Aug. 7, 1945. J. C. STOKES 2,381,844

CORE TAKING APPARATUS

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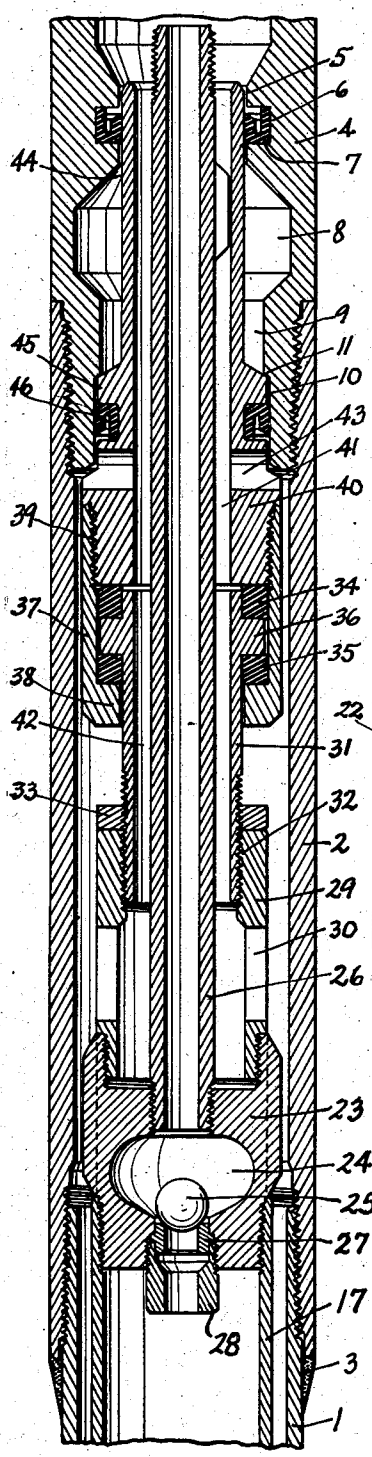

Fig. 1.

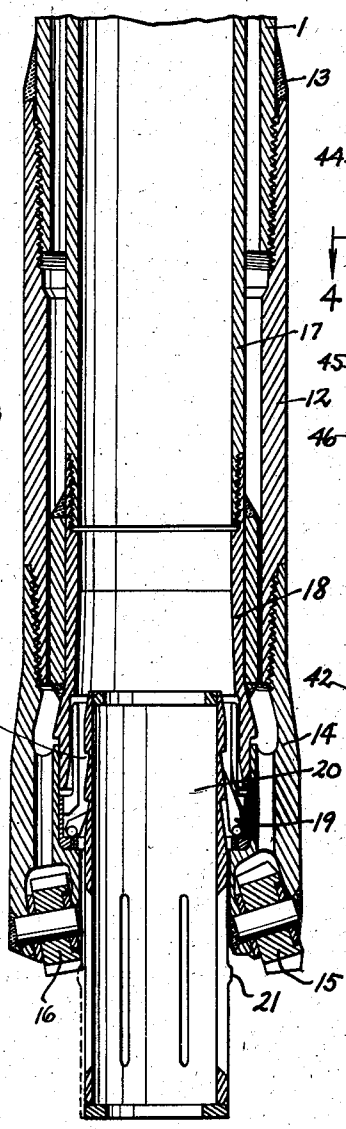

Fig. 2.

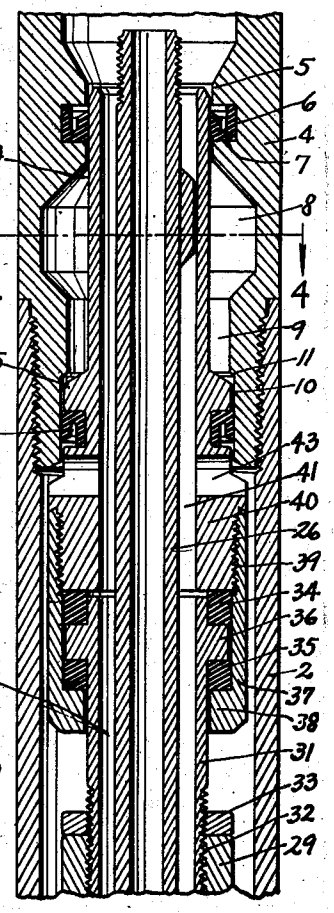

Fig. 3.

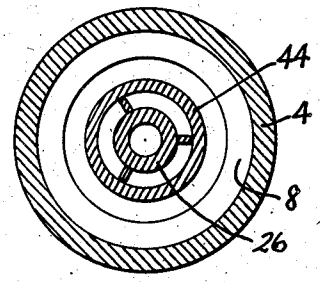

Fig. 4.

