

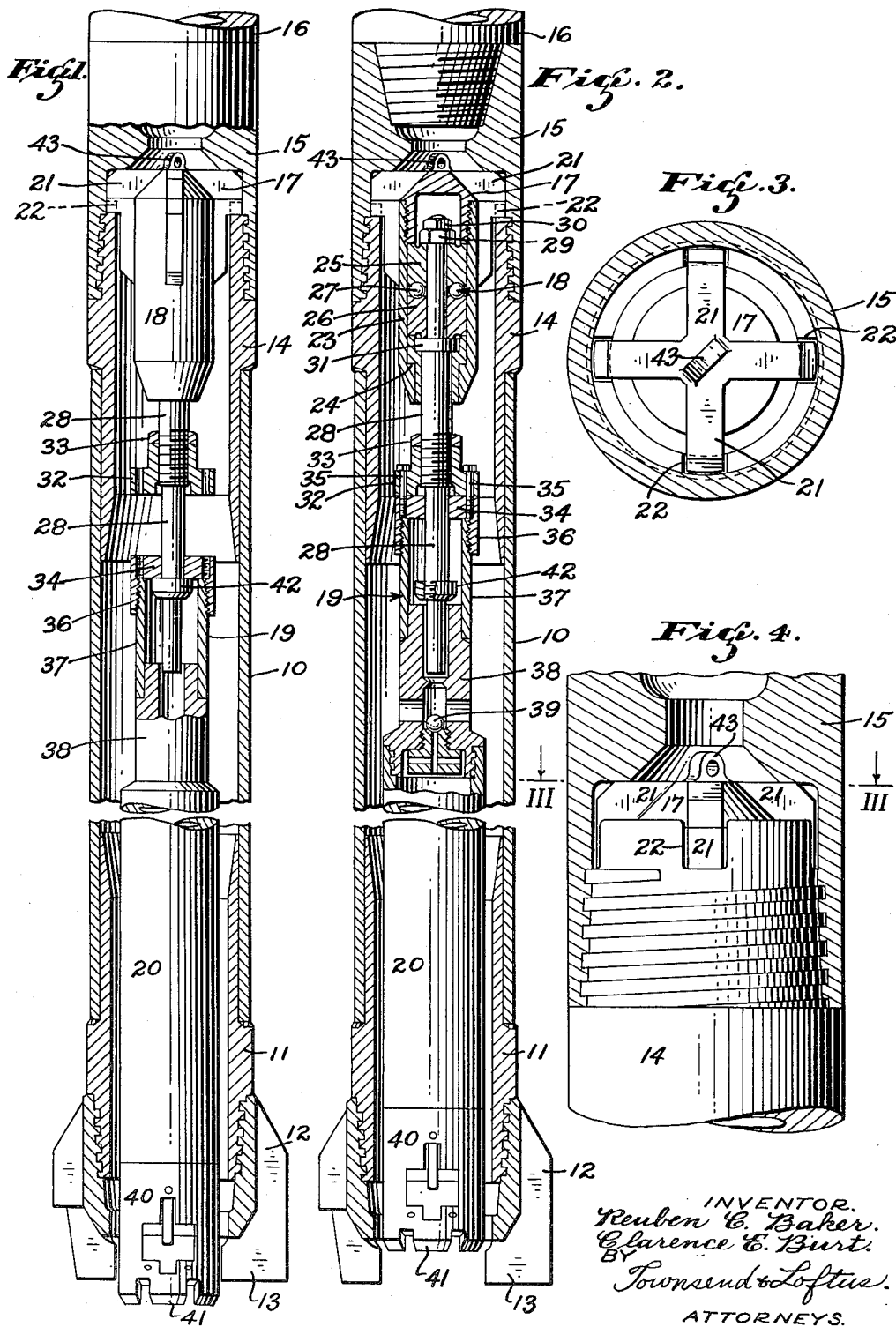
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ROTARY CORE BARREL

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## UNITED STATES PATENT OFFICE

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## ROTARY CORE BARREL

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5 Claims. (Cl. 255—72)

This invention relates to oil well drilling equipment and particularly pertains to improvements in devices for taking samples of the formation penetrated by rotary drilling equipment.

It is common practice in the drilling of oil wells to take a core of the formation to be penetrated. This is accomplished by the use of a core barrel which generally includes a pair of concentrically disposed barrels, the outer being a drill barrel and the inner one a core tube. In operation, the cutter head carried by the drill barrel cuts an annular groove, leaving intact a central core which is received by the core barrel. The lower end of the core barrel is fitted with a trimmer shoe to trim the core prior to its entrance into the core tube. In penetrating comparatively hard formations it is desirable to have the cutter teeth in advance of the core tube. However, in soft formations it is desirable to have the core tube in advance of the cutter teeth in order to effect a maximum recovery and prevent loss of the core due to the washing action of the circulating fluid and disintegration thereof due to the drilling action.

