April 12, 1932. W. S. GATTRELL 1,853,856

WELL DRILLING EQUIPMENT

Filed Oct. 1, 1928 3 Sheets-Sheet 1

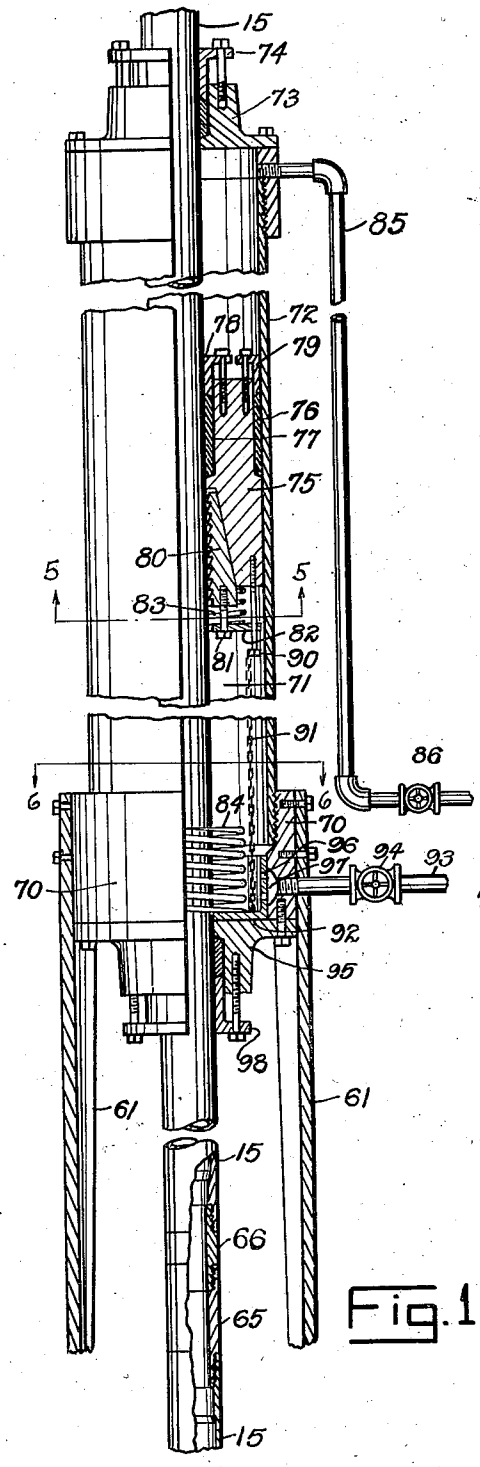

Fig. 1.

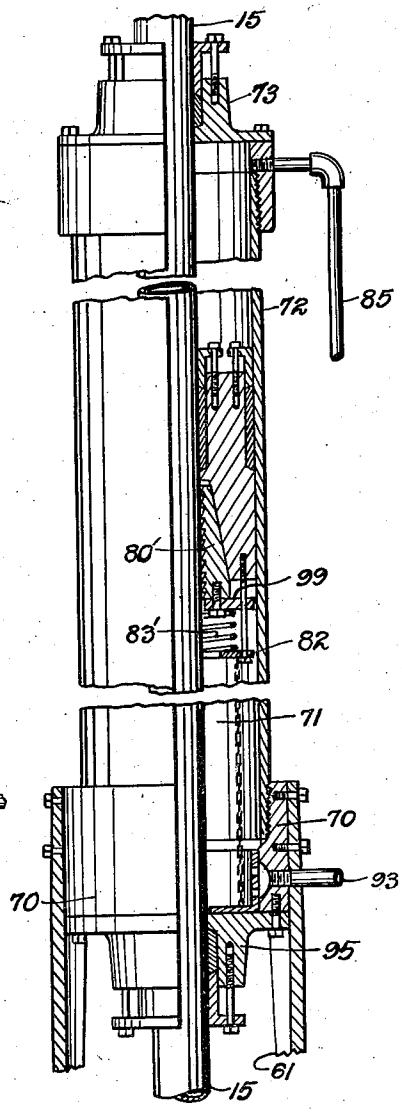

Fig. 2.

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WELL DRILLING EQUIPMENT

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Fig. 3.