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CORE TAKING APPARATUS

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8 Claims. (Cl. 255—72)

This invention relates in general to core taking apparatus and has for its general object the provision of a novel and advantageous means for suspending for free rotation during the taking of a core the core barrel which is adapted to receive the core.

It is customary in connection with core taking apparatus of the type in which the core receiving barrel is carried within an outer barrel and inserted into the well when the drill stem is run in, to provide some means whereby the inner core barrel assembly may be suspended so that it may rotate freely during the taking of a core. However, such means in the past have consisted of some sort of mechanical latching means whereby the core barrel assembly is latched within the outer barrel so that it will be suspended within the outer barrel from its upper end. Such a form of suspension makes it necessary that before the inner barrel can be removed for the purpose of removing and examining the core, some mechanical latching means must be first released. The presence of such latching means also introduces the ever present hazard that the latching means may accidentally become released during the use of the device and thus render useless the intended means for suspending the inner core barrel.

It is therefore an object of the present invention to provide a means for suspending an inner core barrel which means will not involve the use of any mechanical latching device.

Another object of this invention is to provide a suspending means for an inner core barrel assembly, which suspending means will automatically be released upon withdrawal of the device to the surface of the ground after the taking of a core, so that the inner core barrel assembly may be withdrawn from the outer barrel without necessity for releasing any latching device whatever.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing wherein is set forth by way of illustration one embodiment of this invention.

In the drawing:

Fig. 1 is a longitudinal cross section through the upper portion of the device constructed in accordance with this invention.

Fig. 2 is a similar view through the lower portion of the same device.

Fig. 3 is a view similar to Fig. 1 but showing the position occupied by the various parts when the device is at the surface of the ground and not under the fluid pressure which exists at the bottom of a well.

Fig. 4 shows a cross section taken along the line 4—4 of Fig. 3.

Referring now more particularly to the drawing, the outer core barrel is illustrated at 1 and has threadedly secured to its upper end a collar 2, the same being welded to the outer core barrel at 3 to provide a more secure joint. The upper end of the collar 2 is internally threaded for the purpose of receiving the special sub 4 that is in turn carried by the lower end of the drill stem. This special sub 4 has a bore therethrough with zones of various different diameters. An upper portion of this bore is provided with a zone 5 of relatively small diameter, this zone having a recess 6 intermediate its ends adapted to receive a U-shaped packing member 7 so disposed as to prevent the passage of fluid downwardly about a cylindrical member located in this portion of the bore as will be presently described. Below the zone 5 is a zone 8 of relatively much larger diameter and below this zone 8 is a third zone 9 which is again of a smaller diameter but not of as small diameter as the zone 5. Just below the zone 9 is still a fourth zone 10 of slightly larger diameter than the zone 9 so as to provide a shoulder 11 therebetween.

The lower end of the outer barrel 1 is threaded to receive the upper end of a sub 12 which is additionally secured to the outer barrel by means of welding 13. This sub 12 is threaded at its lower end to receive the core drill 14 which may be of any usual or desired construction and in the present instance is shown as provided with roller cutters 15 and 16 such as are ordinarily used for the purpose of drilling through hard rock formations.

The inner core barrel 17 has a fitting 18 secured to its lower end and providing an extension of the inner barrel, and a suitable core catcher element 19 is carried within the drill bit 14 just below the lower end of the fitting 18. A suitable protector sleeve 20 is initially suspended upon the core catcher 19 and prevented from upward movement into the core barrel by means of the projections 21 adjacent its lower end. These projections 21 are mounted on flexible parts of the sleeve 20 so that when a substantial amount of force is exerted on the lower end of the sleeve 20 it may be forced upwardly into the core barrel. Suspension of this sleeve 20 by means of the core catchers 19 is made possible by virtue of the fact that the outer surface of the sleeve 20 adjacent

its upper end is notched as shown at 22 to receive the core catcher fingers.

At its upper end the inner core barrel 17 is provided with the usual core barrel head 23 which may be of any desired form. In this instance it is provided with an enlarged valve chamber 24 adapted to receive a ball valve 25 which is in turn held in place and prevented from upward movement out of the valve chamber 24 by means of a tubular member 26. This valve 25 is adapted to seat against a valve seat 27 which is in turn held in place by means of a nut 28. It will readily be seen that this valve will permit flow upwardly from the inner core barrel during the taking of a core but will not permit flow downwardly into the inner core barrel. However, with this type of device it is intended that after the core barrel has been withdrawn from the well and it is desired to remove the core, the core barrel may be laid on its side so that the valve 25 will move into a lateral portion of the chamber 24, whereupon pressure fluid may be forced in through the tubular member 26 to force the core out of the lower end of the core barrel.

