

Dec. 5, 1939.

R. Q. SEALE

2,181,980

DEVICE FOR OBTAINING CORE SAMPLES

Filed Sept. 16, 1938

3 Sheets-Sheet 1

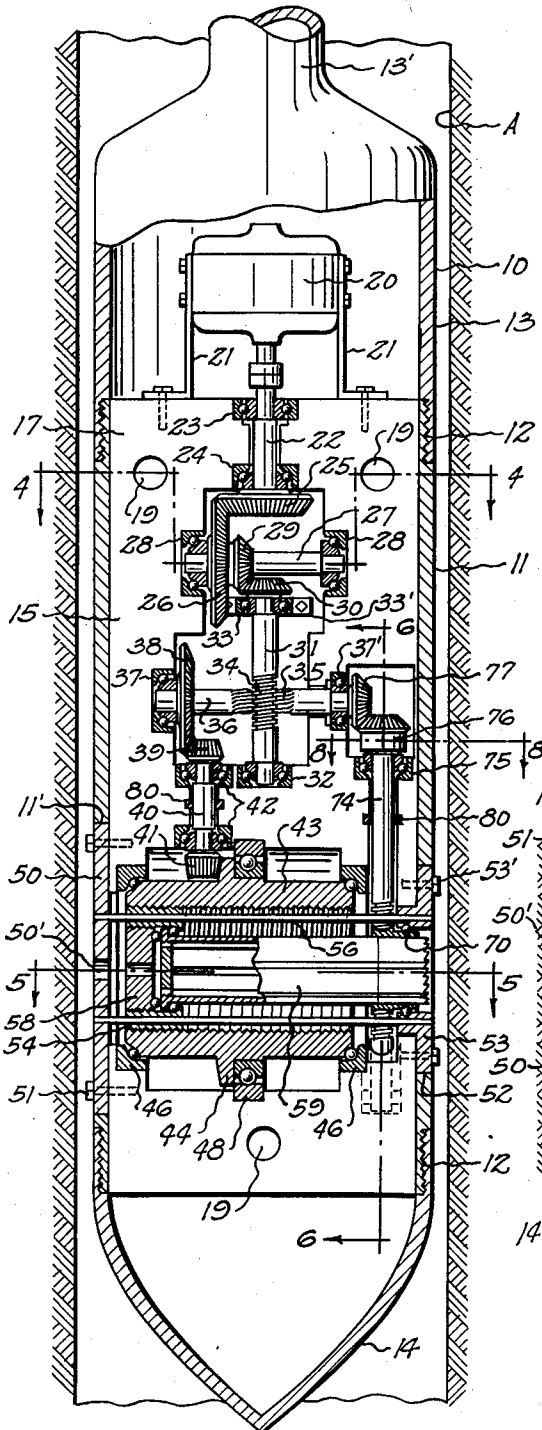


Fig. 1.

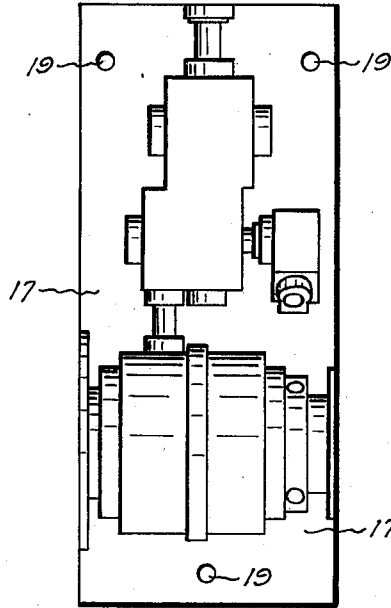


Fig. 3.

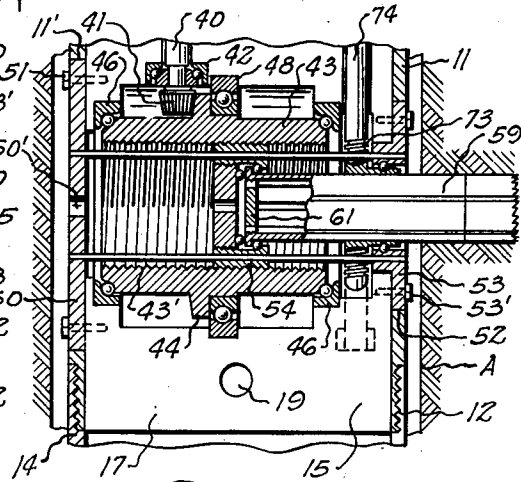


Fig. 2.

Inventor
Roy Q. Seale

Jack A. Ahlby

Attorney

Dec. 5, 1939.

