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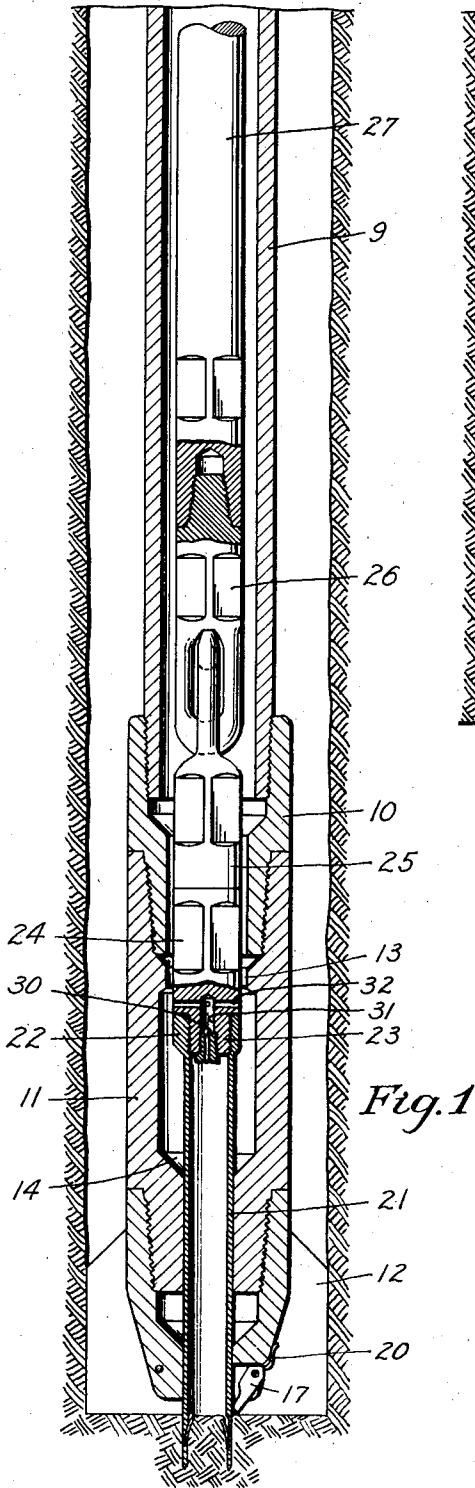
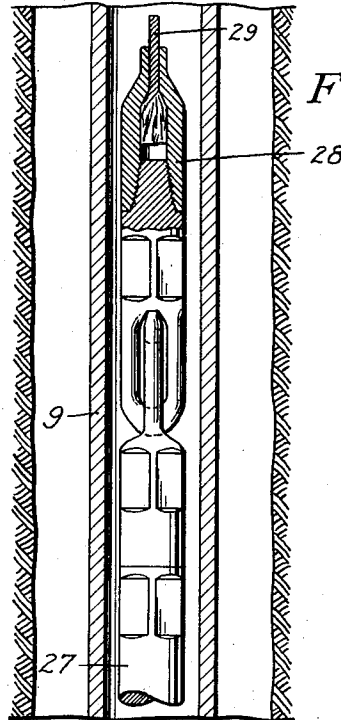
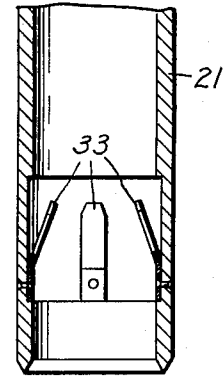
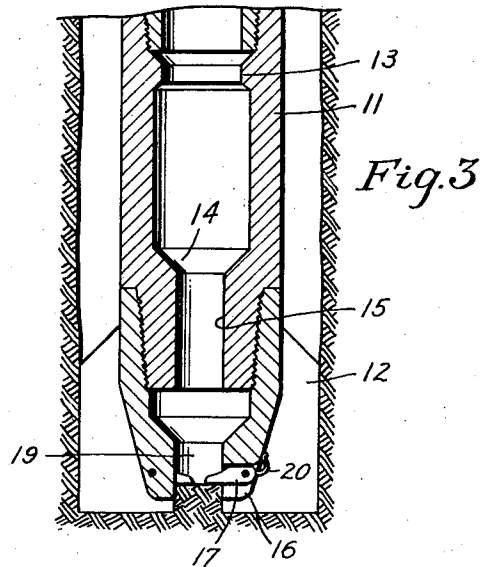
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2,170,716

