June 14, 1932. J. D. MORRISON 1,862,629

WELL DRILL

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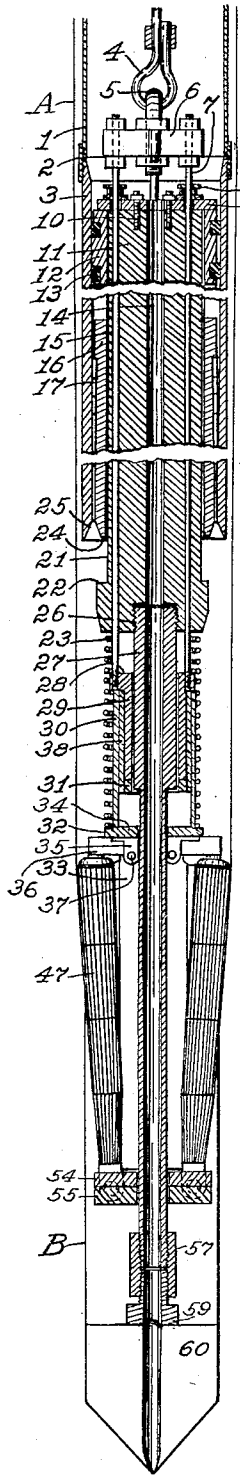

Fig. 1.

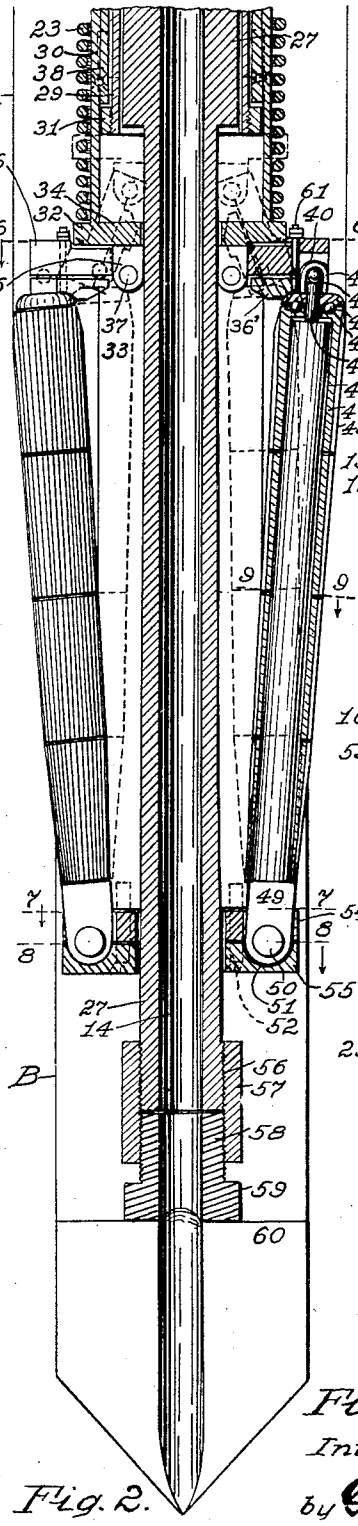

Fig. 2.

