June 27, 1967 J. B. ROBINSON 3,328,068

LIFTER FOR ROTARY CORE DRILLS

Filed Nov. 15, 1965 2 Sheets-Sheet 1

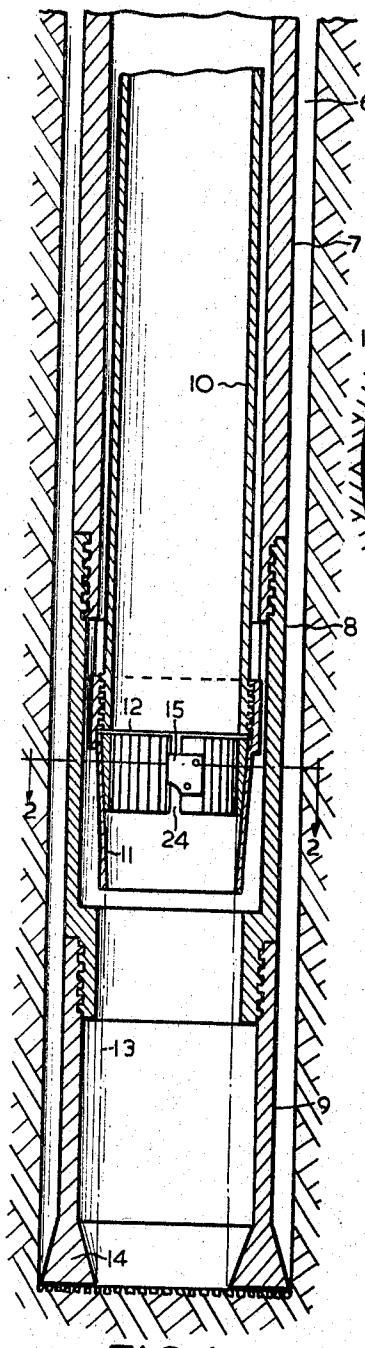

FIG.1

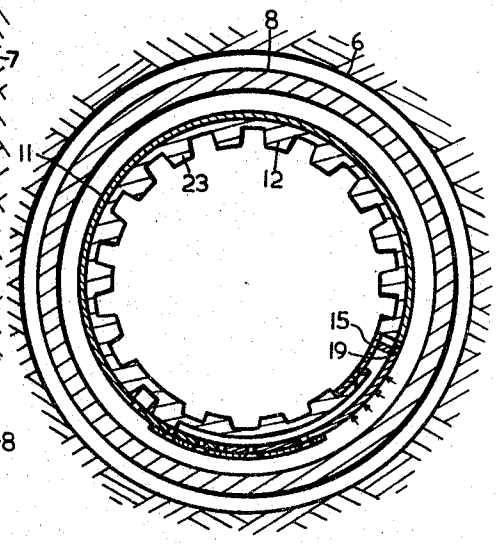

FIG.2

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LIFTER FOR ROTARY CORE DRILLS

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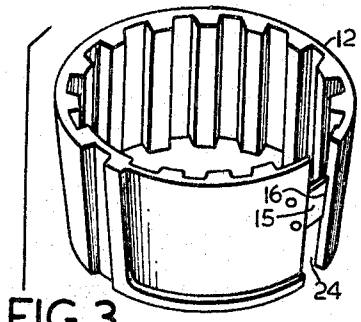