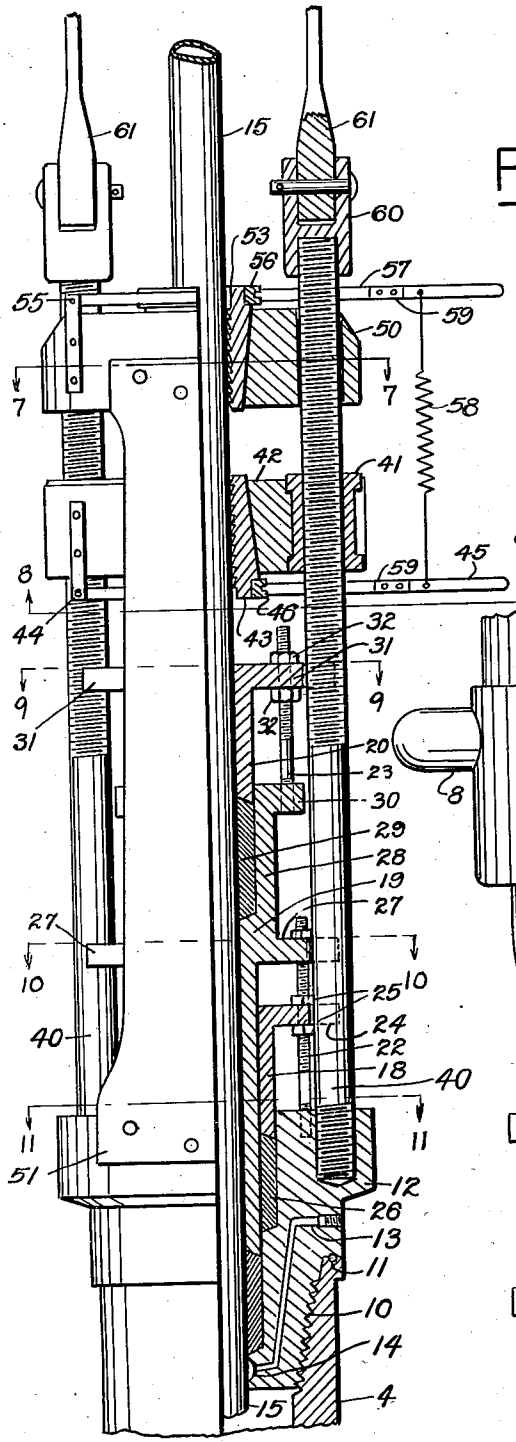
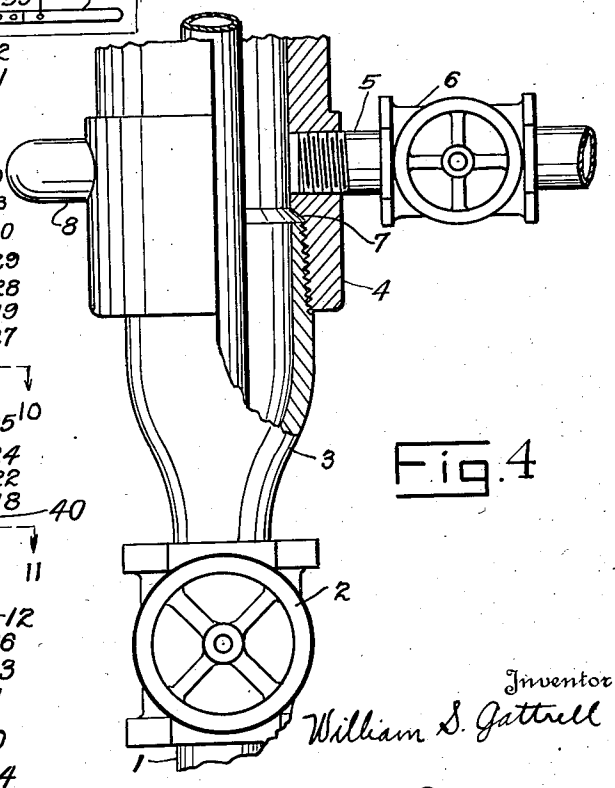


Fig. 4.



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WELL DRILLING EQUIPMENT

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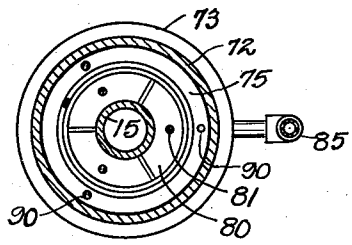

Fig. 5.