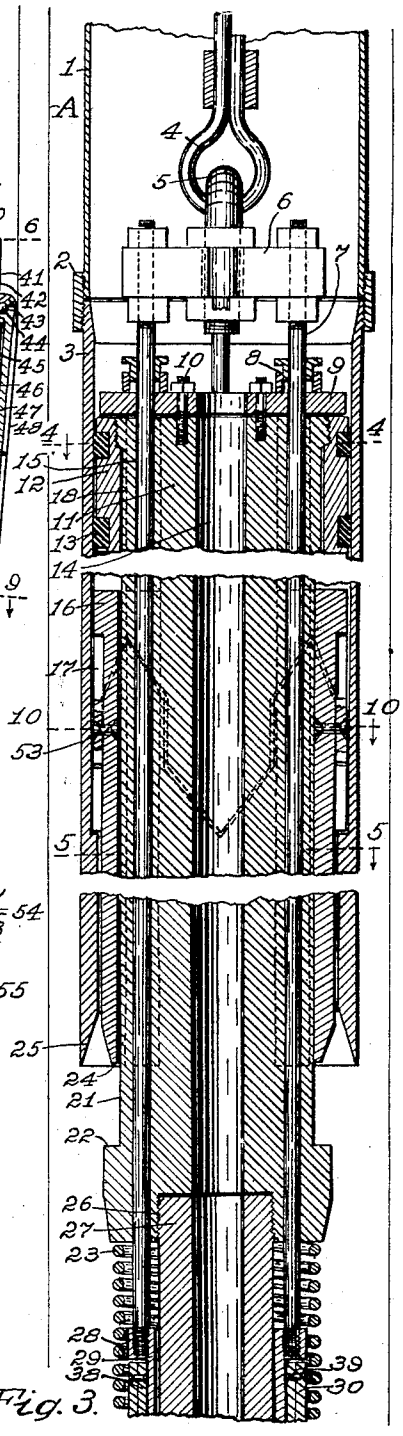

Fig. 3.

Inventor, J.D. Morrison,

by G.G. Kennedy. Attorney

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Fig. 4.

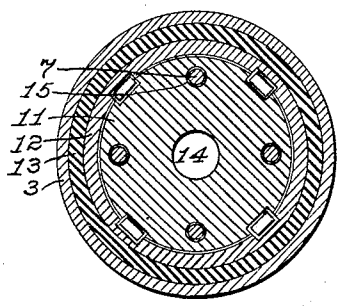


Fig. 6.

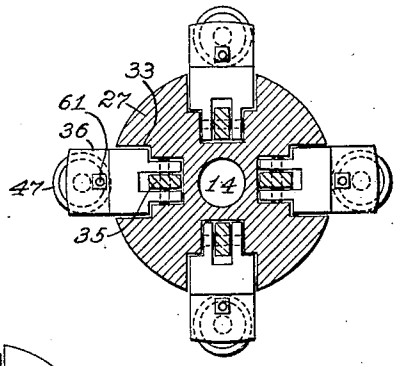
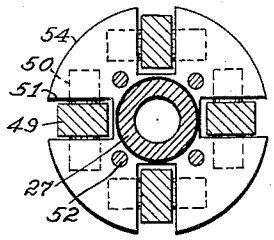


Fig. 7.



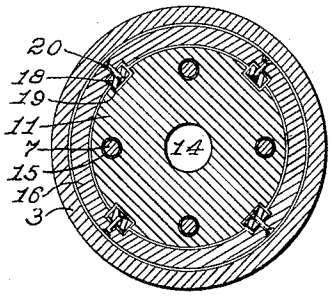


Fig. 5.

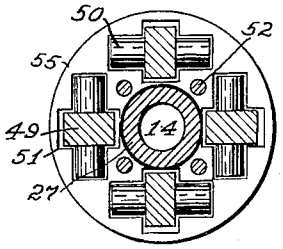


Fig. 8.

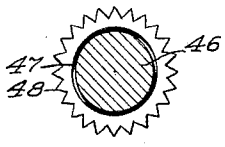


Fig. 9.

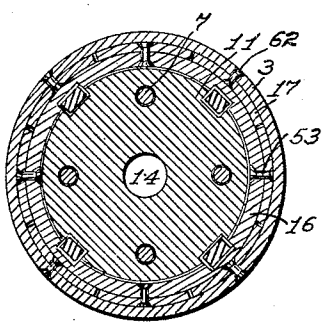


Fig. 10.

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Patented June 14, 1932 1,862,629

UNITED STATES PATENT OFFICE

JAMES D. MORRISON, OF REINBECK, IOWA

WELL DRILL

Application filed May 16, 1928. Serial No. 278,194.

My invention relates to improvements in well drilling apparatus, and an object of my improvements is to supply in combination with a well drilling device, reamers collapsibly associated therewith which permits said device together with the collapsed reamers to pass freely through an inclosing and cooperating drill-pipe in a well-bore, rendering it possible to quickly remove the drilling device from the well, exchange sharp for dull drilling tools, and return the device to working position; thus enabling the operator to drill a hole of uniform size to any depth desired without removing the drill-pipe from the well.

It is to be specifically understood that in my apparatus the casing-pipe and drill-pipe are always one and the same, the rotary action of the casing-pipe, but not its weight, being used in the operation of the drilling device until the well is completed, the pipe then being left in the well as a permanent casing, objects which are not accomplished by any other known method.

Another object of my improvements is to equip the drilling device carrying such reamers with means for extending or collapsing the reamers from a distance.

Another object of my improvements is to operatively associate the drilling device with the drill-pipe in a manner permitting the relative displacement of the drilling device longitudinally of the drill-pipe to a limited extent, whereby the drilling device may continue drilling while the drill-pipe is in rotation notwithstanding that the drill-pipe may not at certain times be moving downwardly in the well hole.