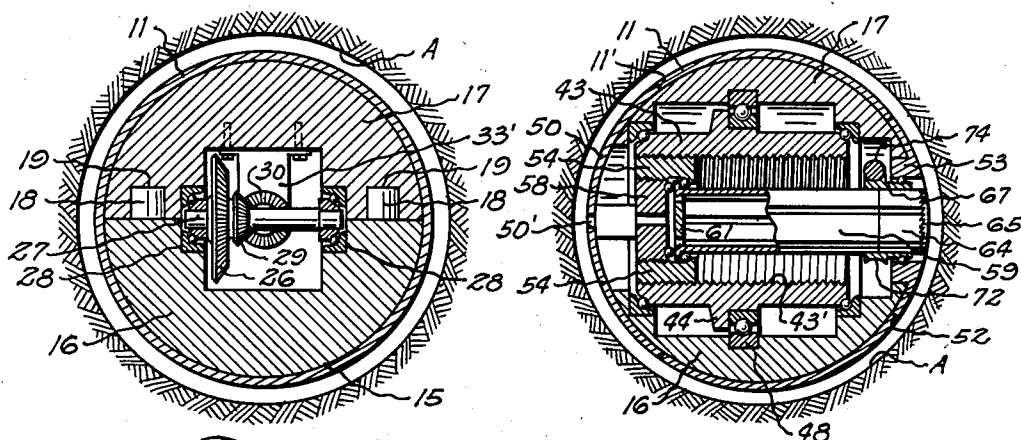
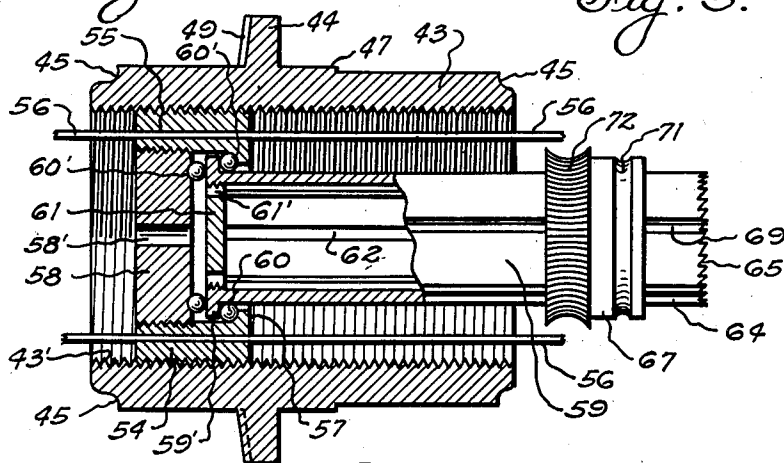
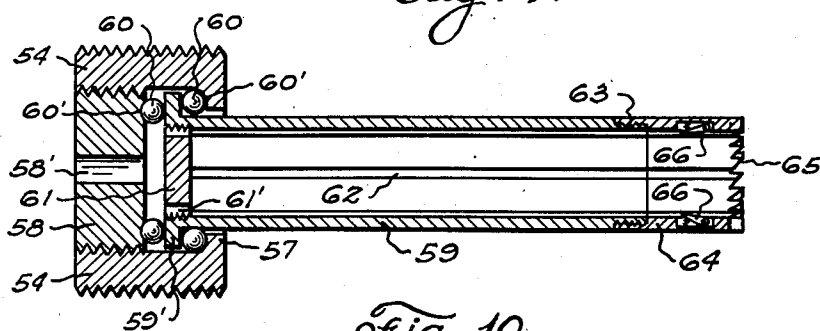
R. Q. SEALE

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DEVICE FOR OBTAINING CORE SAMPLES

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3 Sheets-Sheet 2



Inventor
Roy Q. Seale

Jack A. Chley
Attorney

Dec. 5, 1939.

