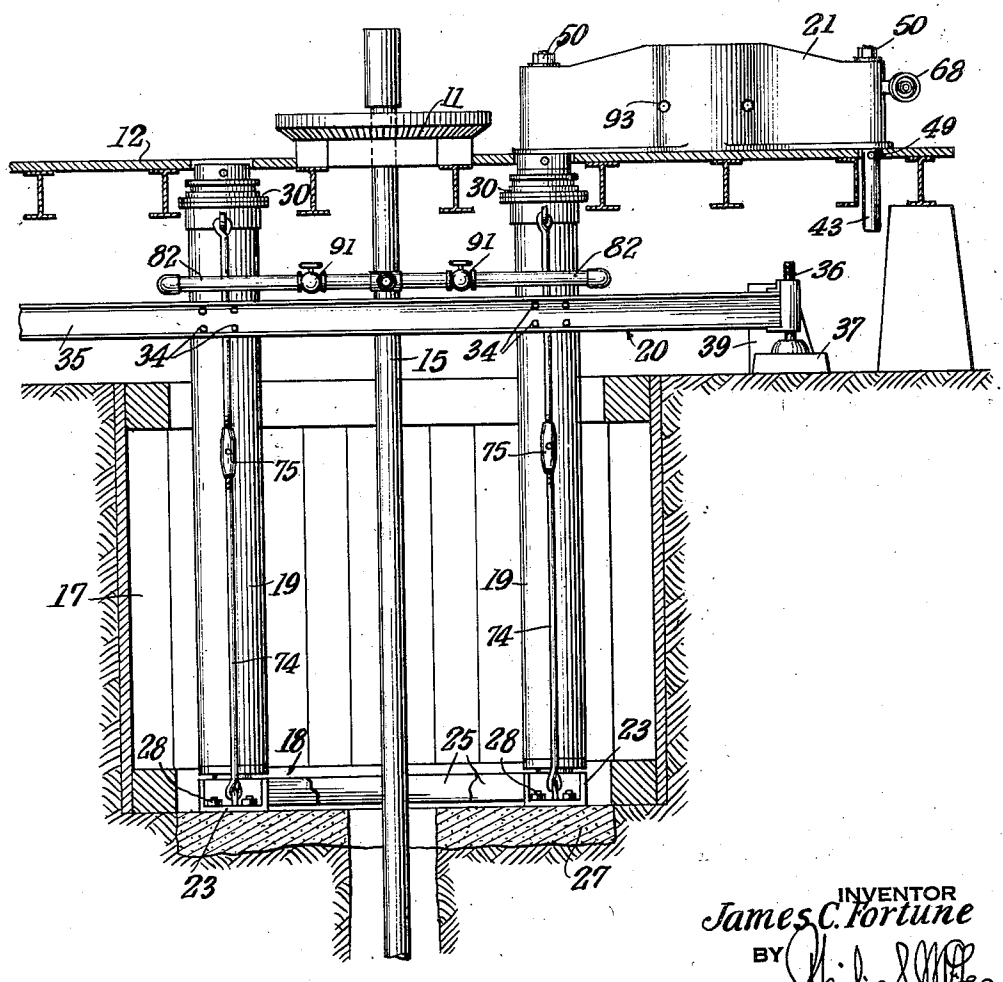


Fig. 3.



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HYDRAULIC FEED FOR ROTARY DRILLING

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Fig. 4.