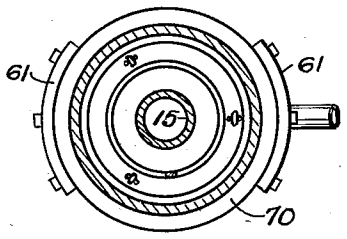

Fig. 6.

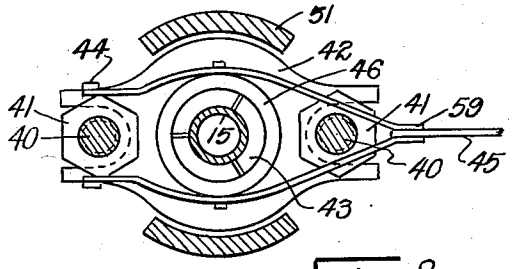

Fig. 8.

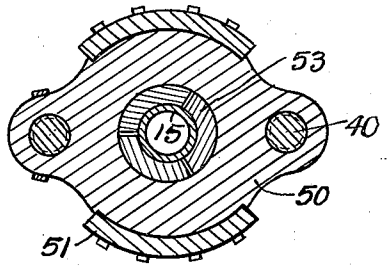

Fig. 7.

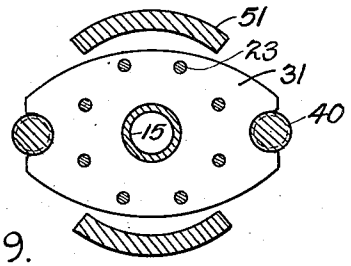

Fig. 9.

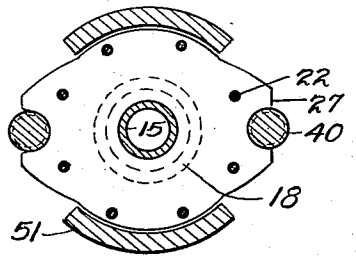

Fig. 10.

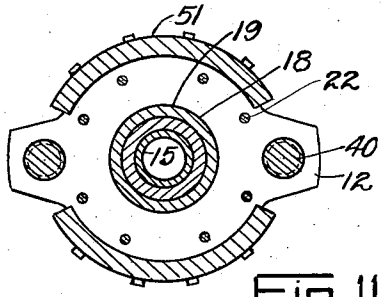

Fig. 11.

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Patented Apr. 12, 1932 1,853,856

UNITED STATES PATENT OFFICE

WILLIAM S. GATTRELL, OF LEES SUMMIT, MISSOURI

WELL DRILLING EQUIPMENT

Application filed October 1, 1928. Serial No 309,619.

My invention relates to equipment to be employed in well drilling where high gas pressure is encountered. The invention contemplates equipping the surface of the well bore with such devices as will permit the drill stem to be removed from, or introduced into, the bore under extreme pressures and also to retain the stem in any desired position to prevent blowing out of the well.

The present device is similar in some respects to that disclosed in my co-pending application filed April 30, 1926, Serial No. 103,191, but embodies certain improvements and points of distinction therefrom.

In drilling wells with a rotary drilling equipment in localities where gas pressure in the well is common, there is always the danger of the gas pressure overcoming the weight of the drill stem and the flushing fluid in the well; when this occurs it is termed a blow-out and usually results in wrecking the well, derrick and all adjacent equipment. Blow-out preventers and other similar devices have been constructed but with most of them now available it is impossible to drill while the pressure exists or to safely remove or insert the drill stem.

It is an object of my invention to equip the well in such a manner that the drill pipe may be manipulated in a well under pressure without danger of a blow-out. It is a particular object of the invention to allow the removal of the drill stem from the well under high pressure and to control the flow of gas and liquid from the well when the high pressure stratum is encountered.

A further object is to provide a device capable of accommodating one or more sections of the drill stem and which is readily removable to be placed in one corner of the derrick where it will be readily available when pressure in the well is impending.

A further object is to construct the device so that by a slight alteration the restraining force may be applied to permit removal or to compel insertion of the drill stem.

Another object is to incorporate in my device novel glands, oiling devices, slip constructions and assemblies and to otherwise improve the structure thereof to obtain a simple, practical mechanism as will be readily apparent to those skilled in the art to which my improvement appertains.