FIG.3

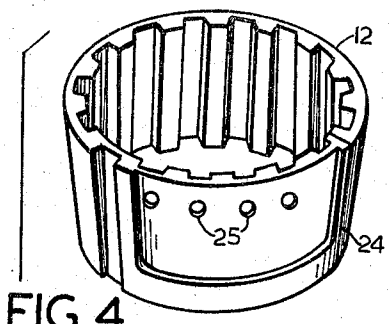
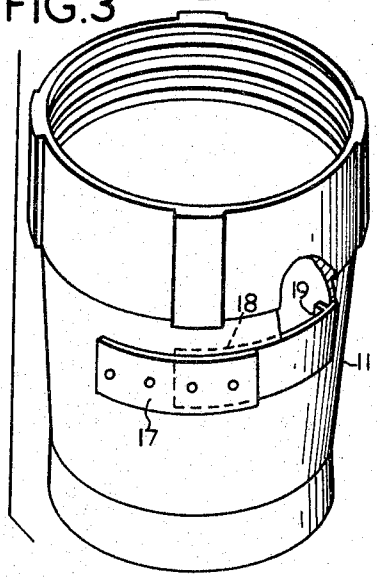
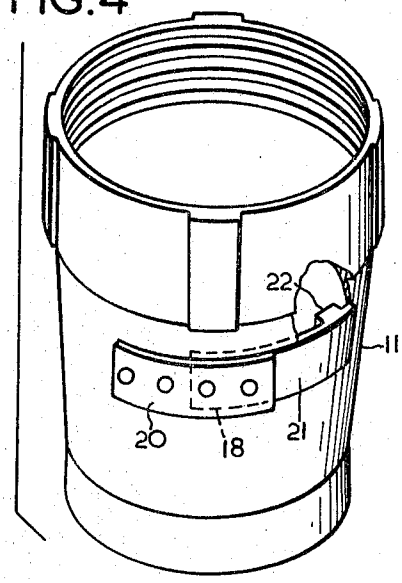


FIG.4





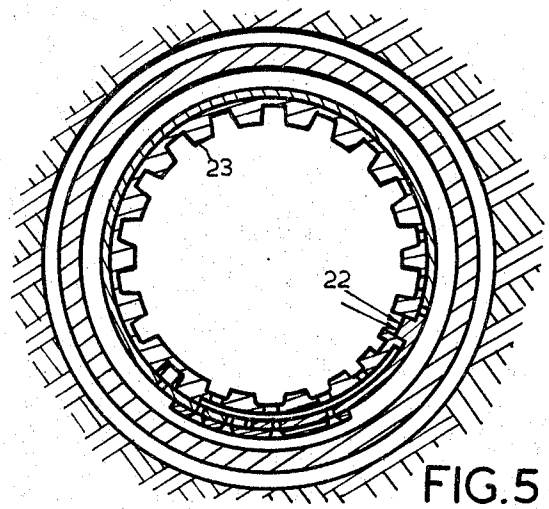


FIG.5

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3,328,068

LIFTER FOR ROTARY CORE DRILLS

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1 Claim. (Cl. 294—86.15)

This invention relates to diamond, tungsten or other rotary core drills. Such a drill, in one form, is a core barrel comprising an inner assembly surrounded by an outer assembly. The outer assembly comprises an outer tube, a reamer shell secured to the bottom of the outer tube and a core bit secured to the bottom of the reamer shell. The inner assembly comprises an inner tube, a core lifter adaptor secured to the bottom of the inner tube and a core lifter located in the adaptor.

The core bit is ring shaped.

In drilling the core barrel is rotated and, at the same time, forced down or allowed to descend under its own weight. The bit cuts an annular hole in the formation through which it passes and a cylindrical core of the formation is left inside the adaptor lifter and inner tube. The drilled material is removed by fluid such as water, air, or mud which passes down the barrel between the outer and inner tubes and returns up the outside of the outer tube or between the outside of the core and the inside of the adaptor and inner tube.

The present invention relates more particularly to the structure of the adaptor and lifter.

Existing adaptors and lifters are deficient in certain respects, particularly where the cores to be obtained and lifted are in weak or friable formations such as certain coals.

The principal object of the present invention is to provide a modified adaptor and lifter substantially free from the disadvantages of existing ones.

The invention also relates to a method of operating the equipment.

In one general form the invention is a lifter for the purpose described comprising a frusto-cone converging downwards of resilient material, open at each end, split from end to end in a direction approximately parallel to the conic axis and normally retained with the sides of the split spaced apart.

In another general form the invention is such a lifter in combination with an adaptor which is frusto-conical, converging downwards, open at each end, adapted at its upper end to be connected to the lower end of the inner tube and has an internal diameter at its lower end less than the external diameter of the lower end of the lifter.