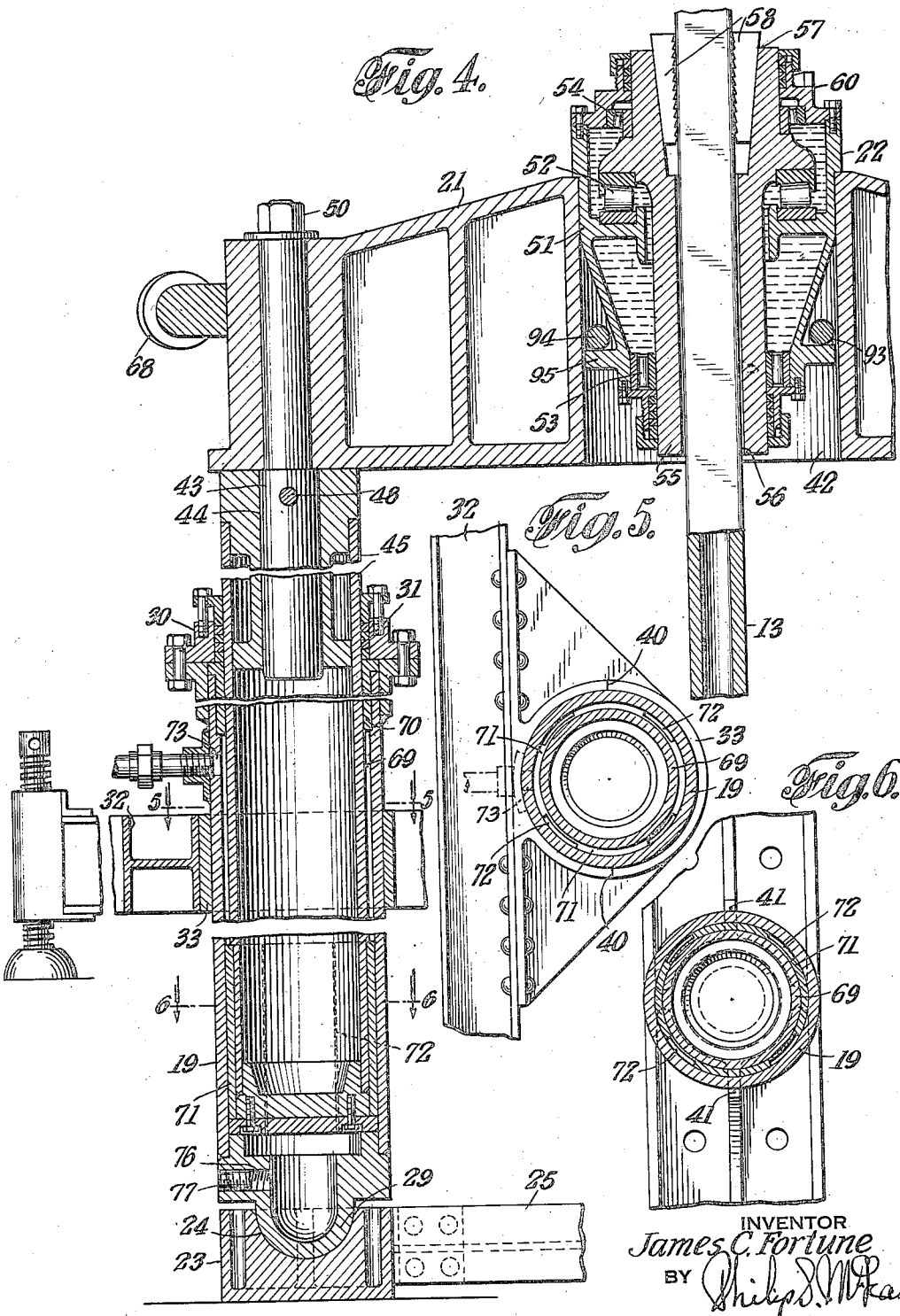


Fig. 5.

Fig. 6.

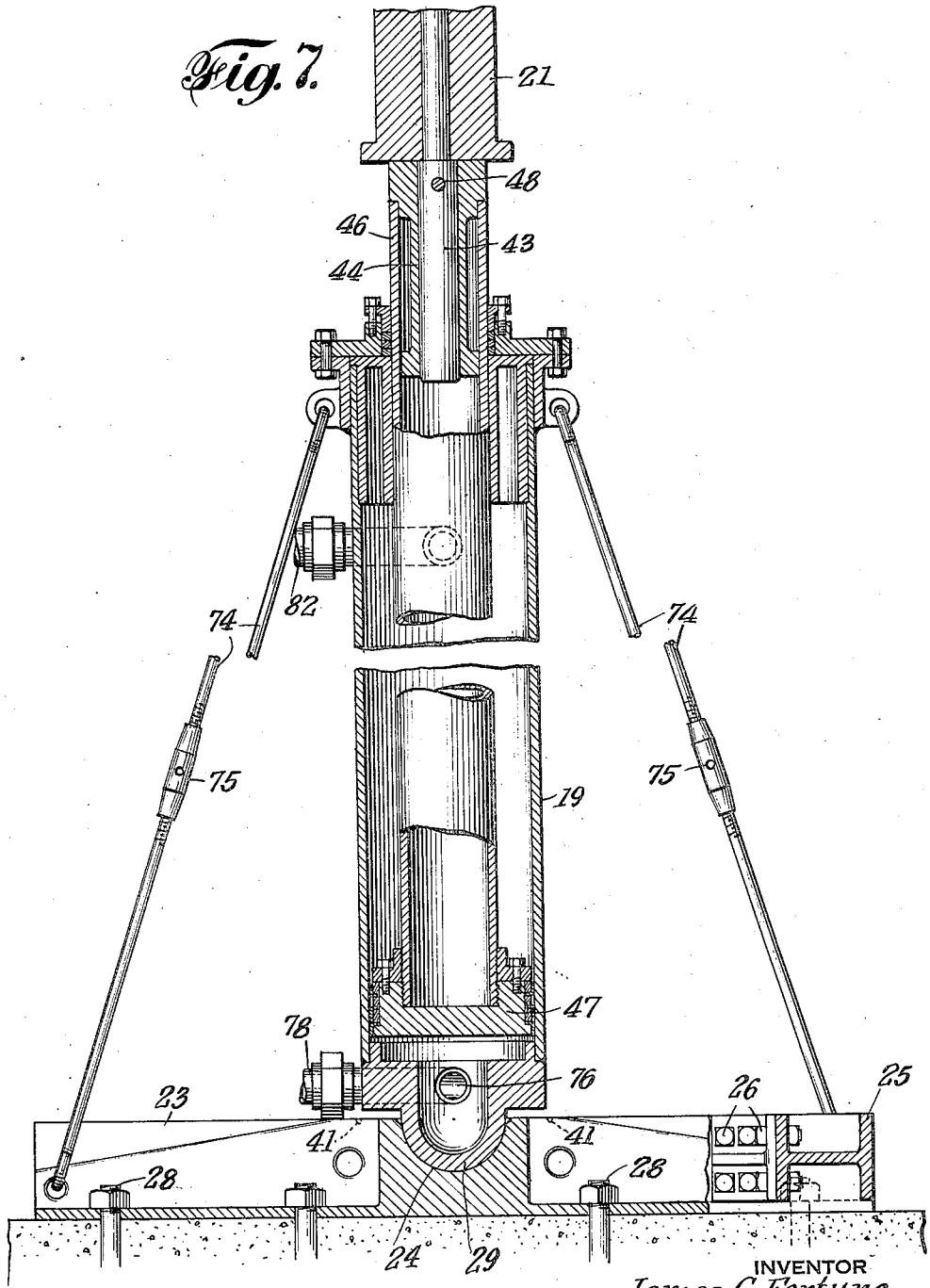
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HYDRAULIC FEED FOR ROTARY DRILLING

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Fig. 7.



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HYDRAULIC FEED FOR ROTARY DRILLING

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Fig. 8.