In the accompanying drawings:—

Fig. 1 shows a vertical elevation, partly broken away to show the internal construction of the control cylinder of my mechanism, this particular assembly being adapted for removing the drill or other tubing from the well under a pressure which would tend to blow the pipe from the well.

Fig. 2 is similar to Fig. 1 but shows the arrangement within the cylinder in order to insert the tubing into a well under pressure.

Fig. 3 is a partial elevation and a partial section of the device adjacent the derrick platform and upon which the cylinder of either Fig. 1 or Fig. 3 is adapted to be supported.

Fig. 4 is an elevation, partly broken away, of the casing head, outlet and gate valves and is a continuation of Fig. 3.

Figs. 5 and 6 ar esections taken on corresponding lines of Fig. 1.

Figs. 7 to 11 inclusive are sections taken on corresponding lines of Fig. 3.

The structure of my improved device will be most readily apparent by having reference to Fig. 4, which shows the usual well casing at 1, with a gate valve 2, swaged nipple 3 and a specially constructed casing head 4 disposed one upon the other with threaded engagement, and being of such diameter as to permit passage of the drill stem, tools, etc. The casing head 4 has a lateral mud line as at 5, which carries a shut-off valve 6. It is through this line that the flushing fluid and desired pressures are admitted to and released from the well bore. It will be noted that the nipple 3 has a beveled upper end or lip 7 which is adapted to seat in a corresponding formation in the casing head 4. This formation gives a smooth passage thru the members and serves to further prevent leaking at this joint.

The casing head 4 also carries a bull plug 8, which is adapted to be replaced by a line of pipe similar to the line 5, when desired. Such a line may be used as an outlet for the flow of the well.

The upper end of the casing head 4 is best

seen in Fig. 3 and has a tool joint seat 10 adapted to receive a connection or base member 12, which is constructed to carry the load of my improved device about to be disclosed. This connection 12 is specially formed, one of the novel features being an oiling passage 13 which extends inwardly and downwardly to terminate in a cavity or a plurality of openings 14 in order that lubricant may be fed to the drill stem 15. It has been difficult in the past to obtain proper lubrication of the drill tubing when the well is under pressure and the packing glands are quickly displaced and destroyed, whereas with the passage just described lubricant may be forced into the cavity 14, as desired It must be remembered that the present device is constructed to withstand high pressures and to this end a triple gland structure has been provided, as shown at 18, 19 and 20.

The gland 18 is formed for sliding adjustment instead of being threaded into the base 12, and bolts 22 are threaded into the base and pass thru openings in the flange 24 of the gland. Thus by adjusting the nuts 25 any desired pressure may be exerted upon the packing 26 in either direction. This sliding type gland has been provided, as in rotary equipment, the drill stem gradually tightens the threaded type of gland and destroys the packing or twists off the gland. With the gland 18, as here shown, the plurality of bolts provided, as will be seen from Fig. 11, prevent any tendency of the gland to rotate and a serviceable packing is thus retained. The nuts above and below the flange prevent the drill pipe from moving the gland in either direction. This gland 18 is located in an enlarged annular seat in the base 12 and surrounds the larger gland 19 which is similar in construction to that of 18 and has a flange 27 to receive the bolts 22. See Fig. 10. The gland 19, however, is provided with an upwardly extending portion 28, having a cavity to receive the packing 29, top gland 20, flange 31 and nuts 32, which have adjusting bolts 23 threaded into the flange 30 of the portion 28. See Fig. 9. It will be noted that the flanges 24, 27 and 31 are somewhat oval in shape, as shown in Figs. 9 and 10, and at their ends are divided to form portions which extend about the rods 40. These portions may abut against the rods to prevent rotation of the glands and act as a further means, in addition to the bolts described, to retain the glands in a rigid position. It will be apparent from the assembly of glands that any leaking along the drill tubing will be entirely eliminated and that readily adjustable, serviceable, non-rotatable packing has been provided.