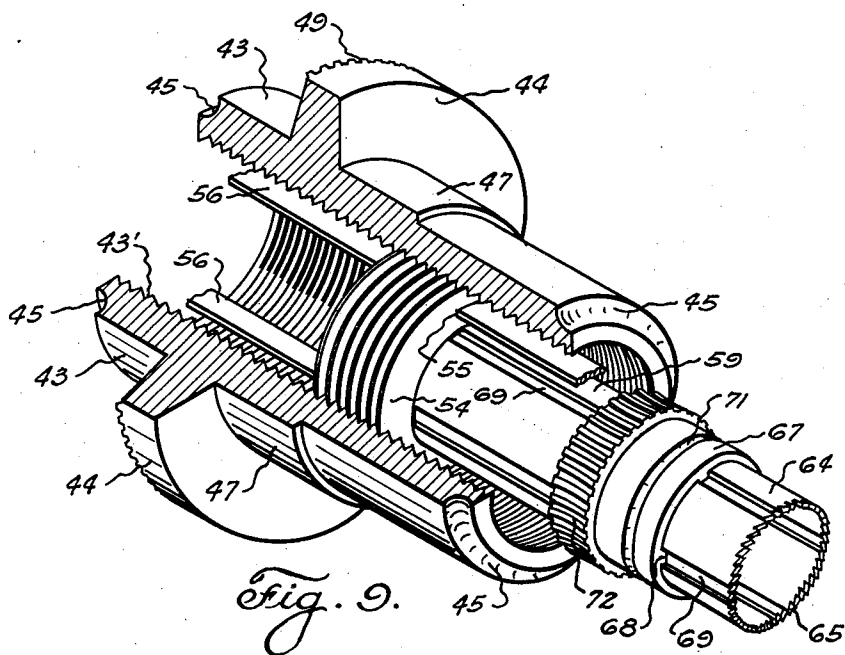
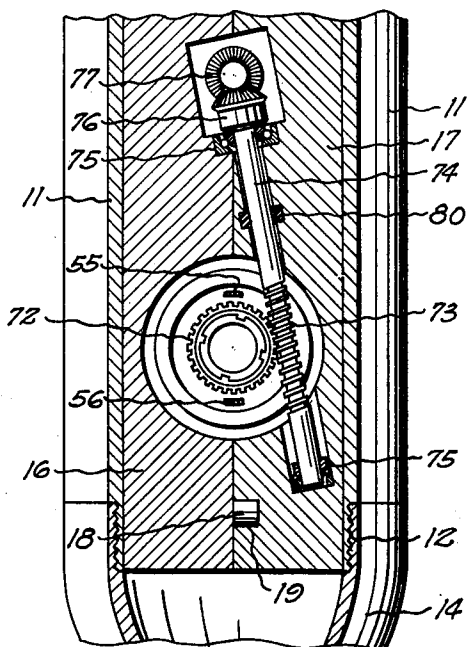
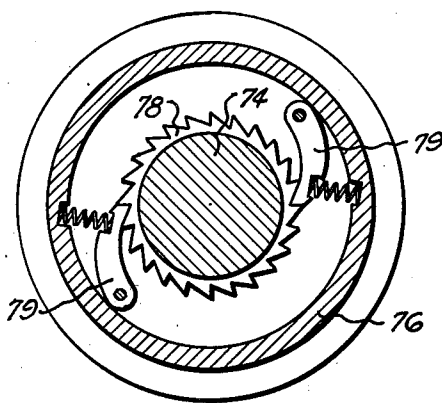
R. Q. SEALE

2,181,980

DEVICE FOR OBTAINING CORE SAMPLES

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3 Sheets-Sheet 3



Inventor
Roy Q. Seale

By *Jack Ashley*
Attorney

UNITED STATES PATENT OFFICE

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DEVICE FOR OBTAINING CORE SAMPLES

Roy Q. Seale, Corpus Christi, Tex.

Application September 16, 1938, Serial No. 230,222

9 Claims. (Cl. 255—1)

This invention relates to new and useful improvements in devices for obtaining core samples.

One object of the invention is to provide improved means for obtaining core samples of sub-surface formations in a well bore.

Another object of the invention is to provide an improved core sampling device including rotatable means for obtaining and retaining a sample core, the device being arranged to be lowered into and removed from a well bore on a wire line, whereby a sample may be taken and removed from the well bore with greater ease and accuracy.

An important object of the invention is to provide an improved core sampling device including a core container for obtaining and retaining a sample core of the formation occurring at any particular depth within the well bore, said core container having a removable cap on its inner end, whereby the sample core may be removed from said barrel in its original form.

A further object of the invention is to provide a core sampling device of the character described, wherein a rotatable core container having small openings in its inner end is employed to permit the passage therethrough of well fluids within the well bore, whereby hydrostatic pressure will not force the sample core out of the core container when it is retracted.

A particular object of the invention is to provide an improved core sampling device including a rotor for ejecting the core removing element and a rotator for rotating the same, the rotor and rotator being adapted to be actuated by suitable gears and an electric motor encased within the device, whereby the movement of said element may be accurately controlled from the surface.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is a view, partly in elevation and partly in section, of a core sampling device constructed in accordance with the invention and showing the core removing element in its retracted or normal position.

Figure 2 is an enlarged transverse, vertical sectional view of the core removing element and its actuating mechanism, the element being shown partially extended.