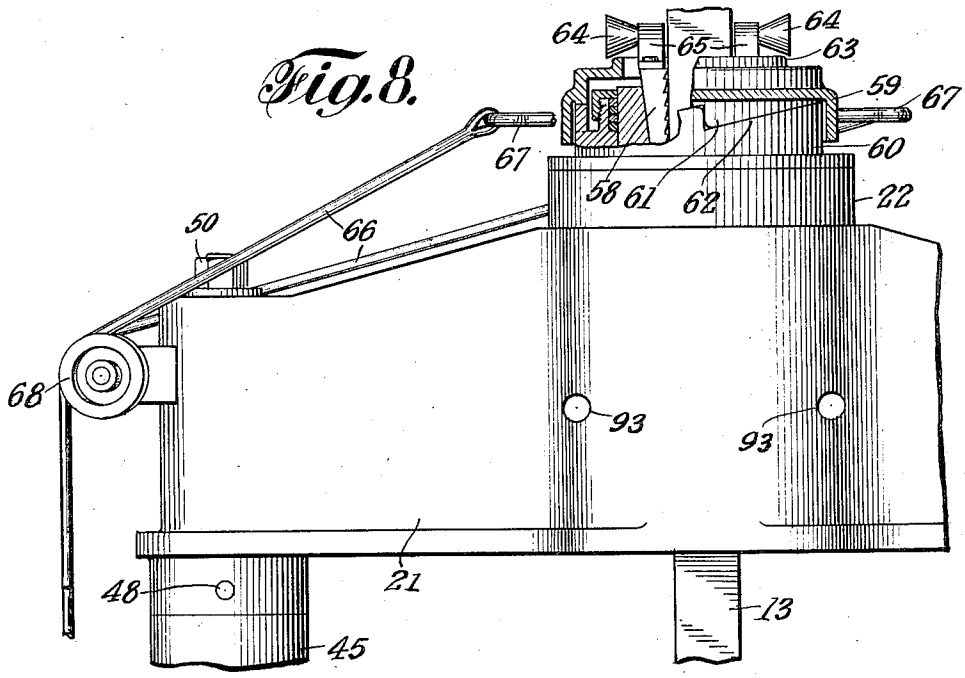


Fig. 9.

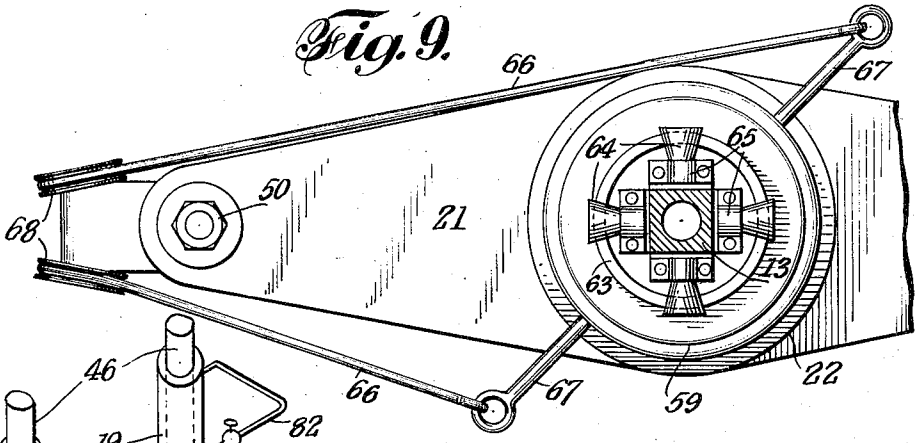
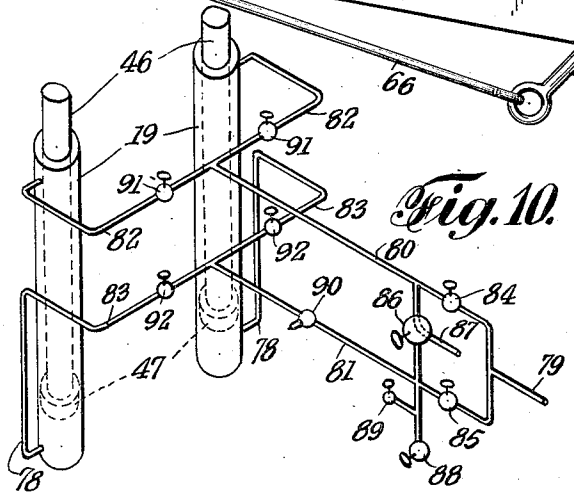


Fig. 10.



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Patented Sept. 27, 1932

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UNITED STATES PATENT OFFICE

JAMES C. FORTUNE, OF MONTEREY, CALIFORNIA

HYDRAULIC FEED FOR ROTARY DRILLING

Application filed November 7, 1931. Serial No. 573,663.

Hydraulic feed mechanisms as heretofore designed have been subject to certain objections, particularly as requiring special and relatively complicated forms of rotaries which take up too much room about the derrick and under the derrick floor and hence interfere with required drilling operations; a large portion of the torque load has had to be carried by the hydraulic, interfering with the stability of the apparatus; special heavy foundations have been required; the feed stroke has been of such limited extent as to seriously impair the utility of the device, particularly for rapid drilling in the softer formations; the opening through the hydraulic for passing casing and the like either had to be reduced or an excessively large overall diameter bearing was required making the overall diameter of the machine objectionably large; and the hydraulic structure interfered with the placing of Christmas tree connections, blow-out preventers, mud returns, flow pipes, etc., making it impossible to use such fittings below the derrick floor unless the entire derrick structure was additionally raised.

The general objects of this invention are to overcome and eliminate the objections and limitations present in prior apparatus and particularly to provide a hydraulic feed which will not take up useful space or interfere with the usual drilling operations; will be free of driving torque; which will give the desired long stroke operation; which can be readily applied and used with any ordinary rotary drilling equipment, without requiring special heavy foundations and which with all these advantages will be comparatively simple, inexpensive and entirely practical.

Special features of the invention by which the foregoing and other objects are attained include the supporting and suspension of the drill pipe free of any driving torque and involves the construction of the apparatus in the form of readily separable and more or less independent units, which can be set up in the cellar of the rig entirely independently of the rotary and of the derrick rig and which are readily removable to enable full and unrestricted use of the rotary and accessory equipment.

Other novel features of 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 as these are primarily for purposes of disclosure, it will be understood that the actual structure may be modified and changed as regards this disclosure, all within the true intent and broad scope of the invention.

Fig. 1 is a side elevation of the apparatus as applied to and in use with existing rotary equipment, with portions of the derrick and cellar structure indicated broken and in section.

Fig. 2 is a broken part sectional and plan view as on substantially the plane of line 2—2 of Fig. 1.