METHOD AND APPARATUS FOR TAKING SAMPLE CORES

Filed Jan. 24, 1938

2 Sheets-Sheet 1



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METHOD AND APPARATUS FOR TAKING SAMPLE CORES

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2 Sheets-Sheet 2

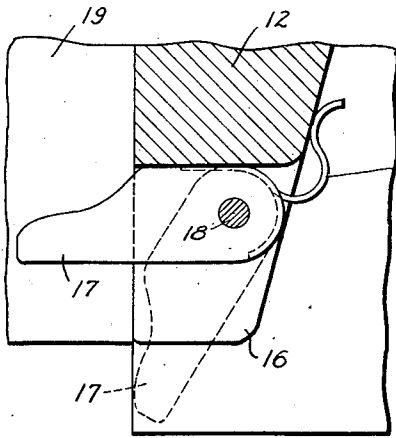


Fig. 8

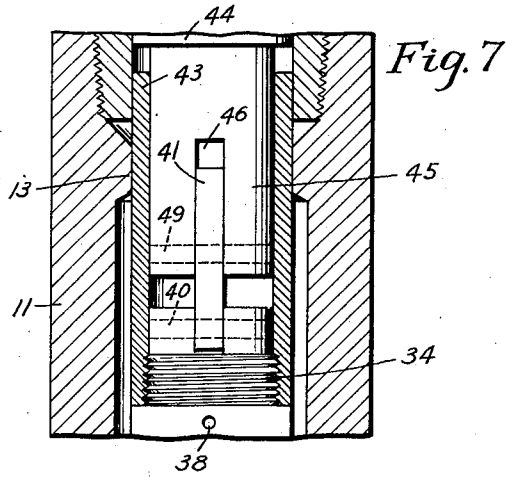


Fig. 7

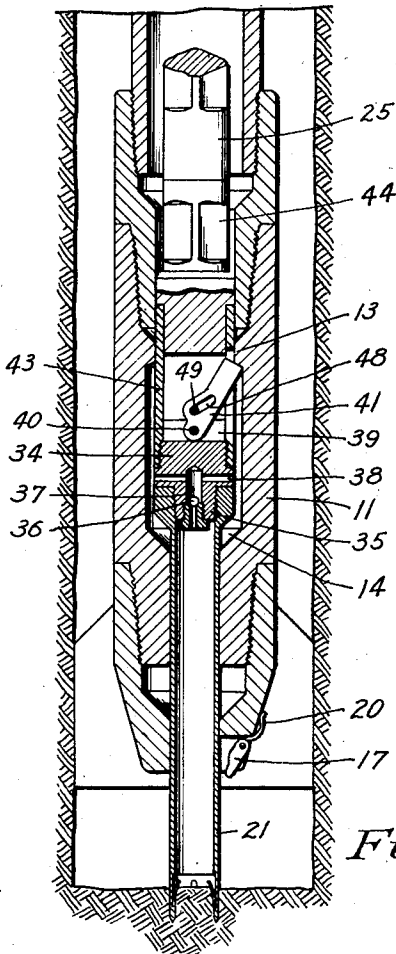


Fig. 5

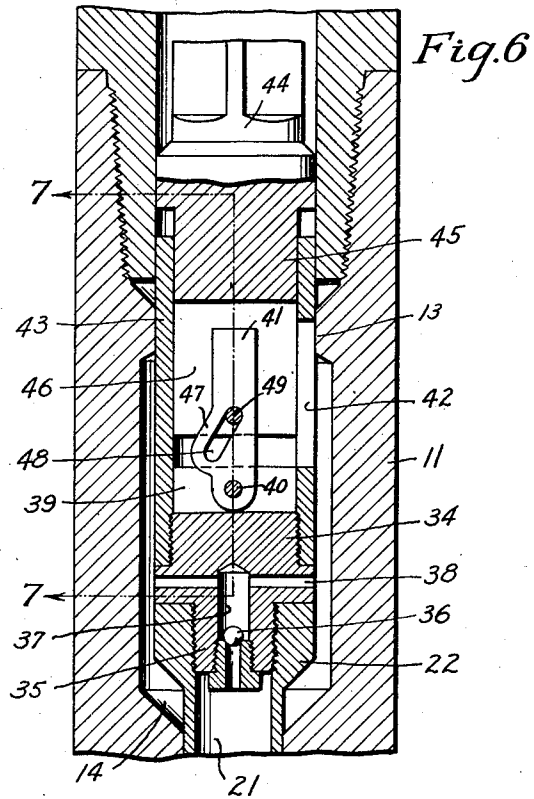


Fig. 6

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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR TAKING
SAMPLE CORES