The equipment I have provided to facilitate handling of the drill pipe under pressure is shown in Figs. 1 and 3, Fig. 3 being a continuation of Fig. 1. This structure comprises the supporting rods 40, threaded or otherwise removably affixed to the support 12 and shown in section in Figs. 7 to 11. These rods 40 are threaded thruout most of their length and, as stated, pass thru the divided ends of the flanges 27 and 31 to the glands. Threaded onto the rods 40 are sleeves 41 which carry a spider 42. Rotation of the sleeves thus causes the spider 42 to travel up or down as desired on the rods. A set of inverted slips or other pipe engaging means 43 are supported by the spider 42 in a tapered seat, and, as shown in Fig. 3, are hinged at 44 by means of a lever 45 and collar 46. See Fig. 7. This set of slips is adapted to grip the tubing or pipe when the pressure in the well tends to force it upwardly. The slips 43 are shown in their normal position and ready at all times to instantly grip the tubing. Above the spider 42 is a second spider 50 which is supported on the base 12 by means of arms 51, also shown in Figs. 7 to 11. This spider 50 carries a second set of slips or other pipe-engaging means 53, disposed in a tapered seat in the spider. These slips are not inverted, but are adapted to grip the pipe to prevent any downward movement and are hinged to the spider 50 at 55 by a collar 56 and lever 57. They are shown in their normal position in Fig. 3. The levers 45 and 57 have a connection as at 59 so they may readily be dismounted, for a purpose to be later described, and are both retained in active position by means of a spring 58 attached to each. By manipulation of the sleeves 41 any locking of both sets of slips may be avoided.

The rods 40 pass thru openings in the spider 50 and extend thereabove, providing a detachable connection 60 for the supports 61, show in both Figs. 1 and 3. The derrick floor is preferably at about the level of these connections 60 so that the structure thereabove, and yet to be described, may be removed. The casing head 4, rods 40, spiders 42 and 50 are all disposed in what is usually termed the "cellar," which is an excavation at the surface of the ground. However, in some instances, the derrick floor is elevated above the ground and the cellar then is of less depth. The present structure requires a cellar of about ten and a half feet, which is about the depth usually employed.

It is desirable that the slip levers 45 and 57 be operative from the derrick floor and appropriate connections may be made as desired by means of levers, or otherwise, to manipulate them for removing the drill stem. An operator, however, may be stationed in the cellar to adjust the glands, valves 2 and 6, and the bushing 41.

The drill stem, as here shown, is of slick pipe, or the flush joint type, and is preferable for use with my improved device, being best shown in Fig. 3. 15 is a section of drill stem,

threaded to a box member 65. The section 15 above carries the pin member 66, which with 65 forms a tool joint which will readily slide or rotate in the glands. When it is desired to remove a tool the stem is withdrawn, or, if under pressure, permitted to rise until the tool abuts the base member 12, the gate valve 2 is then closed below the tool and the entire device unscrewed at 10, raised above the derrick floor by any suitable elevator, and the tool is changed or the desired operation performed. A packing ring 11 is shown between the casing head 4 and base member 12.

The supports 61 extend above the derrick floor for considerable length and gradually change in cross section to take the form shown in Fig. 6, and have attached thereto the coupling 70 which forms the base of a pressure cylinder 71, used to control the movement of the drill stem. This cylinder comprises a section 72 of pipe, which may be about thirty or more feet in length, depending upon the pipe sections being handled and is closed at the upper end by a cap 73 and gland 74 similar in construction to the gland 18 previously described. Within the cylinder 71 is a fluid-tight piston 75 having packings 76 and 77 thereon and retained in position by glands and bolts 78 and 79, respectively. The lower side of this piston 75 has an upwardly tapering seat adapted to receive a set of slips or other suitable pipe engaging means 80. In the structure, as shown in Figs. 1 and 5, the slips 80 carry bolts 81, which retain an annular plate 82. Between this plate and the piston 75 is a coil spring 83 normally spacing the plate 82 away from the piston and thru the bolts 81, maintaining the slips 80 withdrawn from the seat. A large coil spring 84 is disposed in the base of the cylinder 71 and is adapted to receive the plate 82 when the piston approaches the lowermost position. The spring 84 then due to the weight of the piston 75 or to pressure exerted thereon from above compresses the smaller spring 83 and forces the slips 80 into the seat of the piston, and to engaging position on the drill stem 15. A pressure line 85 is shown as leading to the upper end of the cylinder 71 and by means of the hand valve 86 any desired pressure may be maintained on the piston to control the upward movement thereof. It is presumed that the tubing at this time is exerting an upward thrust due to the fluid pressure in the well. Thus a joint adjacent the derrick floor is loosened preparatory to being disconnected. While the pipe is gripped by the slips 43, the piston 75 is lowered and the pipe gripped by the slips 80 sufficient pressure is placed in the upper cylinder 71 to oppose the well pressure. The slips 43 are then loosened by the lever 45 and the piston 75 allowed to be forced upwardly by the tubing and slips 80. The loosened joint adjacent the derrick floor passes into the cylinder 71 and the piston rises with the stem, restraining it until the piston reaches almost the top of the cylinder. The slips 43 are again allowed to grip the stem until the slips 80 release in order that the piston 75 may again be lowered and the operation repeated. The loosened joint on the second trip appears above the cap 73 and the sections above it in the derrick are disconnected. The hoisting of the tubing is repeated until the topmost end is within about a section length of the top of the derrick. As the next tool joint appears at the derrick floor it is loosened as before and the entire circle of operation is repeated. By this means two or more sections of stem may be removed under absolutely safe conditions.