Fig. 3 is a view generally similar to Fig. 1, illustrating the yoke as detached from one of the rams, swung to one side clear of the table and the kelly with the bearing support for the same as lifted out clear of the yoke.

Fig. 4 is a broken part sectional view illustrating details of the ram, yoke and bearing structure.

Figs. 5 and 6 are cross-sectional views as on substantially lines 5—5 and 6—6 of Fig. 4, illustrating the passes for the motive fluid about the ram.

Fig. 7 is a broken vertical sectional view illustrating the substitution of the ram by a piston for exerting a downward pull, as for snubbing-in, or the like.

Figs. 8 and 9 are broken part sectional side and top plan views respectively, illustrating the remote control means for releasing the slips when the yoke is in elevated position.

Fig. 10 is a somewhat diagrammatic view illustrating the piping and control valves for the hydraulic cylinders.

In Fig. 1, a rotary of conventional design is illustrated at 11, mounted on the derrick floor 12 and driving a square kelly 13 through a standard drive bushing 14. The drill pipe is indicated at 15, connected with the kelly by a suitable tool joint at 16. The cellar of

the rig is indicated at 17 of conventional design and size to allow for placing of valves and fittings necessary to complete the well.

The new hydraulic consists in the main of five units, a base unit designated 18, mounted on the floor of the cellar and serving as a positioning and supporting means for the hydraulic cylinders 19, constituting the second unit; a positioning frame 20 for the upper portions of the hydraulic cylinders, forming the third unit; the yoke 21 carried by the rams or pistons of the cylinders and forming the fourth unit; and a bearing 22 for supporting the pipe, removably mounted in the yoke, forming the fifth unit.

The base unit 18 is shown in the form of a rectangular frame comprising bars 23, carrying intermediate bearing steps or ball sockets 24 and secured in spaced parallel relation by spacer bars 25, removably bolted to the bearing bars at 26. This frame is usually bolted down to a suitable concrete base or pad 27, provided on the floor of the cellar, as by means of anchor bolts engaged at 28 with the bearing bars at opposite sides of the ball sockets, Figs. 1, 2, 4 and 7. This readily detachable construction enables the base frame to be easily assembled in the cellar or at any time to be taken apart and removed from the cellar, regardless of well head connections extending up through or passing out of the cellar.

The cylinders 19, of which there may be two, three, four or more, are equipped at their lower ends with ball members 29 to seat in the sockets and at their upper ends with heads 30 carrying the packings 31. Externally the cylinders are of flush construction, so that they may be lowered through guides in the guide frame into seated relation in the sockets or bottom supports.

The guide unit 20 consists in the present illustration of a knock-down frame structure made up of bars 32, Fig. 2, carrying circular guides 33 for the cylinders and secured in spaced parallel relation by being bolted at their ends at 34 to the parallel connecting bars 35. The latter are indicated as equipped at their ends with screw jacks 36, adapted for engagement with pads or supports 37 at the sides of the cellar and serving when adjusted to raise, lower or level the guide frame.

To aid in centering the guide frame with respect to the center of the well and to hold it in centered relation, radially acting screw jacks 38 may be provided as shown in Fig. 2, engaged with abutments 39 and thrusting against different sides of the frame.

Under ordinary circumstances, the base frame is first set up and centered to the well and then the guide frame, after assembly is centered with respect to the base frame. For convenience in performing this latter operation, the guides 33 for the cylinders may carry plumb line markings 40 at opposite sides, Fig. 5, and the base sockets may carry corresponding centering marks 41, Fig. 6, for the plumb bobs.

After setting the base frame and guide frame in properly centered relation, the cylinders may be mounted by simply lowering them down through the guides 33 into engagement with the sockets of the base. If necessary, to provide clearance for flow lines or the like, the guide frames may be bodily raised or lowered as required, by means of the lifting jacks at the four corners of the same and this vertical adjustment can be effected without disturbing the vertical alignment. The guide frame can thus be vertically adjusted entirely independently of the base to suit special conditions of the cellar, flow lines, etc.

In the case of a two cylinder hydraulic, such as here shown, the cylinders are placed at diametrically opposite sides of the well and the yoke 21 in such a construction is simply a straight bar member enlarged at the center for a bore 42, to receive the pipe supporting bearing and of a size equal to the bore of the rotary table, so as to be capable of passing the largest size casing or tools which the table will pass.

An important special feature is the manner in which the yoke is connected with the rams or pistons operating in the cylinders. As shown particularly in Figs. 1, 3 and 4. This connection is effected by relatively long pins or studs 43, in the ends of the yoke which enter in sockets 44 in the upper ends of the rams 45, Figs. 1, 3 and 4, or in the upper ends of the rods 46 of pistons 47, when the latter are used, as in Fig. 7. These pins serve the purpose of accurately centering and rigidly holding the upper ends of the cylinders.

By the arrangement disclosed, the cylinders are accurately located at the bottom by means of the sockets in the base frame and they are accurately positioned at the top by means of the long connecting pins depending from the ends of the yoke. In addition, the cylinders are centered intermediate the top and bottom by the guide frame. Consequently, they are set up in alignment and are braced and retained in such alignment.

The pins of the yoke are releasably secured in the sockets of the rams or piston rods by cross pins or keys 48, which when withdrawn permit the yoke to be disconnected from one or both cylinders as indicated in dotted lines in Fig. 1 and in full lines in Fig. 3. In the latter view, the yoke has been disconnected from the left hand cylinder and, after being swung to one side has been lowered to rest on the derrick floor with the disconnected pin 43 extending into a socket or through an opening in the derrick floor at 49. The pins further are shown as readily removable from the yoke, as for transportation purposes and the like, upon removal of nuts 50, securing the

pins in their long sockets in the ends of the yoke.