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Application January 24, 1938, Serial No. 186,729

5 Claims. (Cl. 255—1)

This invention relates to the art of well drilling and in particular to the taking of sample cores at intervals as the drilling proceeds. In a well drilling operation it is of vital importance that a driller should at all desired times be accurately informed of the exact nature of the earth formation through which the drill bit is passing, and through which it is about to be passed.

The most widely used method of drilling is the rotary method, in which the drill stem and bit are rotated as a unit, and in which a fluid, known to the industry as "mud", is continuously circulated down through the hollow drill stem and bit orifices and up through the well bore to cool the bit, carry off the cuttings, and to seal the wall of the bore while effecting a hydrostatic pressure therein to reduce the likelihood of cave-ins and blowouts. The bit is generally provided with a core barrel holder in which a core barrel is disposed when a sample is to be taken; the barrel seating axially within the bit and rotating with it so that the material of the formation being drilled packs within the barrel. When the barrel is filled, drilling is stopped and the barrel is "fished" to the well surface for examination of its core. During this operation the circulation of the well fluid is continued.

The method as described is open to objection in that the circulation of the drilling fluid tends to wear down the core and wash it away, thereby resulting in the loss of a large percentage of the core being taken. This is especially true in the softer formations, and as the producing area is generally located in the softer formations, the core obtained will not present a true index. In addition to being contaminated by the drilling fluid, the physical aspect of the core is altered by the wearing action of the rotating bit.

An object of the present invention is to provide a method of core taking in virgin formation immediately ahead of the bit while the rotation of the drill stem and bit is arrested and the circulation of the drilling fluid is stopped, so that a true index of formation conditions may be obtained.

Another object is to provide a novel form of coring apparatus for rotary systems, in which means are provided for forcibly projecting a core receiving barrel ahead of a bit and independently of rotation of the drill stem or bit.

A further object is to provide a core taking barrel for rotary systems, arranged for core taking and removal in advance of a bit and independently of bit or drill stem operation.

Still another object is to provide a novel means for effecting releasable latching engagement be-

tween a core barrel and a drill stem in which it is mounted when the weight of the drill stem is to be used to force the core barrel ahead of the bit.

With the above objects in view, and such others as will be apparent to those skilled in the art, the invention resides in the novel construction, combination and arrangement of parts hereinafter described and claimed, and illustrated in the accompanying drawings in which:

Figure 1 is substantially a vertical section through the bit end of a drill stem with a core barrel operatively positioned to take a core.

Figure 2 is a similar section through the upper end of the stem.

Figure 3 is a vertical section through a bit and the lower end section of the drill stem as arranged for drilling with the core barrel removed.

Figure 4 is an enlarged vertical section through the lower end portion of the core barrel employed.

Figure 5 is substantially a vertical section through the bit end of a drill stem, illustrating an alternative embodiment of the invention.

Figure 6 is an enlarged vertical section through the core barrel latching means of Figure 5.

Figure 7 is a section taken on the line 7—7 of Figure 6.

Figure 8 is an enlarged fragmentary section, partly in elevation, illustrating a means for preventing coring at the drill bit when same is not desired.

In detail the invention comprehends the usual rotary drill stem 9 carrying at its lower end a coupling 10 in connection with a conventional drill collar 11 to which is attached the bit 12. At its upper end the drill collar 11 is provided with an internal annular shoulder 13 and adjacent its lower end with a conical seat 14 surrounding the inner end of the reduced axial bore 15 which opens at its outer end into the bit. The body of the bit is formed at its lower extremity with a series of radial slots 16, one of which is shown in Figures 3 and 8, each housing a core breaking dog 17 pivoted as at 18 and normally projected radially into the bit bore 19 under the influence of a bowed leaf spring 20 or some other suitable biasing means, as shown in full lines in Figures 3 and 8. When no core is being taken these dogs extend into and across the bit bore in a plane perpendicular to the axis of the bore, presenting obstructions to the formation of a core within the bit during drilling. When a core barrel 21 is moved axially downward through the bit bore 19 it forces the dogs into their housing slots against tension of their springs 20; the dogs assuming

position as shown in dotted lines in Figure 8. When the core barrel is removed upwardly the dogs spring back into obstructing position across the bit bore.