It is, therefore, the principal object of the present invention to generally improve upon the construction of core barrels and to provide a core extractor that will effect a maximum core recovery of a well in soft or sandy formations as well as in harder formations.

The object is attained by enabling the position of the lower end of the core barrel to be changed in an axial direction relative to the cutting teeth of the drill barrel so that in soft formations the lower end of the core tube may be positioned in advance of the drilling shoe and thus receive and protect the core before it has been disrupted by the drilling fluid and action of the cutter teeth and in hard formations the core tube may be positioned with the cutter teeth in advance thereof so that the core is formed by the cutter head and then received by the core tube.

A further object of our invention is the provision of improved means for mounting the core tube within the drill barrel body which facilitates the ready removal of the core tube from the drill barrel after the core has been taken.

One form which the invention may assume is exemplified in the following description and illustrated by way of example in the accompanying drawing, in which:

Fig. 1 is a central vertical section of a rotary core barrel constructed in accordance with the invention and showing the core tube in a low-

ered position suitable for taking a core from soft or sandy formation.

Fig. 2 is a similar view showing the core barrel in its raised or normal position for extracting a core from harder formations.

Fig. 3 is a section taken on the line III—III of Fig. 4.

Fig. 4 is an enlarged fragmentary view partly in section illustrating the construction of the thrust sub which permits easy removal of the core barrel from the drill barrel.

Referring more particularly to the drawing, a rotary core barrel is shown as comprising a drill barrel 10 which is fitted at its lower end with a threaded sleeve 11. This sleeve 11 is welded to the drill barrel body and receives a drilling shoe or cutter head 12 on its lower threaded end. The cutter head 12 is provided with cutting teeth 13 which upon rotation of the drill barrel cut an annular groove in the formation penetrated to form a core that may be extracted from the well for examination.

The upper end of the drill barrel body 10 is connected by welding or other suitable means with a sleeve 14 exteriorly threaded at its upper end for connection to a drill barrel sub 15, which sub has a threaded socket for the reception of a drill stem 16 by means of which the core barrel is operated.

A core tube assembly is carried interiorly of and coaxially with the drill barrel body 10 and consists of a thrust sub 17 supporting the assembly, a swivel joint and thrust bearing 18, an extensible coupling generally indicated at 19 and a core tube 20.

The thrust sub 17 consists of a central body member with four radially extending arms 21 as best shown in Figs. 3 and 4, it being understood that the number of arms employed may be more or less at the option of the manufacturer. The outer ends of the arms 21 fit in notches 22 formed in the upper edge of the sleeve 14 to prevent rotation of the thrust sub, and longitudinal movement of the sub is prevented as it is securely held between the drill barrel sub and the upper edge of the sleeve 14.

A sleeve 23 is threadedly secured to the thrust sub 17 and depends downwardly therefrom having an inwardly extending annular shoulder 24 at its lower end. This shoulder 24 supports a thrust bearing which forms a swivel connection between the drill barrel body and the core assembly. This thrust bearing comprises thrust rings 25 and 26 and ball bearings 27. An axial spindle 28 extends upwardly through the sleeve

and thrust bearing and is fitted with a nut 29 and a lock nut 30 at its upper end so that its weight is supported by the thrust bearing and it is free for rotational movement relative to the drill barrel body. A thrust collar 31 prevents upward movement of the spindle 28.

The spindle 28 extends downwardly and forms a part of the extensible coupling 19. The coupling 19 consists of a collar 32 threadedly connected to the spindle 28 and secured against rotational movement thereon by means of a lock nut 33. A slip collar 34 is mounted for sliding movement on the spindle 28 below the collar 32, and as shown in Fig. 2, is held against the collar 32 by means of stud bolts 35. The slip collar 34 is provided with a downwardly extending interiorly threaded sleeve-like extension 36 for the reception of a sleeve 37 which is welded at its lower end to a core tube sub 38 which supports the core tube 20 in a conventional manner. The core tube sub 38 is provided with the usual check valve 39 which serves to prevent drilling fluid from entering the core tube from the upper end thereof but permits escape of the fluid within the core tube as the tube receives the core.

In the operation of the device as so far described, the entire unit is lowered into the well from which a core is to be taken. The drill barrel is rotated so that the teeth of the cutter head 12 cuts an annular groove to produce a core. As the groove is cut, the entire device moves downwardly and a trimmer shoe 40 fixed to the lower end of the core tube trims the outer wall of the core before it is received by the tube, it being understood that the core tube does not rotate because of the provision of the swivel joint in the core tube assembly.