The supporting bearing 22 for the drill pipe seats down in the bore 42 of the yoke as shown in Fig. 4 and is constructed to carry radial as well as thrust loads, so as to accurately center the pipe over the table, as well as to carry up and down thrust loads. In the illustration, this combination bearing is shown as an elongated casing 51, seating down in the yoke and carrying intermediate its ends a thrust bearing 52 for supporting the full load of the drill pipe or casing, a radial bearing 53 at the lower end and a combined radial and thrust bearing 54 at the upper end, these three bearings cooperating with and supporting the sleeve or bushing 55. This bushing is constructed with a bore to fit or cooperate with the grief stem or pipe and accordingly is shown in the present instance, as having a rectangular bore 56 to cooperate with the square grief stem. At its upper end, the bushing is constructed with a socket 57 to receive the slips 58, which are designed to engage and grip the shape of stem or pipe in use.

To enable quick release of the slips when the yoke is at some height above the table, the special means illustrated in Figs. 1, 8 and 9 may be used, the same consisting of a collar 59 swivelled on the neck 60 of the supporting bearing and having a cam portion or portions 61, riding on the stationary cams or inclines 62, said collar having at its upper end a rim or track 63 for engaging and lifting the conical rolls 64 outstanding from the upper ends of the slips. These rolls are shown in Figs. 8 and 9 as carried by special brackets 65 bolted on the upper ends of the slips. The slip raising ring or collar is shown as rotated by means of pull cables 66 connected with arms 67 outstanding from opposite sides of the collar and extending down over guide pulleys 68 on the yoke to a position for convenient operation by the driller.

In the usual cycle of operations, as the hydraulic approaches the lower end of its stroke, the full weight of the hanging pipe is transferred to the hydraulic swivel hanging from the travelling block and the hydraulic is then lowered a further stage, so as to release the slips from holding engagement with the pipe or grief stem. The cam ring is then turned to bring the track at the upper end of the same into supporting engagement with the rolls on the slips, which because of their conical shape lift the slips and slide them outwardly entirely free of holding engagement with the kelly. With the slips held in this fully released condition, the yoke of the hydraulic is elevated and at or about the top of its stroke the cam ring is turned back to drop the slips into position for holding engagement with the kelly. The hydraulic then takes hold again when the weight of the drill string is transferred back to the hydraulic.

The rams and cylinders are of special construction, as will be clear from Figs. 4, 5 and 6, which show the rams as of less diameter than the cylinders to provide the annular water spaces 69, as guided in the tops of the cylinders by bearing bushings 70 and as carrying at the lower ends, bushings 71 sliding in the cylinders and grooved down the sides at 72 to pass the water beneath the heads of the rams. In assembling, the parts are so located that a solid or full diameter portion of the ram bushing 71 will line up with the inlet port 73 in the side of the cylinder near the upper end of the same, so as to act as a "cut-off" for automatically closing the inlet port as the ram reaches or approaches the upper end of its stroke. In the illustration, the guide bushing 70 at the upper end of the cylinder serves as a stop for engagement by the guide bushing on the ram to limit the travel of the ram and the automatic cut-off described prevents injury such as might result from the ram being thrown up against the guide and stop bushing of the cylinder.

The automatic cut-off feature is particularly important for quick return stroke of the hydraulic, since it enables the hydraulic to be returned to the top of its stroke at full speed, without loss of time to slow down the ram toward the end of the stroke, the ram itself through this automatic cut-off shutting off power at the proper instant, after using full power for practically the full length of the stroke.

For snubbing operations and the like, where downward pull is required, pistons 47 as in Fig. 7 may be used in place of the rams and in such case, the cylinders may be anchored down to the base as by stays 74, which may be equipped with turn-buckles 75. The ball castings forming the lower ends of the cylinders are shown as ported in the sides at 76, which ports when not in service, as in Fig. 4, may be closed by plugs 77 and which may be used, when the plugs are removed, for the connection of piping thereto as indicated at 78 in Fig. 7.

In Fig. 10, flow connections are illustrated for effecting the desired control and operation of the hydraulic, using the pistons for exerting either upward or downward thrust. In this view, the feed line from the pump or other source of fluid supply is indicated at 79. This line is branched at 80, 81, for top and bottom connections and the latter are in turn branched at 82, 83, for connection with the individual cylinders. Shut off valves 84, 85, are shown provided in the top and bottom branches and a three-way valve is shown at 86, connected across these branches and serving in conjunction with an exhaust line 87, to relieve pressure or vent either the

tops or the bottoms of the cylinders. A main or rapid bleed valve is indicated at 88, connected with the bottom line of the cylinders and in the same branch with this main or rapid bleed, there is shown a smaller relief valve 89, operable to serve as a slow leak or bleed for effecting a more accurate or slower feed of the hydraulic. A pressure relief valve 90 is shown provided in the lower line 81, which can be set to release a dangerous excess of pressure, such as might be occasioned by a dropping and then catching of the drill string. Also the cylinders may be segregated one from the other by individual shut-off valves for the two cylinders, as shown at 91 and 92 in the upper and lower branches 82, 83, leading to the cylinders. These segregating valves are employed when the cylinders require independent control as for operation such as indicated in Figs. 1 and 3, where, after lifting the kelly and supporting bushing out of the yoke and pulling the key 48 connecting the yoke pin with the left hand ram, pressure is released from the left hand cylinder to drop the ram away from the yoke pin and the yoke is then swung off to one side of the table as indicated in dotted lines, Fig. 1, and the right hand ram is then lowered to bring the yoke down into supported position on the derrick floor clear of the rotary. If desired, the yoke may be lifted off clear of both rams and placed elsewhere, or be entirely removed from the derrick.

The bore through the yoke for the supporting bearing is shown as intercepted by transverse passages 93, Fig. 4, to receive keys or pins 94, overstanding the annular flange 95 on the case of the supporting bearing for locking the bearing down in the yoke.

In the simplest form of the invention, two cylinders are employed and this is a particularly desirable form from the standpoint of simplicity and because of the clearance allowed in the cellar beneath the rotary, this clear space as shown in Figs. 1, 2 and 3 being greater than the overall diameter of the rotary. If greater space is required, one or both of the cylinders may be lifted out, leaving the base frame and guide frame in position to receive the cylinder or cylinders when hydraulic feed operations are resumed. For greater lifting power three, four, or more cylinders may be employed, so as to gain the greatest lifting power without increasing the water pressure.