In one specific form the lifter consists of a split externally tapered ring or lifter of plastic, metal or other suitable single or composite material housed in a metal sleeve having an internal taper and comprising the core lifter adaptor. This adaptor is attached to the inner tube of the core barrel and lies within both the reamer shell and the boring bit.

The lifter, at the commencement of drilling sits inside the adaptor in a fully open position at the top of the taper and offers no impedance to the passage of the drill core through its centre. When compressed the lifter closes around the drill core and is locked in this position by a ratchet arrangement on the adaptor and lifter. Thus at the desired time, when the core barrel is raised in the bore hole, the internal taper of the adaptor engages positively with the external taper of the lifter and the grip is further tightened to take the stress of breaking the core at the base of the hole and retaining it inside the core barrel until it is removed to the surface. This is in contrast with core lifters currently in use which are designed to grip the core during drilling operations with sufficient force to ensure that, when the barrel is raised, the respective tapers of the adaptor and lifter will engage. These lifters rely on friction between the core and the inside wall of the lifter and are not actuated by a force applied to the lifter itself.

The force applied in this new device is preferably hydraulic and is obtained by creating a pressure differential between the inside and outside of the adaptor by manipulation of the core barrel, the surface drill pump and its pressure relief valve.

Alternatively a substance may be introduced into the drilling fluid which will travel to the bit and obstruct the fluid passages.

When the pressure on the outside wall of the adaptor exceeds that on the inside wall by a given amount, springs located on the outside wall of the adaptor are forced inwards through ports in the wall and apply a compressive force to the core lifter, thereby locking the lifter around the core.

In its simplest form, two similar leaf springs are symmetrically disposed at about the mid height of the adaptor. Each spans a slot in the adaptor wall and is secured at one end of its slot.

The passage of fluid through the slots in the adaptor wall is prevented by surrounding them externally by a resilient material such as adhesive tape which is impervious to the circulating fluid and transmits pressure on the outside of the adaptor to the underlying leaf springs.

The core lifter is disposed with its upright gap or split between the springs, the free ends of which are disposed towards each other and close to the outer surface of the lifter. The spring to lifter clearance is small but clear during drilling.

When differential pressure is provided as described later, the free ends of the springs move inwards to engage the lifter and reduce its diameter so that it grips the core.

One form of ratchet to retain the lifter in the core gripping condition comprises parallel upright sets of teeth formed on the outside of the lifter on each side of the split and two spaced leaf pawls on the inside of the adaptor between the leaf springs. Each pawl engages a set of teeth and the latter are designed in conventional fashion so that, as the lifter is compressed to narrow the split, the pawls ride over the teeth but, when the pressure on the springs is released, the pawls engage the teeth and prevent return movement of the lifter.

The increased external pressure on the springs is only required for a short time. It can be achieved, for example, by forcing the core bit against the hole bottom to limit or prevent fluid discharge from the bit and increasing the flow between the inner and outer tubes for a short period. This will increase the pressure from between the tubes on the adaptor springs. It may not even be necessary to force the core bit against the hole bottom.

Although preferably of plastic the lifter may be of rubber or other suitable resilient material and may include an external metal shell or metal attachments or inserts.

One split is preferred but there may be two or more spaced splits.

More than two springs may be used and they may be suitably housed helical springs.

This core lifter assembly provides a positive means of recovering core from boring operations in such a fashion that no damage is done to the core during drilling and the grip although positive is softer than that which can be obtained from other lifting devices.

Two other forms of the invention are shown in the accompanying drawings in which:

FIGURE 1 is a vertical section showing the general arrangement of the bore, tubes, shell and bit and a specific form of adaptor and lifter,

FIGURE 2 is a section on the line 2—2 of FIGURE 1 to an enlarged scale,

FIGURE 3 is an exploded perspective view of the lifter and adaptor of FIGURE 1,

FIGURE 4 is a view corresponding to FIGURE 3 of the preferred form of lifter and adaptor, and

FIGURE 5 is a section corresponding to FIGURE 2 but showing the lifter and adaptor of FIGURE 4.