The piston 75 is provided with additional safety means in event enormous pressures are encountered. This means includes the bolts 90 on the underside of the piston, which have attached thereto chains 91 and which are in turn connected with a cup-shaped annular ring 92 resting in the base of the cylinder. These chains are arranged so that they are about one half the length of the path of travel of the piston 75. Thus when the piston has been raised half way up the cylinder the chains begin to lift the cup 92, which thereafter slides upwardly but acts as a bushing or support as regards the stem 15 supporting it and preventing any buckling which might otherwise occur. This ring 92 also serves as an abutting shoulder for the piston 75 when the spring 84 is compressed and prevents injury to the bolts 81 and plate 82.

A pressure line 93 with a valve 94 is connected to the base of the cylinder 71 and may be used to force the piston upwardly or to cushion it on the downward stroke as desired. The ring 92 has openings 96 adjacent the cavity 97 to admit the pressure fluid which may be either liquid or gas, as convenient. It would be possible to connect the lines 85 and 93 to the natural pressure in the well, if desired, as the exposed area of the piston 75 is greater than that of the area of the tool in the well. If such expedient were used these lines could be tapped into the casing head 4 or nipple 3, as desired. The valves 86 and 94 may have an exhaust connection so that a single pipe line is sufficient to release the pressure from the cylinder 71 or an exhaust pipe and valve may be used.

The base of the cylinder 71 is made readily removable by forming a base 95, similar to the cap 73, and carrying a gland 98, similar to 74. This lower cap may be removed for purposes or repairs, or replacements to the piston 75, or other parts.

The apparatus just described is preferably used to restrain the tubing while in the well bore or to safely remove it under pressure which tend to force the tubing from the well.

Such structure as shown in Fig. 1 is desirable when the well blows in and it is necessary to restrain the tubing, or to remove it, or to retain it in any one position. Thus if pressure suddenly develops the slips 43 instantly grip the tubing as it starts up. The cylinder 71 is then attached at 61 and the tubing hitched out, as previously described.

In some instances the gas pressure in the well is intermittent and forces the tubing up for a second and then allows it to drop. Such action is termed as "bobbing". Should this occur while the piston 75 and slips 80 are gripping the tubing, the downward movement may release the slips 80, but the tubing is instantly gripped by the downward resisting slips 53 in the cellar. The slips 43 may then become operative and any tendency toward bobbing of the tubing is instantly controlled.

When the well is subject to a heavy internal pressure, drilling can proceed best when the weight of the drill stem and tool is greater than the pressure in the well. It is, therefore, necessary to provide a device to insert the stem and tool in the well against this pressure until the pressure is overcome by the weight of the stem. To provide for such a situation, I have arranged for a slight alteration of the structure within the cylinder 71, which will enable the operator to force the drill stem into the well in much the same manner as it was hitched out. This construction is shown in Fig. 2 and varies from that of Fig. 1 only in the arrangement of the spring 83. As stated, the spring 83 of Fig. 1 normally unseated the slips 80, whereas the spring 83′ of Fig. 2 is adapted to normally seat the slips 80′. This is provided for by inserting a ring 99 against which the spring 83′ abuts and which rests against the slips 80′. The cushion spring 84 may be removed when this form is in use if desired. It will be seen that the action of this form is similar except that the slips engage the tubing at the top of cylinder 71, and by pressure from the line 85 the piston 71 is forced downwardly carrying with it the tubing. The slips 43 are brought into play and grip the tube until the piston is raised to secure another hold on the tube. Other than the changes here set out, Fig. 2 shows the same structure as Fig. 1. The alterations are quickly made to the form of Fig. 1, but have been shown as a separate construction for clearness.