This invention, it will be seen, makes it possible to combine the advantages of hydraulic feed with a rotary drill, without modifying the rotary and without interfering with or restricting the use of the rotary and various accessories. The base is made in parts which can be assembled piece by piece, on the floor of the cellar, irrespective of whether the rotary, and the casing and fittings are in place. In the same fashion the guide frame may be put together and quickly centered over the base frame irrespective of whether flow lines and other parts of the rig are in position. After locating and lining up the parts, the cylinders can be lowered down through the guides into supported position on the base. The ball and socket mountings enable a certain amount of self-adjustment of the cylinders, for the base to be slightly off the horizontal. When the yoke is lowered down over the cylinders and the pins of the yoke entered in the rams or piston rods, the entire structure becomes rigidly braced and tied together in proper alignment. The supporting bearing, mounted as it is in the bore of the yoke is definitely and accurately centered over the well but may be quickly removed if occasion requires. When this bearing is lifted out, casing or tools of the largest diameter which will pass through the table may be lowered or pulled up through the yoke. The pressure relief valve saves the hydraulic from injury in the event of dropping the pipe and the automatic shut off enables full speed quick return of the hydraulic. The long stroke cylinders enable a long feeding action without change, permitting fast work in soft and caving formations. The cylinders preferably are of the same size and interchangeable for two, three or more cylinder hydraulics and they may be individually controlled for dropping the rams away from the yoke or the like. In lowered position they stand below the derrick floor and so do not interfere with operations about the rotary. At any time before or after completion of the well, the hydraulic may be taken down and removed without disturbing the rotary, valves or flow lines, etc. Of particular importance is the fact that the hydraulic simply carries the weight of the drill string, free of any torque, other than the "drag" in the supporting bearing and the rotary is left free to impart the turning force independently of and without any load from the hydraulic. Furthermore, the parts are all of simple sturdy design.

By mounting the coupling pins on the yoke and the sockets for the same in the rams, the rams are left without any projecting parts when the yoke is removed and consequently the rams may be used for the full stroke right up to the derrick floor and still occupy a position below the derrick floor when the yoke is removed. The guide frame, if desired, may be jacked up to exert a lifting effect on the hydraulic cylinders, for example, in the illustration Fig. 4, by engagement with shoulders on the otherwise flush cylinders, such as the shoulders provided by the top flanges of the cylinders or the flanges of the bosses to which the water connections are made. In this way, the guide frame may be made to bear a part of the load of the hydraulics, so

as to in effect widen the base and thus distribute the load over a wider area.

The invention is of broad scope, so the terms employed herein have been used in a descriptive rather than in a limiting sense, except possibly for such limitations as may be imposed by the state of the prior art.

What is claimed is:

1. Hydraulic feed mechanism for rotary drilling, comprising a base in separable sections adapted for mounting on a cellar floor, a guide frame in separable sections adapted for mounting above the base and provided with guides for hydraulic cylinders, hydraulic cylinders adapted to be lowered through said guides into supported position on the base, a yoke detachably mounted on the hydraulic cylinders and provided with a bore to register with the center of the well and a bearing for supporting the drill string removably mounted in said bore in the yoke.

2. Hydraulic feed mechanism for rotary drilling, comprising a base in separable sections connectible laterally about a drill stem and thereby adapted for assembly on a cellar floor about a drill string already in position and extending down through said cellar, a guide frame in separable sections connectible laterally about a previously located drill string and adapted for mounting above and independently of the base and provided with guides, hydraulic cylinders supported on the base and held in alignment by said guides, means for effecting lateral shifting of said guides and independently of the base for setting the cylinders vertical on the base, ram elements operating in the cylinders and a yoke detachably mounted on said ram elements and provided with a bearing for supporting a drill string.

3. Hydraulic feed mechanism for rotary drilling, comprising a base in separable sections adapted for assembly on a cellar floor, a guide frame in separable sections adapted for mounting above and independently of the base and provided with guides, hydraulic cylinders supported on the base and held in alignment by said guides, ram elements operating in the cylinders and a yoke detachably mounted on said ram elements and provided with a bearing for supporting a drill string, said ram elements having elongated sockets and the yoke having long dependent pins detachably engageable in said sockets.

4. In combination with a rotary for imparting rotation to a drill string, a bearing for supporting the drill string, a yoke carrying said bearing and extending across the rotary, long stroke hydraulic rams supporting the ends of said yoke, a guide frame positioning and supporting the upper portions of said hydraulic rams below the rotary and independent of the rotary structure, a base below the rotary, independent of the guide frame and the rotary structure, said base having seats on which the hydraulic rams are removably and pivotally supported and means for variously adjusting the guide frame to rock the hydraulic rams on the base for vertically aligning the rams.

5. In combination with a rotary for imparting rotation to a drill string, a bearing for supporting the drill string, a yoke carrying said bearing and extending across the rotary, long stroke hydraulic rams supporting the ends of said yoke, a guide frame positioning and supporting the upper portions of said hydraulic rams below the rotary and independent of the rotary structure, a base independent of the guide frame and the rotary structure, said base having seats on which the hydraulic rams are removably supported, said seats and the ends of the hydraulic rams having the companion elements of ball and socket joints and means for shifting said guide frame to rock the rams on said ball and socket joints into positions of vertical alignment.

6. In combination with a rotary for imparting rotation to a drill string, a bearing for supporting the drill string, a yoke carrying said bearing and extending across the rotary, long stroke hydraulic rams supporting the ends of said yoke, a guide frame positioning and supporting the upper portions of said hydraulic rams below the rotary and independent of the rotary structure, a base independent of the guide frame and the rotary structure, said base having seats on which the hydraulic rams are removably supported and means for adjustably positioning and securing the guide frame independently of the base frame.

7. In combination with a rotary for imparting rotation to a drill string, a bearing for supporting the drill string, a yoke carrying said bearing and extending across the rotary, long stroke hydraulic rams supporting the ends of said yoke, a guide frame positioning and supporting the upper portions of said hydraulic rams below the rotary and independent of the rotary structure, a base independent of the guide frame and the rotary structure, said base having seats on which the hydraulic rams are removably supported, indicating means for assisting in the centering of the guide frame over the base and means for adjusting and securing the guide frame in centered relation over the base.