5 While drilling, the stem 9, drill collar 11, and bit 12 are rotated in the usual manner by the rotary apparatus, not shown, at the well head. The "mud", or drilling fluid is at the same time continuously pumped down through the bore of the drill stem, collar, and bit to issue through the bit, whence it rises through the well bore around the exterior of the drill stem to the surface.

10 When a core is to be taken the drilling is stopped and also the circulation of the drilling fluid. The hollow core barrel 21 open at its lower entrant end is then lowered through the drill stem, drill collar, and bit, and is forcibly projected into the virgin material immediately ahead of the arrested bit.

20 The upper end of the barrel 21 is provided with an enlarged head 22, the diameter of which is less than the internal diameter of the drill stem and of the drill collar shoulder 13 but greater than the diameter of the reduced bore 15, so that as the barrel is projected the head engages the seat 14 in the drill collar and at that point prevents further outward movement of the barrel.

30 The core barrel head 22 has threaded attachment over a nipple 23 on the bottom of a driving head 24 attached to the lower end of a lower jar 25. The jar 25 has a linked connection with an upper jar 26 threaded onto a sinker bar 27 which at its upper end is connected to a set of jars secured to a suspension head 28 attached to the end of an operating cable 29 which is manipulated by appropriate means, not shown, at the well head to lift and drop the jar to drive the core barrel to the limit of its projection ahead of the bit. The cable, of course, also provides the means by which the jar string and attached core barrel are inserted and removed through the drill stem.

45 The driving head nipple 23 is provided with a relief valve 30 and discharge bores 31 and 32 through which air and drilling fluid trapped in the barrel is relieved to the interior of the drill collar ahead of the rising core entering through the lower end of the core barrel as it is driven into the formation ahead of the bit. Also, as seen in Figure 4, the lower end of the core barrel is provided with core holder means, here shown as spring fingers 33, to prevent the core from dropping back out of the barrel as it is removed to the surface of the well.

55 Under certain conditions of drilling it may be found desirable to utilize the weight of the drill stem as the motive force for driving the core barrel, and a means for accomplishing such purpose is shown in the embodiment of the invention illustrated in Figures 5, 6 and 7.

60 In this embodiment a latching means is interposed between the head of the core barrel and the jar 25 by which the core barrel may be releasably latched to the drill stem in a manner to be driven by the weight of the stem. This means comprises a coupling 34 having a nipple 35 threaded into the head 22 of the core barrel 21 and provided with a relief valve 36 and discharge bores 37 and 38 through which trapped air and drilling fluid is delivered from the core barrel to the interior of the drill collar 11. The head of the coupling is formed with a diametrical slot 39 in which is pivoted, on the pintle pin 75 40, the lower end of an upwardly extended de-

tent 41 adapted to move radially outward through an axially extending slot 42 provided in a sleeve 43 which is threaded at its lower end to the coupling.

5 In this form of the invention the lower jar 25 connects to a driving head 44 which, when operating without latching to the drill stem, functions as does the head 24 in the form shown in Figure 1. The lower end portion 45 of the head 44 is diametrically reduced sufficiently to have a free sliding engagement within the upper end of the sleeve 43, and is formed with a deep diametrical slot 46 opening to its bottom.

10 The upper end portion of the detent 41 is received in and plays within the slot 46. As seen best in Figure 6, the detent is formed with a lateral edge enlargement 47 accommodating a closed end slot 48 in the body of the detent. The slot is angled with respect to the longitudinal axis of the detent and has its upper end disposed in such axis. A pin 49 is mounted diametrically in the bottom end of the reduced portion 45 of the driving head 44 and plays in the detent slot 48 through which it extends parallel with the pintle pin 40 of the detent.

