Sept. 3, 1929. W. L. DIEHL 1,727,276

HYDRAULIC ROTARY DRILL

Filed April 22, 1929 2 Sheets-Sheet 1

Fig. 1.

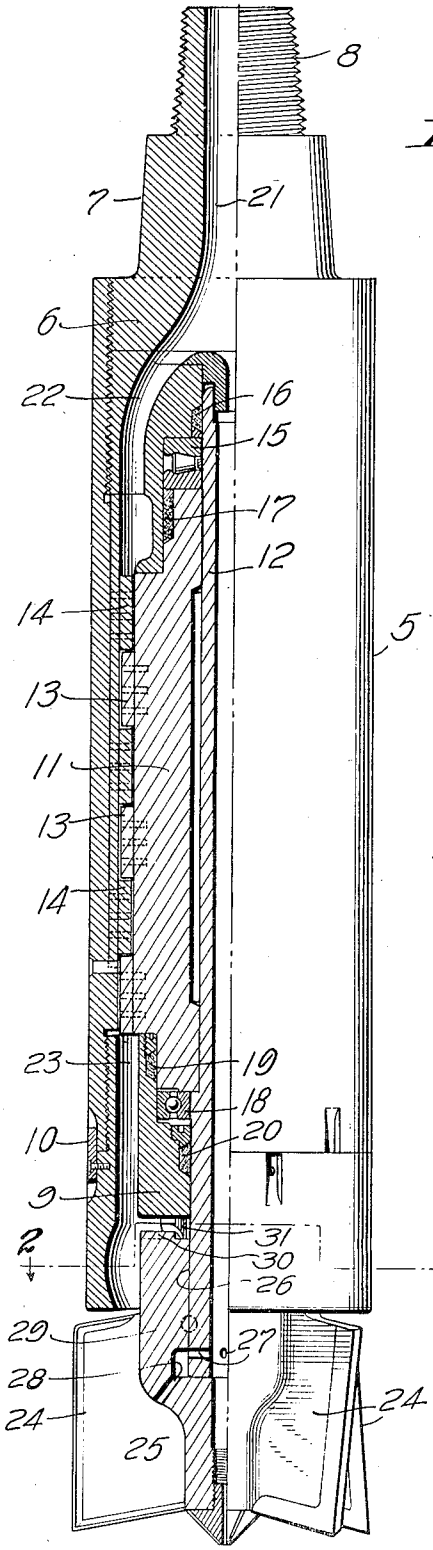
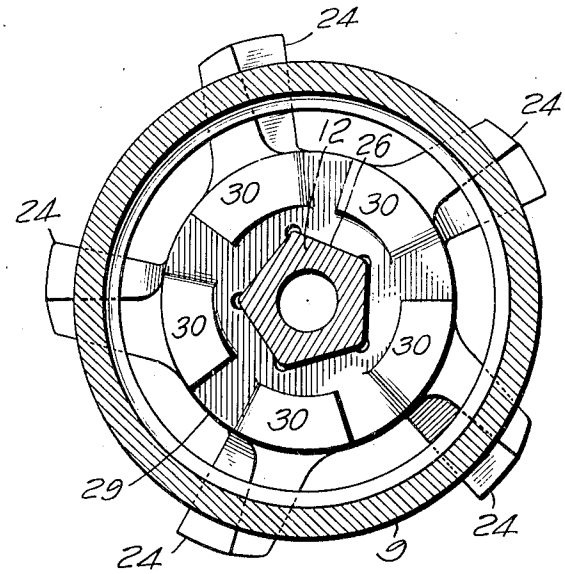


Fig. 2.



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Fig. 3.