Another object of my improvements is to construct the drilling device of sections for easy assemblage, or for certain relative movements or adjustments, for facilitating their maintenance or operation, or cooperation with a terminal bit, said reamers, or with the coacting drill-pipe.

Another object of my improvements is to furnish new and more effective reaming cutters in association with the drill device, and appropriate connections and operating and adjusting means which permit the extension outwardly of the reamers to a suitable reaming action, or for the retraction or collapse of the reamers upon the drill body to contract the diametral scope of these elements sufficiently to allow them to traverse the bore of the drill-pipe in either direction longitudinally, without necessity for withdrawal of the drill-pipe from the well-hole, or for substitutions of other devices for effecting the drilling operations in stages.

I have accomplished the above objects by the means which are hereinafter described and claimed, and which are illustrated in the accompanying drawings, in which Fig. 1 is a central longitudinal section of my improved well drilling apparatus, with parts thereof in elevation or broken away. Figs. 2 and 3 are respectively reproductions on a larger scale of said apparatus, being respectively the lower and the upper parts thereof. Fig. 4 is a cross section of the device taken on the broken line 4—4 of Fig. 3. Fig. 5 is a cross section taken on the broken line 5—5 of said Fig. 3. Figs. 6, 7 and 8 are cross sections taken respectively on the broken lines 6—6, 7—7 and 8—8 of Fig. 2. Fig. 9 is a cross section, taken on a larger scale, of one of the reaming cutters 46—47 of the device taken on the broken line 9—9 of Fig. 2. Fig. 10 is a cross section of the device taken on the broken line 10—10 of said Fig. 3.

My invention is not restricted to the precise construction and arrangement of parts herein shown and described, nor to the various details thereof, as the same may be modified or rearranged in various particulars without departing from the spirit and scope of my invention, one practical embodiment of which has been herein illustrated and described without attempting to show all of the various forms and modifications in which my invention might be embodied.

The drilling of deep wells has heretofore been accomplished in stages, beginning with a relatively wide bore, and following with successive bores of decreasing diameters, to the required or necessary depth. This method is a relatively slow and costly one, for it is necessary to change the drilling device at each stage for another of different diam-

eter. My improved apparatus obviates a large amount of the cost and delay, as no stages of drilling are required, as my device permits the drill hole to be bored of a single and relatively small diameter, whatever the depth of the well may be, and no substitutions are necessary, for the drilling tool and its reamers are collapsible diametrically when desired, allowing them to be freely moved through the associated drill-pipe to and fro when collapsed, and when extended below the drill-pipe to function effectively in drilling and reaming out the hole quickly.

Referring now to the drawings, the character A denotes the completed upper part of the wall of the drill hole, and the character B the lower end of the drill hole extending upwardly as far as the upper working ends of the reamers of the drilling device which is represented as seated in the drill hole.

The numeral 1 denotes the hollow cylindrical drill-pipe, seated in the drill hole A and broken away, the drill-pipe having a bottom terminal section 3 secured thereto by a coupling sleeve 2, and having a beveled terminal edge 25. This section 3 is preferably thicker than the wall of the section 1, inwardly beveled to meet the latter smoothly at their junction so as to present no interference with passing parts of the drilling device. The lower part of the section 3 is thickened inwardly at an annular shoulder shaped with pointed detents 17 to detachably mesh with like comating detents on an inner concentric sleeve 16 of the drilling device, as indicated in Fig. 3 and the sectional view Fig. 10. The preferred shape of each detent is shown by the dotted lines of said Fig. 3. The detents 17 of the section 3 are preferably riveted thereon at 62, and the comeshing detents of the sleeve 16 are riveted thereon at 53.

The drilling device has a cylindrical upper section or core 11 provided with an axial bore 14 therethrough which bore is continuous with a central hole in a discoidal top plate 9 secured upon the core 11 by means of screw-bolts 10. The core 11 has a number of longitudinal holes or seats 15 to receive the rods or stems 7 slidably therein and arranged at the same radial distance from said bore 14. The stems 7 project upwardly through holes in the top-plate 9 and stuffing-boxes 8 thereon and their upper ends are secured removably in apertured arms of a spider 6. The spider 6 is centrally apertured to seat loosely a swivel eye-bolt 5 whose eye receives the lower looped end 4 of a depending cable whose upper part (not shown) is mounted upon a winding drum of an apparatus positioned above.