8. In combination with a rotary for imparting rotation to a drill string, a bearing for supporting the drill string, a yoke carrying said bearing and extending across the rotary, long stroke hydraulic rams supporting the ends of said yoke, a guide frame positioning and supporting the upper portions of said hydraulic rams below the rotary and independent of the rotary structure, a base independent of the guide frame

and the rotary structure, said base having seats on which the hydraulic rams are removably supported and means for raising and lowering the guide frame independently of the base and the rotary structure.

9. In combination with the rotary of a drilling rig, said rig including a cellar below the rotary, a base frame mounted on the floor of said cellar independently of the rotary structure, a guide frame below the rotary and mounted independently of the base and independently of the rotary structure, guides carried by said guide frame below the rotary table, hydraulic cylinders adapted to be lowered down through said guides into supported relation on the base and adapted to be independently removed from such guided and supported positions, ram elements operating in the cylinders, a yoke removably mounted on said ram elements and extending across the top of the rotary, a bearing casing removably seated in said yoke, a rotatable bushing provided with a grief stem passage, and with a clamping socket, grief stem engaging slips seating in said socket and combination thrust and radial bearings mounting said grief stem bushing in said removable bearing casing.

10. In combination with the rotary of a drilling rig, said rig including a cellar below the rotary, a base frame mounted on the floor of said cellar independently of the rotary structure, a guide frame below the rotary and mounted independently of the base and independently of the rotary structure, guides carried by said guide frame below the rotary table, hydraulic cylinders adapted to be lowered down through said guides into supported relation on the base and adapted to be independently removed from such guided and supported positions, ram elements operating in the cylinders, a yoke removably mounted on said ram elements and extending across the top of the rotary, a bearing casing removably seated in said yoke, a rotatable bushing provided with a grief stem passage, and with a clamping socket, grief stem engaging slips seating in said socket and combination thrust and radial bearings mounting said grief stem bushing in said removable bearing casing, the ram elements having long sockets in the upper ends of the same and the yoke carrying long pins seating in said sockets and transverse fastenings for removably securing said pins in said sockets.

11. In combination with the rotary of a drilling rig, said rig including a cellar below the rotary, a base frame mounted on the floor of said cellar independently of the rotary structure, a guide frame below the rotary and mounted independently of the base and independently of the rotary structure, guides carried by said guide frame below the rotary table, hydraulic cylinders adapted to be lowered down through said guides into supported relation on the base and adapted to be independently removed from such guided and supported positions, ram elements operating in the cylinders, a yoke removably mounted on said ram elements and extending across the top of the rotary, a bearing casing removably seated in said yoke, a rotatable bushing provided with a grief stem passage, and with a clamping socket, grief stem engaging slips seating in said socket and combination thrust and radial bearings mounted said grief stem bushing in said removable bearing casing, said combination bearings being constructed to carry vertical thrust in both directions, and means for removably securing the bearing casing to resist vertical thrust in both directions.

12. Hydraulic feed mechanism for rotary drilling comprising in combination long stroke hydraulic rams consisting of cylinders with ram elements operating therein, a base frame consisting of separably connected parts carrying seats for the lower ends of the cylinders, a guide frame consisting of separably connected parts carrying guides for the cylinders and provided with means for raising and lowering and supporting the guide frames independently of the base frame, a yoke provided with a large diameter bore therethrough, long pin and socket detachable couplings between the ram elements and the ends of the yoke and a bearing unit removably mounted in the bore of the yoke and consisting of a grief stem gripping bushing and combination thrust and radial bearings supporting said bushing.

13. Hydraulic feed mechanism for rotary drilling, comprising in combination, a base, hydraulic cylinders mounted on said base, a guide frame for positioning and supporting the upper portions of said hydraulic cylinders, means for vertically adjusting said guide frame with respect to the base, ram elements operating in said cylinders, a yoke carried by said ram elements and a bearing for supporting drill pipe, carried by said yoke.

14. Hydraulic feed mechanism for rotary drilling, comprising in combination, cooperating power cylinder and piston members, said piston members having deep sockets in the upper ends of the same, means for supporting the cylinder members in spaced vertical relation, a yoke for bridging the space between the cylinders, said yoke having long dependent pins at the ends of the same to enter the sockets in the upper ends of the piston members and whereby said yoke is reliably but releasably mounted on the piston members and whereby the removal of the yoke will leave the piston members without projecting parts at the upper ends of the same and pipe supporting means carried by said yoke.

15. Hydraulic feed mechanism for rotary

drilling, comprising in combination, cooperating power cylinder and piston members, said piston members having deep sockets in the upper ends of the same, means for supporting the cylinder members in spaced vertical relation, a yoke for bridging the space between the cylinders, said yoke having long dependent pins at the ends of the same to enter the sockets in the upper ends of the piston members and whereby said yoke is reliably but releasably mounted on the piston members and whereby the removal of the yoke will leave the piston members without projecting parts at the upper ends of the same, pipe supporting means carried by said yoke, means for releasably securing the pins of the yoke in the sockets of the piston members and means for independently controlling flow of pressure fluid to and from the cylinder members for enabling, when the pin securing means are released, the lowering away of the piston member from one end of the yoke to thereby leave the yoke pivotally hung by the pin at the other end of the yoke on the other piston member and free to be swung clear of the first piston member.

16. In combination with a rotary for imparting rotation to a drill string, a bearing for supporting the drill string, a yoke carrying said bearing and extending across the rotary, long stroke hydraulic power cylinders supporting the ends of said yoke, a guide frame positioning and supporting the upper portions of said hydraulic power cylinders below the rotary and independently of the rotary structure, a base frame independent of the guide frame and the rotary structure, said base having seats on which the hydraulic power cylinders are removably and adjustably supported and jacks for adjustably positioning and securing the guide frame independently of the base frame.