Threadedly secured to the upper end of the core barrel head 23 is a cage 29 having lateral openings 30 therefrom. This cage 29 is suspended by means of a suspension head 31 threaded at 32 to the cage 29, this threaded connection being locked by means of a lock nut 33.

This suspension head is rotatably mounted between two suitable bearing rings 34 and 35 which may be of rubber or some similar material, the suspension head 31 having a flange 36 that fits between these bearing rings. The bearing rings themselves are carried within a cup-shaped retainer 37 which has an inturned flange 38 at its lower end and is threaded at 39 at its upper end on to the plunger 40.

The plunger 40 has a bore 41 therethrough corresponding in diameter to the diameter of the bore 42 through the suspension head 31, and this plunger is also provided with lateral outlets 43 from this bore.

The plunger 40 is provided with an upper cylindrical part 44 adapted to be disposed within the zone 5 of the special fitting 4, and with a lower part 45 of relatively larger diameter adapted to fit within the zone 10 of the fitting 4 but of a sufficiently large diameter so that it will not pass upwardly past the shoulder 11. This portion 45 is provided with a circumferential groove adapted to receive a sealing ring 46 which may be of U-shaped form and so disposed as to prevent the flow of any fluid between the plunger 40 and the inner surface of the fitting 4 in an upward direction. The ring 7 previously mentioned also forms a seal about the portion 44 of the plunger and prevents the downward flow of any fluid about the outside of this plunger and within the fitting 4. There is thus provided what may be termed a differential piston, or one having a greater effective area at one end than at the other, so that when both ends are subjected to the same pressure, the net result will be a force tending to move the piston in one direction which in this case is in an upward direction.

In operation the device is placed within the well with the parts in the positions shown in the drawing with the exception that the plunger will occupy the position shown in Fig. 3 instead of that shown in Fig. 1. It will be seen that when the inner core barrel assembly consisting of the inner barrel and the parts 23, 29, 31 and 40 carried thereby is placed within the outer core barrel and the core drill 14 is secured to the lower end of the outer core barrel, the inner core barrel will rest upon its lower end within the drill bit 14. Prior to placing the device within the well the parts are assembled in the atmosphere and there will be trapped within the zone 8 a volume of air which will be compressed and will serve as a cushion upon upward movement of the plunger 40. As the device is lowered into the well however, the pressure due to the drilling fluid in the well increases. Due to the difference in area between the portion 45 of the plunger 40 and the portion 44 thereof, this increase in pressure of drilling fluid surrounding the device will have a differential effect tending to raise the inner core barrel assembly. When the pressure of the fluid surrounding the device becomes great enough this inner core barrel assembly will rise until the upper end of the portion 45 of the plunger 40 comes in contact with the shoulder 11. This disposition of the various parts is illustrated in Fig. 1 of the drawing and it will be seen that in this figure the inner core barrel assembly will be suspended from the plunger 40.

With the parts in the position indicated the core is taken, the core barrel assembly within the outer core barrel being meanwhile suspended by means of the differential fluid pressure.

After the core has been taken the entire device is removed to the surface of the well. As it is withdrawn and the hydraulic pressure surrounding the device decreases, the differential pressure tending to raise the inner core barrel assembly to its uppermost position as shown in Figs. 1 and 2 will decrease until the point is reached where this core barrel assembly will drop down and the lower end of the inner core barrel will rest upon the interior of the drill bit 14.

When the device has been completely withdrawn from the well, the drill bit 14 may be taken off and the entire inner core barrel assembly removed without the necessity for disconnecting any mechanical latch or other device of any kind.

It will thus be seen that a means has been provided whereby the inner core barrel assembly of a coring apparatus may be suspended during the taking of a core so that it may rotate freely, but this has been accomplished without the use of any mechanical latching mechanism which would require release before the inner core barrel assembly could be withdrawn, or which might become accidentally released so that it would be of no effect. On the other hand, with the device provided by the present invention a sure suspension is provided during the taking of a core, and this suspending means is released automatically as the device is withdrawn from the well.

Means has thus been provided for carrying out all of the objects and advantages sought by this invention.

While it forms no part of the present invention, it will be understood that the tube 26 may be left out when the device is run into the well and that the ball valve 25 may then be dropped into place after the device is already in place in the well. In order that the upper end of this tubular member 26 may be properly centered within the bore through the plunger 40, the tubular member is provided with radially extending fingers or vanes which serve to center it within the plunger.