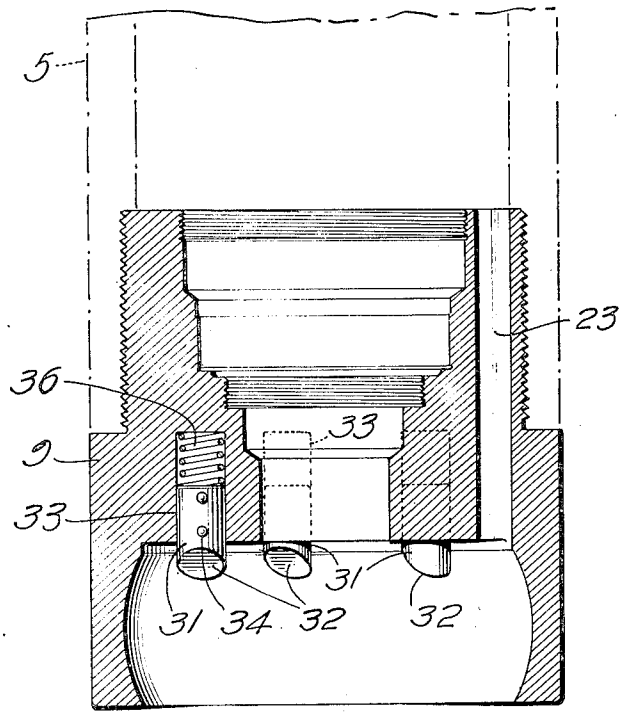


Fig. 5.

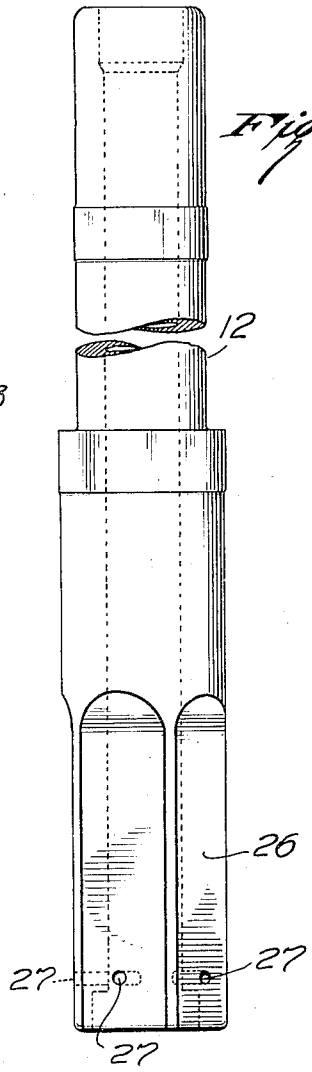


Fig. 4.

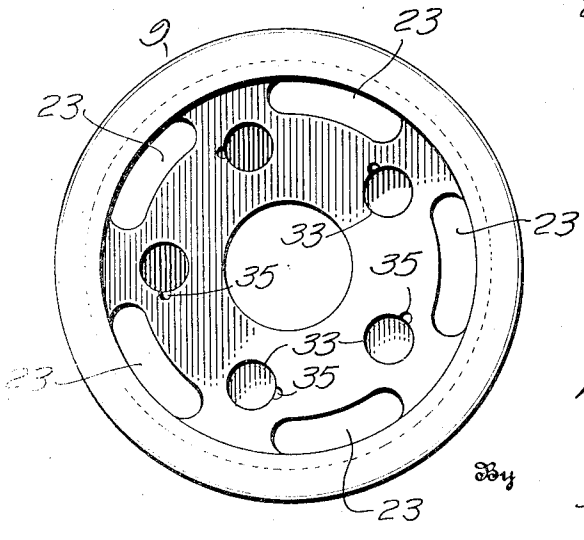
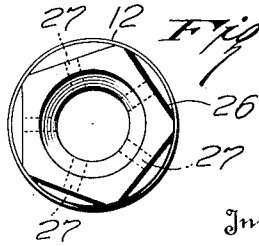


Fig. 6.



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UNITED STATES PATENT OFFICE.

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HYDRAULIC ROTARY DRILL.

Application filed April 22, 1929. Serial No. 357,259.

My invention relates to improvements in hydraulic rotary drills, of the general type shown in my co-pending application for hydraulic pressure rotary drills, filed March 29, 1928, Serial No. 265,719.

In accordance with the present invention, the body portion or casing of the drill is rotated during the drilling operation. This body portion carries a rotary drill bit which is driven by a turbine, preferably in the same direction as the body portion, but at a higher speed. The turbine will drive the rapidly rotating drill bit under normal conditions, but when the drill bit engages a hard formation, such as rock, the drill bit may be held against turning movement and can not be rotated by the turbine, and means are then thrown into action for effecting driving connection between the rotary drill bit and the rotating body portion, whereby the drill bit is rotated with and at the same speed as the body portion. When the drill bit is then again free from engagement with the rock or the like, the turbine will drive the same at a higher speed than the rotation of the body portion.