In FIGURES 1, 2 and 3 the arrangement is for the case where the outside pressure is greater than the inside pressure.

We refer first to FIGURE 1. **6** is the bore. **7** is the outer tube to which are secured in turn the reamer shell **8** and the core bit **9**. **10** is the inner tube which is closed at its upper end below the upper end of the outer tube. The core lifter adaptor **11** is secured at its upper end to the lower end of the inner tube **10**. The core lifter **12** seats in the adaptor **11**. The core **13** is cut from the formation by the ring **14** of cutting elements, e.g., diamonds, on the lower end of the bit **9**. Spaced passages for fluid (not shown) are formed through the ring **14** from inside the bit to the bore.

The lifter **12** is as described later with respect to FIGURES 4 and 5. To one side of the split **24** is secured a short tongue **15**, the free end **16** of which abuts the adjacent other side of the split **24** and keeps the split sides apart in the position in which the core **13** can slide freely through the lifter.

A spring plate **17** hinged at one end and located in the adaptor slot **18** carries a projection **19** which, when the plate **17** is forced inwards by suddenly increasing the water pressure in the space between the inner and outer tubes, engages the tongue **15** and moves it out of engagement with the split face. The inherent resiliency of the lifter then brings the split faces together so that the lifter grips the core.

The outside of the slot **18** has a flexible cover (not shown) which prevents inflow of water but allows the outside water pressure to displace the plate inwards.

FIGURES 4 and 5 show the preferred form of the invention.

The core lifter adaptor **11** has formed through its wall a slot **18** in which is pivotally mounted a closely fitting spring steel plate **20** to which is attached a mild steel flap **21** carrying a small stud **22** on its inner face near its free end. The slot periphery may be tapered and the plate **20** similarly tapered to ensure that the outside pressure normally forces the plate into fluid tight engagement with the slot **18**.

The lifter **12** is externally converging downwards and internally cylindrical with a smooth outer surface and a series of spaced ribs **23** around its inner surface. The lifter is of spring steel and is split lengthwise at **24** approximately parallel to the lifter axis. It is so constructed

that its resiliency biasses the sides of the split against each other.

The lifter is normally located in the adaptor with the stud **22** between the end faces of the split **24**, the lifter then being in a distorted large circumference, large radius condition in which it does not grip the core (see FIGURE 5).

A series of holes **25** is formed through the lifter wall at the same level as the slot **18** in the adaptor wall.

In use the core gripping procedure is as follows:

Although most of the return water passes upwards outside the outer tube **7**, some of it passes into the inner tube **10**. Air is trapped between the water in the inner tube and the closed upper end of the inner tube. When it is required to grip the core **13**, the pump pressure is held at about 200 lbs./square inch. The air in the inner tube above the water is compressed.

The bit **9** is sealed to the bore floor by downward mechanical pressure. This substantially prevents escape of air and water until the pump pressure is relieved.

When the pump pressure is relieved, the air above the water acting as a spring forces water against the spring plate **20** which moves outwards through the adaptor slot **18**. The stud **22** is withdrawn from between the ends of the lifter split **24** and the resiliency of the lifter brings its ends together and reduces its circumference and radius so that it grips the core.

What I claim is:

The combination comprising an outer tube, an inner tube, a core lifter adaptor and a core lifter mounted on said inner tube, said core lifter adaptor comprising a sleeve open at each end, internally frusto conical and converging downwardly and secured at its upper end to the lower end of said inner tube, a partial circumferential slot through the wall of said adaptor between its ends, a plate having a hinge near one end on said adaptor wall and fitting closely for part of its length in said slot, a stud on the inside of said plate near its end remote from said hinge, said core lifter comprising a sleeve of resilient material, externally frusto conical and converging downwardly, open at each end, split from end to end in a direction approximately parallel to the conic axis and normally disposed in said adaptor with said plate stud between the sides of said core lifter split, the inherent resiliency of said lifter tending to close said split which is normally prevented by said stud.

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