Having described my invention, I claim:

1. In a coring apparatus, an outer core barrel, an inner core barrel, and a differential piston on the inner core barrel and fitting within the outer

core barrel, said piston having opposed surfaces of different areas and arranged to be subjected to the action of a fluid exerting the same pressure on the surfaces when the device is immersed in said fluid, said outer core barrel having a cylinder correspondingly shaped to receive the piston and provide a space intermediate the differential surfaces of the piston containing a compressible fluid, and serving for suspending the inner core barrel when the device is immersed in a fluid under pressure.

2. In a coring apparatus, an outer core barrel, an inner core barrel, and a hollow differential piston on the inner core barrel and fitting within the outer core barrel, said piston having opposed surfaces of different areas and arranged to be subjected to the action of a fluid exerting the same pressure on the surfaces when the device is immersed in said fluid, said outer core barrel having a cylinder correspondingly shaped to receive the piston and provide a space intermediate the differential surfaces of the piston containing a compressible fluid, and serving for suspending the inner core barrel when the device is immersed in a fluid under pressure, said hollow piston having a passageway therethrough longitudinally for the purpose of conveying drilling fluid therethrough.

3. In a coring apparatus, an outer core barrel, an inner core barrel, and a differential piston on the inner core barrel and fitting within the outer core barrel, said piston having opposed surfaces of different areas and arranged to be subjected to the action of a fluid exerting the same pressure on the surfaces when the device is immersed in said fluid, said outer core barrel having a cylinder correspondingly shaped to receive the piston and provide a space intermediate the differential surfaces of the piston containing a compressible fluid, and serving for suspending the inner core barrel when the device is immersed in a fluid under pressure, and a swivel connection between said piston and said inner core barrel whereby when said inner core barrel is suspended by said piston the inner core barrel may rotate freely during the taking of a core.

4. In a coring apparatus, an outer core barrel, an inner core barrel, and a differential piston arrangement comprising a relatively larger lower and a relatively smaller upper piston part having a gas filled spaced therebetween at a pressure relatively lower than the pressure of the fluid in which said device is adapted to operate, said differential piston arrangement fitting within correspondingly dimensioned parts of the outer core barrel for suspending the inner core barrel when the device is immersed in a fluid under pressure.

5. In a coring apparatus, an outer core barrel, an inner core barrel, and a differential piston arrangement comprising a relatively larger lower and a relatively smaller upper piston part and a space therebetween filled with air at atmospheric pressure, said differential piston arrangement being carried on the inner core barrel and fitting within correspondingly dimensioned parts of the outer core barrel for suspending the inner core barrel when the device is immersed in a fluid under pressure.

6. In a coring apparatus, an outer core barrel, an inner core barrel, a cylinder carried by the outer core barrel, a piston reciprocably mounted in said cylinder and carrying said inner core barrel, and means closing the upper end of said cylinder and providing a chamber above the piston containing a compressible fluid capable of compression when the apparatus is immersed in a fluid under pressure for suspension of the core barrel.

7. In a coring apparatus, an outer core barrel, an inner core barrel, a cylinder carried by the outer core barrel, a piston reciprocably mounted in said cylinder and carrying said inner core barrel, said cylinder being of restricted diameter at its upper end and the piston having a portion of reduced diameter extending through said restricted portion of the cylinder and through the non-restricted portion of the cylinder to provide an air space in the non-restricted portion of the cylinder between the non-restricted portion of the piston and the restricted portion of the cylinder, the lower end of the cylinder being open to expose the under surface of the piston, and means for supplying a fluid under pressure to both the upper and lower surfaces of the piston to effect an upward movement of the piston and the inner core barrel due to the differential effect of the pressure applied to both sides of the piston and suspend the inner core barrel.

8. In a coring apparatus, an outer core barrel, an inner core barrel, a cylinder carried by the outer core barrel, a piston reciprocably mounted in said cylinder and carrying said inner core barrel, said cylinder being of restricted diameter at its upper end and the piston having a portion of reduced diameter extending through said restricted portion of the cylinder, the lower end of the cylinder being open to expose the under surface of the piston, means for supplying a fluid under pressure to both the upper and lower surfaces of the piston to effect an upward movement of the piston and the inner core barrel due to the differential effect of the pressure applied to both sides of the piston, and suspend the inner core barrel, and means associated with the cylinder intermediate the upper and lower piston surfaces providing a chamber containing a compressible medium to oppose upward movement of the piston.

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