In the accompanying drawings, forming a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a side elevation of a rotary drill, embodying my invention, parts being shown in central vertical longitudinal section,

Figure 2 is a horizontal section taken on line 2—2 of Figure 1,

Figure 3 is a central vertical section through the pawl pin carrier.

Figure 4 is a bottom plan view of the same,

Figure 5 is a side elevation of the rotor shaft, and,

Figure 6 is an end elevation of the lower end of the same.

In the drawings, wherein for the purpose of illustration, is shown a preferred embodiment of my invention, the numeral 5 designates a cylindrical body portion or casing, constituting the turbine casing. The upper end of this turbine casing is internally screw-threaded for receiving a plug 6, provided with an upstanding stem 7, having a screw-threaded pin 8, for connection with the rotating drill stem or tube. The lower end of the casing 5 is internally screw-threaded for receiving the upper reduced end of a pawl pin carrier 9. These parts are held against relative turning movement by means of a locking key 10, as shown.

Rotatable within the turbine casing 5, which functions as a stator, is a rotor 11, which is mounted upon a tubular rotatable shaft 12, and is keyed to the same so that it rotates with the shaft. The rotor is equipped with rotor blades 13, arranged to co-act with stator blades 14 carried by the inner side of the casing 5, as shown.

The upper end of the shaft 12 is carried within a bearing 15, with suitable packing means 16 and 17 arranged above and below the bearing, as shown. The roller bearing 15 is mounted within an annular recess formed within the inner portion of the plug 6. The lower end of the shaft 12 is mounted within a bearing 18 which is held within a recess formed in the carrier 9, as shown. Packing means 19 and 20 are arranged above and below this bearing, as shown.

The plug 6 is provided with a main central water supply opening or bore 21, which branches at its lower outlet end into a plurality of downwardly discharging ports or passages 22 for supplying water to the annular passage between the rotor 11 and the turbine casing 5, such water passing between the rotor and stator blades, as is customary, and effecting the rotation of the rotor. After passing the blades, the water discharges through openings or ports 23, formed in the carrier 9, and the lower outlet ends of these openings discharge over the blades 24 of a rotary drill bit 25. The water from the turbine thus discharges upon the blades of the drill bit, serving to cool and clean the same. The drill 25 is mounted upon the lower end 26 of the shaft 12, which end is polygonal in cross section, and is keyed or otherwise held thereon. The shaft 12 is tubular, as explained, and is provided at its lower end with radial outlet ports 27, in communication with ports 28, formed in the hub 29 of the rotary drill bit. The ports 28 discharge water outwardly in a direction generally radially of the blades 24, thus serving to wash or clean the blades.

Preferably formed integral with the upper end of the hub 29, are ratchet teeth 30, adapted to be engaged by reciprocatory pins or pawls 31, having lower beveled ends 32. These pins are slidably mounted within openings 33 formed in the lower end of the carrier 9, and

are held against turning movement upon their longitudinal axes by pins 34 which operate in grooves 35, as clearly shown in Figure 4. The pins 31 are forced downwardly by springs 36, as shown.

The operation of the drill is as follows:

The body portion 5 of the drill is carried by a rotating stem or tubing and is continuously turned in a clockwise direction, during the drilling operation. The body portion 5 is ordinarily driven at about 60 revolutions a minute. During this operation, water under pressure is supplied through the stem or tubing and passes through the opening or bore 21, and enters the ports 22 and also the tubular shaft 12. The water supplied under pressure to the turbine blades, causes the rotor 11 to turn at a high speed, in a clockwise direction, or in the same direction with the body portion 5. The rotor is ordinarily driven at 1,150 revolutions per minute. This rapid turning movement of the rotor is transmitted to the shaft 12, and by it to the rotary drill bit 25. The hub 29 of the drill bit is, therefore, turning at a higher speed than the pins 31, and the teeth 30 will, therefore, trip the pins, and the hub 29 will rotate with relation to the carrier 9 and at a greater speed. The water discharging from the turbine passes through the openings 23 and discharges upon or about the blades 24 of the rotary bit into the lower end of the well being drilled. The water which enters the tubular shaft 12 discharges through ports 27 and 28, upon or in proximity to the blades 24, such water traveling outwardly and radially and serving to clean or wash the blades 24.