The cylinder 71 is adapted to stand on and be supported by the member 61 so that it may be placed in one corner of the derrick and occupy the same space as a section of casing but is immediately available for use when needed.

There is still another advantage to be obtained with my improved device in that the arrangement of tight glands and casing head would permit all the flushing fluid to be blown from the well by compressed air or gas. The drill stem and tool could be inserted before or after the flushing fluid had been discharged. Drilling could then proceed and with my device the cuttings could be blown and carried away by the compressed air or gas, thus dispensing entirely with the use of flushing fluid. This would be especially advantageous in drilling in the well with a rotary as the mud would not be present to mud off the formation.

I have disclosed herein an embodiment of my present improvements which I believe to be entirely satisfactory and practical for the purposes in view. Nevertheless, it is to be understood that the several essential parts of the improved embodiment might be constructed in various other alternative forms, and it is accordingly to be understood that in the further development of the device that I reserve the privilege of resorting to all such legitimate changes therein as may be fairly embodied within the spirit and scope of the invention as claimed.

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

1. A well drilling equipment including a plurality of pipe engaging means, one of said means being fixed upon the casing head of the well, one being vertically adjustable with respect to said fixed head and another being slidable vertically to carry the pipe therewith, all of said means surrounding said pipe and being coaxial with the pipe to be engaged.

2. A well drilling equipment including two sets of oppositely disposed pipe engaging means adapted to restrain movement of a drill pipe longitudinally and another pipe engaging means surrounding said pipe and adapted to restrain or compel movement of said drill pipe against internal well pressure, all of said means being coaxial.

3. A well drilling equipment comprising a casing, a casing head, a base member carried by said head, rods carried by said base member, and a spider adjustably mounted on said rods, arms on said base member and a spider carried by said arms, each of said spiders having a set of pipe engaging means therein, said rods passing thru both of said spiders and adapted to support a pipe controlling mechanism.

4. A well drilling equipment comprising oppositely disposed drill pipe engaging means adapted to restrain movement of the pipe longitudinally, a cylinder mounted above said means and coaxial with said pipe, and pressure controlled means in said cylinder to compel movement of the drill stem against internal well pressure.

5. A well drilling equipment comprising oppositely disposed drill pipe engaging means adapted to restrain movement of the pipe longitudinally, a cylinder mounted above said means and coaxial with said pipe, and pres-

sure controlled means in said cylinder to compel movement of the drill stem against internal well pressure, supports for said cylinder which permit access to the drill pipe.

6. In a well drilling equipment, a means to compel or restrain movement of a drill pipe in a well having internal pressures in excess of the weight of the said pipe, said means comprising a cylinder, a piston therein, pipe engaging means forming a part of said piston and also within said cylinder and fluid pressure for compelling or restraining movement of said piston.

7. In a well drilling equipment, a means to compel or restrain movement of a drill pipe in a well having internal pressures in excess of the weight of said pipe, said means comprising a cylinder, a piston therein, pipe engaging means carried by said piston and fluid pressure for compelling or restraining movement of said piston and additional means movable by said piston to prevent buckling of said pipe.

8. In a well drilling equipment, a means to compel or restrain movement of the drill pipe in a well having internal pressures in excess of the weight of said pipe, said means comprising a cylinder, a piston therein, pipe engaging means carried by said piston and fluid pressure for compelling or restraining movement of said piston, and additional means movable by said piston to prevent buckling of said pipe, and a cushioning spring for said piston operable to seat said pipe engaging means.

9. In a well drilling equipment, a means to compel or restrain movement of a drill pipe in a well having internal pressures in excess of the weight of said pipe, said means comprising a cylinder, a piston therein, pipe engaging means carried by said piston and fluid pressure for compelling or restraining movement of said piston, and additional means movable by said piston to prevent buckling of said pipe, and a cushioning spring for said piston operable to seat said pipe engaging means, and additional means carried by said piston and normally tending to unseat said pipe engaging means.

10. A well drilling equipment comprising pipe engaging means anchored to the well casing, a fluid pressure cylinder surmounting said means and also anchored to the well casing, pipe engaging means slidably disposed in said cylinder to restrain or compel movement of the drill stem for at least a distance equal to a section length thereof.

In testimony whereof I hereunto affix my signature this 24 day of Sept., A. D. 1928.

WILLIAM S. GATTRELL.