The trimmer shoe 40 is fitted with core retaining mechanism generally indicated at 41 which serves the purpose of pinching off the core and retaining it within the core tube as the device is drawn from the well. This mechanism is fully described and claimed in a copending application entitled "Core tube trimmer shoe", filed June 7, 1933, Ser. No. 674,651.

The operation as above described is applicable to the position of the core tube assembly illustrated in Fig. 2 of the drawing, which position is employed when the core is being taken from solid formation.

When the formation from which the core is to be taken is soft or sandy, the device is used in the position shown in Fig. 1, in which position the stud bolts 35 have been removed, permitting the slip collar 34 to slide downwardly upon the spindle 28 until it abuts a thrust collar 42 which limits its downward movement. As the slip collar 34 supports the core tube through the sleeve 37 and sub 38, this downward movement permits the core tube to move downwardly until the lower edge of the trimmer shoe extends to a position in advance of the cutting edges of the teeth 13, as clearly illustrated in Fig. 1.

The weight of the core tube 20 and the frictional force of the drilling fluid which is being pumped downwardly through the drill barrel to lubricate the cutter head serve to maintain the core tube in this downward position and cause the trimmer shoe to be advanced into the formation prior to action upon the formation by the cutting teeth 13 and the drilling fluid. Thus, the soft or sandy formation is received by the core tube before it has been broken up and disrupted by the drilling operation. Thus, by simply removing the stud bolts 35, the device may be

converted from a core extractor capable of operation in hard formations to a core extractor that is particularly adapted to the removal of soft or sandy cores.

When a core of the length desired has been extracted, the entire device is drawn from the well and in order to remove the core tube assembly from within the drill barrel, it is merely necessary to remove the drill barrel sub 15 from the sleeve 14, said members being threadedly connected as described above. After the sub 15 has been removed, the thrust sub may be grasped by an upwardly extending perforated boss 43 and the entire core tube assembly drawn from within the drill barrel whereupon the core is removed from the core tube in a conventional manner.

From the foregoing it will appear that the present invention provides a rotary core barrel which through simple and novel mechanical means is made adaptable to the recovery of cores from either soft or hard formations and in which the core tube assembly may be expediently removed after the core has been extracted.

While we have shown the preferred form of our invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A core barrel comprising a drill barrel, a core tube in the drill barrel, and a connection between the core tube and drill barrel comprising a spindle supported axially of the drill barrel and free to rotate relative thereto, a sliding collar on said spindle, means connecting the core tube to said collar to permit movement of the core tube axially of the spindle, a pair of collars fixed to the spindle above and below said sliding collar to limit said movement, and means for securing said sliding collar to the uppermost of said fixed collars.

2. A core barrel comprising a drill barrel, a core tube in the drill barrel, and a connection between the core tube and drill barrel comprising a spindle supported axially of the drill barrel and free to rotate relative thereto, a sliding collar on said spindle, means connecting the core tube to said collar to permit movement of the core tube axially of the spindle, a pair of collars fixed to the spindle above and below said sliding collar to limit said movement, and bolts securing said sliding collar to the uppermost of said fixed collars to retain the core tube in a raised position relative to the drill barrel, said bolts being removable to permit the core tube to move to a lower position.

3. A core barrel comprising a drill barrel having notches formed in its upper end, a thrust sub having radial extensions fitting in said notches, a spindle supported by said thrust sub and free to rotate relative thereto, a swivel connection permitting relative rotation of said spindle and sub, a core tube supported by said spindle, and an extensible connection between the core tube and spindle whereby the position of the core tube may be varied axially of the spindle and drill barrel.

4. A core barrel comprising a drill barrel, a core tube suspended in said drill barrel, means for supporting said core tube in the drill barrel, said means comprising a sub having radially extending arms, the inner wall of the drill barrel

being notched for the reception of said arms to prevent turning movement of the sub in the barrel, a spindle carried by said sub and held from axial movement thereby, but rotatable in said sub, and an operating connection between said sub and said core tube.

5 5. A core barrel comprising a drill barrel, a core tube suspended in said drill barrel, means for supporting said core tube in the drill barrel, 10 said means comprising a sub having radially extending arms, the inner wall of the drill barrel

being notched for the reception of said arms to prevent turning movement of the sub in the barrel, a spindle carried by said sub and held from axial movement thereby, but rotatable in said sub, an operating connection between said sub and said core tube, said operating connection enabling the position of the core tube to be axially adjusted on said sub. 5

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