17. In combination with a rotary, hydraulic feed mechanism for said rotary, comprising a base below the rotary, hydraulic power cylinders resting on said base, said cylinders and base having companion ball and socket members, whereby said power cylinders are rockably supported on the base, guides for the upper portions of the power cylinders, a yoke connected with the power cylinders and extending across the rotary, a drill string rotated by the rotary, a bearing for supporting said drill string carried by the yoke and means for shifting said guides laterally to line up the power cylinders on the base in proper working relation to the rotary and the drill string.

18. In combination with a rotary, hydraulic feed mechanism for said rotary, comprising a base below the rotary, hydraulic power cylinders resting on said base, said cylinders and base having companion ball and socket members, whereby said power cylinders are rockably supported on the base, guides for the upper portions of the power cylinders, a yoke connected with the power cylinders and extending across the rotary, a drill string rotated by the rotary, a bearing for supporting said drill string carried by the yoke, means for shifting said guides laterally to line up the power cylinders on the base in proper working relation to the rotary and the drill string, the guides for the power cylinders including a frame structure and the shifting means including jacks acting on said frame.

19. In combination with a rotary, hydraulic feed mechanism comprising a base, hydraulic power cylinders resting on said base, a yoke actuated by said power cylinders and extending across the rotary, a bearing for the drill pipe carried by said yoke and means for jacking up the power cylinders independently of the base and rotary for securing and supporting the power cylinders in respect to both the base and the rotary.

20. In rotary drilling, the combination of derrick floor and cellar construction below the same, a rotary mounted on the derrick floor, a drill string rotated by the rotary and extending down through the cellar, a base in sections adapted to be assembled in the cellar about the drill string and seats on said base sections, a guide frame in sections adapted to be assembled beneath the derrick floor about the drill string, hydraulic rams including cooperating cylinder and piston members, said cylinder members having a rocking mounting on the seats of the base and held in the guide frame above the base, means at the guide frame for effecting rocking adjustments of the cylinders on the base seats for vertically aligning the cylinders, a yoke detachably engaged with the piston members and extending across the rotary above the derrick floor and a bearing for rotatably supporting the drill stem carried by said yoke.

21. In rotary drilling, the combination of a derrick floor and cellar construction beneath the same, a rotary mounted on the derrick floor, a drill string rotated by said rotary and extending down through the cellar, a base mounted in the cellar and provided with seats, hydraulic rams including cylinder members having a rocking mounting on said seats and piston members operating in the cylinder members, laterally acting screw means acting on the cylinder members above the base for rockingly adjusting and holding the cylinders in vertical alignment on the base, a yoke detachably connected with the piston members and extending across the rotary above the derrick floor and holding means for the drill string rotatably mounted in said yoke.

22. In rotary drilling, the combination of a derrick floor and cellar construction be-

neath the same, a rotary mounted on the derrick floor, a drill string rotated by said rotary and extending down through the cellar, a base mounted in the cellar and provided with seats, hydraulic rams including cylinder members having a rocking mounting on said seats and piston members operating in the cylinder members, laterally acting screw means acting on the cylinder members above the base for rockingly adjusting and holding the cylinders in vertical alignment on the base, a yoke detachably connected with the piston members and extending across the rotary above the derrick floor, holding means for the drill string rotatably mounted in said yoke, said screw means including jacks, abutments for said jacks beneath the derrick floor and a cylinder engaging frame engaged by said jacks.

23. In rotary drilling, the combination of a derrick floor and cellar construction beneath the same, a rotary mounted on the derrick floor, a drill string extending from the rotary down through the cellar, a base mounted in the cellar and provided with seats, a guide frame mounted beneath the derrick floor above the base and provided with guides for hydraulic power units, hydraulic power units including cooperating cylinder and piston members, said cylinder members adapted to be lowered down through said guides and having bearings at their lower ends making rocking engagement with the seats of the base, means for accurately centering the guide frame to bring the guides into vertical register over the seats on the base, a yoke detachably engaged with the piston members over the rotary table and a bearing for supporting the drill string carried by said yoke.

24. In rotary drilling, the combination of derrick floor and cellar construction beneath the same, a rotary on the derrick floor, a drill string rotated thereby and extending down through the cellar, a base on the floor of the cellar having seats at opposite sides of the drill string, hydraulic power units comprising cooperating cylinder and piston members at opposite sides of the rotary, said cylinder members standing on the seats on the base in the cellar and extending to substantially the level of the derrick floor, the piston members adapted to lower in the cylinder members to substantially the level of the derrick floor, the seats on the base definitely spacing the lower ends of the cylinders and said cylinders having a rocking bearing thereon to enable alignment of the cylinders above the base, a yoke mounted on the piston members and separable therefrom substantially at the derrick floor level, said yoke adapted to extend across the top of the rotary, said yoke and the upper ends of the piston members having cooperating long pins and deep sockets by which the yoke is removably connected with the piston members and by which said yoke serves to definitely space the power units at the top, intermediate spacing means for the power units including positioning frame means engaging the upper portions of the cylinders below the derrick floor and means for laterally shifting said frame means independently of the supporting base and a bearing for rotatably supporting the drill string carried by the yoke over the table.

25. In combination with a rotary, hydraulic feed mechanism comprising a base, hydraulic power cylinders resting on said base, a yoke actuated by said power cylinders and extending across the rotary, a bearing for the drill pipe carried by said yoke, means for jacking up the power cylinders independently of the base and rotary for securing and supporting the power cylinders in respect to both the base and the rotary and screw means for shifting the power cylinders laterally and to secure them in properly aligned relation on the base.

26. Hydraulic feed mechanism for use with a rotary, comprising in combination, a base, hydraulic power cylinders rockably resting on said base, a yoke actuated by said power cylinders, a bearing carried by said yoke and constructed for rotatably supporting a string of drill pipe aligned for rotation by a rotary, a shiftable guide frame for positioning and holding said power cylinders above the base and screw means carried by said guide frame for adjustably positioning and securing the same independently of the base.

In testimony whereof I affix my signature.

JAMES C. FORTUNE.