25 When core taking with this form of apparatus, rotation of the drill stem and circulation of the drilling fluid are stopped. The drill stem is then raised so that the bit is spaced above the well bore bottom, as in Figure 5. The core barrel attached to the jar string is then lowered through the drill stem until stopped by engagement of the core barrel head 22 with the drill collar seat 14. As descending movement of the head 44 will not be stopped until the upper end of the sleeve 43 engages the shoulder formed by the diametrical reduction of the portion 45, the pin 49 moving down in the detent slot 48 will cam the detent and cause it to pivot on the pintle 40 to project the upper end of the detent through the sleeve slot 42 into the drill collar beneath the overhang of the shoulder 13. The drill stem is then lowered and as the shoulder 13 of the drill collar engages the detent the core barrel will be caused to move with the drill collar 11 under the driving force of the weight of the drill stem to enter the virgin formation at the bottom of the well bore, as shown in Figure 5.

50 When coring is completed the jar string and core barrel are lifted independently of the drill stem and the resultant upward movement of the pin 49 playing in the inclined detent slot cams the detent to move from beneath the drill collar shoulder, unlatching the core barrel and drill collar and permitting the barrel to be removed to the surface.

55 In the usual types of devices employed for locking a drill stem and core barrel a serious difficulty frequently arises in that the latch detent becomes jammed under the drill collar shoulder so tightly that it is impossible to release the latch when it is desired to remove the core barrel to the surface. In such cases the entire drill stem must be pulled. Should the detent jam in the assembly of this invention it may be released by operating the jars to drive the core barrel slightly downwardly sufficiently to release the jamming pressure. Also, if the core barrel should become bent or stuck in the drill collar or bit to such extent that it is impossible to remove, the pins 40 and 49 may be sheared thereby enabling the entire assembly above the sleeve 43 to be removed from the drill stem. The stem may then be removed from the well and the core barrel dislodged. The shear-

ing strength of the pins may be so proportioned as to eliminate possibility of breakage of other parts.

In both forms of the invention the amount of core taken into the barrel will be equal to the distance that the core barrel projects beyond the cutting edge of the drill bit. The length of core to be taken is determined by barrel length, and obviously any desired length may be used.

Having thus described the invention what is claimed is:

1. Core taking apparatus comprising in combination, a drill stem including a drill collar and bit, a core barrel movable axially therethrough to project ahead of the bit, cooperating stop means on said barrel and drill collar limiting projecting movement of said barrel, an internal abutment in said drill collar, a detent carried by said barrel, and means operable by functioning of said stop means to project said detent into the path of descending movement of said drill collar abutment whereby said barrel is moved axially by and with the drill collar and stem to take a core, by a reciprocatory motion of the drill stem.

2. In combination, a drill stem including a bit, a removable core barrel insertable therethrough to project ahead of the bit, a coupling on the upper end of said barrel, a tubular sleeve fixed at its lower end to said coupling, said sleeve being axially slotted at one side, a latch detent pivoted at its lower end to said coupling within said sleeve, a member slidable axially in the upper end of said sleeve and recessed to take over said detent, said detent being slotted through a portion of its length at an angle to its longitudinal axis, a pin carried by said slidable member and engaged in said detent slot whereby said detent connects said barrel-carried coupling and slidable member for limited relative axial movement, means connected to the upper end of said slidable member for lifting and lowering said

member, coupling and core barrel, a fixed internal shoulder in said drill stem, the pin on said slidable member causing said detent to move outwardly through the sleeve aperture into latched engagement beneath said drill stem shoulder on descending movement of said slidable member, and means for reciprocating the drill stem axially to take a core.

3. A drill bit including a drill collar attachable body provided with an axial core barrel receiving bore from top to bottom, said body having a plurality of radial slots opening to the bore and the bit bottom, a core breaking dog pivoted in each slot to swing radially of the bit, and means biasing said dogs to positions extended radially into and across the bit bore in the absence of a core barrel therein.

4. The method of taking a core ahead of a bit in a rotary well drilling operation, which comprises stopping the drilling and the circulation of the drilling fluid, lifting the drill stem to space the bit above the well bottom, lowering a core barrel axially through the drill stem and bit to project beneath the raised bit, latching the barrel to the drill stem for axial movement therewith, lowering the drill stem to force the core barrel into the formation at the well bottom by weight of the drill stem, and thereafter unlatching and removing the core barrel.

5. Core taking apparatus comprising in combination a drill stem including a bit, a core barrel movable therethrough to project ahead of the bit, a fixed internal abutment in said stem, and a latch detent carried by said barrel and engageable with said abutment to positively hold the barrel in projecting relation to said bit and against upward movement axially relative to the drill stem to take a core by a reciprocatory motion of the drill stem.

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