The said sleeve 16 is positioned around the core 11 below another sleeve 12 at the top of the core, the sleeve 12 and the upper end of the core having meshing threads for releasably securing the sleeve 12 in place. The sleeve 12 is in its outer wall annularly grooved at one or more places to receive packing rings 13 which may be made of any appropriate material, metal or rubber, or otherwise to contact slidably with the inner cylindrical wall of the drill-pipe 3 and seal the interspace against passage of a liquid downwardly from above. The sleeve 16 is longitudinally slidably splined to the core 11 Fig. 5, by keys 18 mounted in comating or registering longitudinal grooves 19 in the core 11 and the sleeve 16, the keys being fastened to the sleeve 16 by means of the rivets 20. The lower end of the sleeve 16 is beveled inwardly to a flat termination 24 for a purpose to be described. The core 11 has at its lower end below the sleeve 16 a widened termination providing a shoulder 22 for engaging the end 24 of the sleeve 16 at times.

The lower part of the core 11 has a central interiorly threaded socket 26 to receive the exteriorly threaded upper end of a core section 27 which has an axial bore continuing the bore 14 downwardly therethrough, the lower part of the core section 27 having a number of longitudinally recessed outer grooves 33, and being diminished below said grooves with an exteriorly threaded termination at 56 to receive a coupling sleeve 57 which also couples the diminished threaded shank 58—59 to the section 27, the shank part 59 having a terminal bit 60 of a simple shape integral therewith. The shape of said bit may be of any desired type, as I do not claim the bit specifically.

A sleeve 29 is mounted around the upper part of the core section 27 and has its top annularly widened with upwardly opening threaded sockets to receive the threaded lower ends of the said stems 7. The diminished body of the sleeve 29 is at its lower end exteriorly threaded to receive a sleeve-nut 31 therearound. A sleeve 38 is mounted around the sleeve 29 between the upper flange of the latter and the said sleeve-nut 31.

A sleeve 30 is positioned around the sleeve 38 to be coterminous therewith above and to project below the latter to terminate with an outwardly and inwardly widened part 32. A coiled compression spring 23 is mounted around the core section 27 and its concentric outer sleeves 29, 38 and 30 and engaged between the lower termination of the section 11 and the outer flange of the outer sleeve part 32. The inner annular lugs 34 at the lower end of the sleeve 30 have spaced pairs of depending stems 35 apertured to receive the pintles 37 on which are rockingly mounted the furcations of link-bodies 36. The bodies 36 have thereunder contacting sections 36′ which are detachably secured thereto by means of bolts 61. The bodies 36 have hollowed seats 40 to receive movably the upper parts of loops 41 which latter traverse end

recesses in the bodies 36′ and are secured in bearing disks 43 below. The disks 43 are centrally apertured to receive the upwardly directed diminished cylindrical parts 45 of cores 46 therethrough to engage at their upper ends with anti-friction balls 42 mounted in the loops 41. The lower faces of the disks 43 are concentrically recessed as raceways for anti-friction balls 44. The lower end parts 49 of the cylindrical cores 46 have pintles 50 mounted in hollowed seats at 51 respectively in mating faces of the contacting rings 54 and 55 seated around the diminished lower part of the core section 27 below and secured to the upper widened part thereof by screws 52.

The numeral 47 denotes a hollow reaming cutter composed of alined sections, and which sections are mounted to be freely rotatable upon each core 46. The cutter sections have longitudinally ridged outer faces 48, but the outer faces may be otherwise patterned with cutting devices or means if desired. The upper ends of the cutter devices 47 are flanged inwardly around the parts 45 and have raceways for the balls 44. It will be understood that these balls anti-frictionally connect the cutters 47 with the mated link-bodies 36 and 36′, hingedly.

It will be understood that when the spider 6 is displaced longitudinally with its stems 7 relatively to the core sections 11 and 27, the connected sleeve 29 together with the outer concentric sleeves 38 and 30 with the flanged parts 32 and 34 are likewise displaced longitudinally, whereby the spring 23 is compressed between the lower end of the sleeve 16 and the flanged part 32. Simultaneously the link bodies 36 and 36′ are rocked on the pintles 37 and also drawn up along the longitudinal recesses 33 as indicated in dotted lines in Fig. 2. The swinging inwardly of the outer parts of said link bodies causes the retraction or collapse inwardly of all the cores 46 and their circumferential rotary cutters 47 far enough to clear the inner wall of the drill-pipe 1—3, so that the collapsed device may traverse the drill-pipe without interference.