The drill bit will be driven by the turbine at the high speed until it encounters a hard formation, such as rocks, at which time its rotation may stop or decrease below the speed of rotation of the body portion 5. When this occurs, the pins 31 engage behind the teeth 30, locking the hub 29 to the carrier 9, so that these parts rotate as a unit, in the same direction at the reduced speed.

It is to be understood that the form of my invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of my invention, or the scope of the subjoined claims.

Having thus described my invention, I claim:—

1. In a rotary drill, a turbine casing having stator blades, means for connecting the turbine casing with a drill stem so that the casing is rotated during the drilling operation, a rotor mounted within the casing and having rotor blades for co-action with the stator blades, a rotary drill bit connected with the rotor to turn therewith, and a separate driving connection between the turbine casing and drill bit, said driving connection being inactive when the speed of rotation of the drill bit exceeds that of the turbine casing.

2. In a rotary drill, a turbine casing adapted to be rotated during the drilling operation, a rotor mounted within the casing and having rotor blades, stator blades carried by the turbine casing, a rotary drill bit connected with the rotor to turn therewith, and pawl and ratchet driving connecting means between the turbine casing and the rotary drill bit.

3. In a rotary drill, a turbine for connection with a drilling stem to be turned thereby, said turbine comprising a casing and rotor, a rotary drill bit connected with the rotor to turn therewith, and pawl and ratchet means serving to effect a driving connection between the rotary bit and casing.

4. In a rotary drill, a turbine casing having means for connection with a rotary drill stem, said casing having stator blades, a rotary shaft arranged within the casing, a rotor mounted upon the shaft and having rotor blades for co-action with the stator blades, a drill bit mounted upon the shaft to be driven thereby and provided with ratchet teeth, pawl elements to engage the ratchet teeth, and a carrier for the pawl elements mounted upon the turbine casing.

5. In a rotary drill, a turbine casing having means at its top for connection with a rotary drill stem and having stator blades, a rotary shaft arranged within the casing, a rotor mounted upon the shaft to turn therewith and having rotor blades for co-action with the stator blades, a drill bit mounted upon the lower end of the shaft to turn therewith and having ratchet teeth, a carrier secured to the lower end of the casing and having longitudinal openings formed therein, and pins slidable within the openings and arranged to engage the ratchet teeth.

6. In a rotary drill, a turbine casing having means at its top for connection with a rotary drill stem and having stator blades, a rotary shaft arranged within the casing, a rotor mounted upon the shaft to turn therewith and having rotor blades, a drill bit having a hub mounted upon the rotary shaft and provided upon the inner end of the hub with ratchet teeth, a carrier secured to the lower end of the casing and surrounding the ratchet teeth and having longitudinal openings formed therein, and spring pressed pins mounted within said openings and having their outer ends arranged to engage the ratchet teeth.

7. In a rotary drill, a turbine casing having stator blades upon its inner side, a plug for connection with a rotary drill stem and extending into the upper end of the casing, said plug having openings formed therein to supply water under pressure to the stator blades, a carrier secured to the lower end of

the casing and having openings formed therein to receive the water from the stator blades, said plug and carrier having central openings, a tubular rotary shaft arranged within said central openings and provided near its lower end with radially extending ports, a rotor arranged within the casing and mounted upon the rotary shaft and having rotor blades to co-act with the stator blades, a rotary drill bit having a hub which is mounted upon the lower end of the rotary shaft, said hub being provided at its inner end with ratchet teeth, said carrier having inner longitudinal openings formed therein, spring pressed pins slidable within the inner openings and arranged to engage the ratchet teeth, said hub having outwardly extending ports discharging between the blades of the drill bit and in communication with the radial ports of the rotary shaft.

In testimony whereof I affix my signature.

WEBSTER L. DIEHL.