When the collapsed drilling device is thus caused to traverse the drill-pipe downwardly and then passes below the lower end of the latter, as in a drill-hole, and the spider 6 is freed to permit the spring 23 to extend, the linking connections above described cause the link bodies to swing upwardly outwardly to extend outwardly the reamers 47 to their full line positions where engagements thereof with the sleeve body 30 at the lower end thereof stop further movements outwardly, placing the reamers in operative positions as shown in Fig. 2.

The drill-pipe is rotated by the usual mechanism (not shown) and, by means of the connections at 17, the sleeve 16, the core 11, the bit 60, and the reamers 47 are also rotated. The sliding connections by means of which the sleeve 16 rotates the core 11 allow the latter a few feet of longitudinal motion independent of the drill-pipe. In the work of drilling, the drill-pipe remains stationary longitudinally until the core 11 in its downward course brings the lower end of the sleeve 12 into contact with the upper end of the sleeve 16, when drilling ceases for want of pressure downwardly on the drilling tools. The operator then lowers the drill-pipe the proper distance, which restores pressure to the tools and drilling proceeds as before.

Particular attention is invited to the uppermost sleeve 12 with its packing rings 13 which close the joint between the core 11 and the inner wall of the drill-pipe. In drilling installations of this class, a pumping mechanism is required to deliver water or other liquid under pump pressure into the drill-pipe 1, and which pump pressure is exerted against the upper face of the plate 9 of the drill device tending to thrust the latter downwardly in addition to the considerable weight of the drilling device itself, which may be twenty or more feet in length. The weight of the drilling device without this reinforcement of pump pressure, is usually insufficient for effective use of the device in drilling, especially in relatively hard strata of rock. As the sealing-rings 13 close the interspace around the drilling device, the pump pressure may be thus utilized upon the device, and this added pressure is considerable according to the area of the top parts of the drilling device subjected to such added pressure.

It will be understood that the liquid delivered by the pump into the drill-pipe is forced downwardly through the bore 14 of the drill device to the bit 60 in the usual manner, but the static pressures opposing each other upon the device, balance, and hence do not affect the overplus of downward pressure from the pump through the liquid upon the top area of said device.

It is evident that my drill device, by reason of the collapsibility of the reamers inwardly, may be employed for the drilling of wells of any desired depth and having a single and relatively small bore, so that it becomes unnecessary to drill and case by stages as in changing from one set of drill devices and drill-pipes to others of less diameters, which saves much time and labor expense, as also a saving of apparatus.

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

1. In apparatus of the character described, in combination, a rotatable drill-pipe, an axially apertured drill-device mounted within and limitedly slidably and non-rotatably separably connected to said drill-pipe, and a

sealing-device secured around the upper part of the drill-device to slidably contact with the inner wall of the drill-pipe, whereby the drill-device only is propelled downwardly relative to the drill-pipe by its own weight only plus the pressure exerted by the pump which delivers liquid into said drill pipe, said drill-pipe being adapted to become a permanent well-casing on completion of the well.

2. In apparatus of the character described, in combination, a rotatable drill-pipe, and a drill-device mounted non-rotatably, sealingly and longitudinally slidably within said drill-pipe, said drill-device having a limited longitudinal relative displacement within the drill-pipe, and operable under its own weight only plus liquid pressure thereon, said drill-pipe being adapted to become a permanent well-casing on completion of the well.

3. In apparatus of the character described in combination, a rotatable drill-pipe, a drill-device having a terminal bit and mounted non-rotatably, longitudinally, slidably and detachably within said drill-pipe, said drill-device having a limited longitudinal relative displacement within the drill-pipe, and reaming devices mounted for lateral extensions and retractions upon the drill-device above said bit, whereby the reaming devices when retracted upon the drill-device may uninterruptedly traverse the hollow of said drill-pipe, said drill-device being operable under its own weight only plus liquid pressure thereon, said drill-pipe being adapted to become a permanent well-casing on completion of the well.

4. In combination, a rotary drill-pipe, and a separate removable drilling device non-rotatably slidingly connected thereto for limited relative longitudinal movements, whereby the drilling device is operated only under its own weight and the pump pressure of liquid thereupon and independently of the weight of the drill pipe.

In testimony whereof I affix my signature.

JAMES D. MORRISON.