Figure 3 is a side elevation of one shell of the body.

Figure 4 is a horizontal, cross-sectional view, taken on the line 4—4 of Figure 1.

Figure 5 is a horizontal, cross-sectional view, taken on the line 5—5 of Figure 1.

Figure 6 is a transverse, vertical sectional view, taken on the line 6—6 of Figure 1.

Figure 7 is an enlarged view, partly in elevation and partly in section, of the rotator and core removing element.

Figure 8 is an enlarged horizontal, cross-sectional view, taken on the line 8—8 of Figure 1.

Figure 9 is an enlarged isometric view of the rotator being partially broken away to show its connection with the core container, and

Figure 10 is an enlarged longitudinal, cross-sectional view of the core removing element showing the bit screw-threaded thereon.

In the drawings, the letter A designates a well bore through which a sampling device 10 is lowered by a wire line or cable (not shown). The sampling device includes an elongate cylindrical housing or casing 11, the ends of which are provided with externally screw-threaded flanges 12. A cap 13, having a reduced tapered shank 13' extending upwardly and axially from its upper end is secured to the upper flange 12 and has its shank suitably fastened to a wire line (not shown), whereby the device is supported by said line. A tapered cap or thimble 14, being internally screw-threaded, is arranged to engage the lower flange 12 so as to form a pointed lower end for the device, whereby the same may be readily lowered through the well bore A. A cylindrical body 15, having an external diameter substantially equal to the internal diameter of the housing 11, engages within said housing so as to have a snug fit therein. If desired, the body 15 may be fastened to the housing by suitable means (not shown).

The cylindrical body is composed of a pair of elongate arcuate members or shells 16 and 17, having flat inner faces or surfaces, which are placed face to face to form said body as shown in Figures 5 and 6. The shells 16 and 17 are preformed or cast with suitable recesses and grooves on their inner or flat faces (Figure 3) to accommodate the mechanism of the sampling device, as will be hereinafter fully explained. A plurality of cylindrical lugs or ears 18 are provided on the inner face of the shell 16 and said lugs engage within complementary openings 19 formed in the inner face of the shell 17, whereby

said shells are held together and prevented from moving vertically or laterally.

An electric motor 20 is mounted axially upon the upper end of the body 15 and is supported thereupon by suitable legs or standards 21 which are bolted or otherwise fastened to said body. It is pointed out that the cap 13 completely encloses the motor 20 and lead wires (not shown) may be entwined with the strands of the wire line (not shown), whereby said motor may be furnished with suitable power and can be controlled from the surface of the well. The motor is inverted so that its depending drive shaft may be connected to a vertical shaft 22 which lies within grooves or recesses provided in the inner faces of the shells 16 and 17. A bearing 23, preferably of the ball and race type, engages around the upper portion of the shaft 22, while a similar bearing 24 is mounted on the lower portion thereof. The bearings engage within arcuate recesses in the shells 16 and 17 and permit the free rotation of the shaft within the vertical grooves.

A bevelled gear 25 is mounted upon the lower end of the shaft 22 so as to be in constant mesh with a bevelled gear 26 carried by a short, horizontal shaft 27. The ends of the shaft 27 are journaled within ball bearings 28 which engage within arcuate recesses formed in the shells 16 and 17, whereby said shaft is supported therein. A small bevelled cog 29 is also mounted upon the shaft 27 and engages a second bevelled cog 30 carried by vertical shaft 31 having its lower end journaled within a ball bearing 32. A similar bearing 33 surrounds the shaft 31 immediately below the cog 30 and said bearing is suitably fastened to the inner face of the shell 17 of the body by a bracket 33' as shown in Figure 1. A worm gear 34 is formed on the central portion of the vertical shaft 31 so as to engage a complementary or helical gear 35 formed on the central portion of a horizontal shaft 36, whereby the latter is actuated by the former. Although the gears 34 and 35 may be constructed in any suitable manner, it is preferred to cut the same in the surfaces of the shafts 31 and 36. The latter extend at right angles to each other and are in close proximity so that the worm gear will be in constant mesh with its complementary gear.

The shaft 36 is suitably supported by ball bearings 37 and 37' which engage within arcuate recesses in the shells of the body. A slightly-bevelled gear 38 is carried by the shaft 36 and engages a bevelled pinion 39 so as to be in constant mesh therewith. The pinion 39 is supported upon the upper end of a short vertical shaft 40 which has a similar pinion 41 mounted on its lower end. The shaft 40 is suitably supported by a pair of bearings 42 located adjacent the pinions 39 and 41, whereby said shaft and pinions are free to rotate.

A cylindrical rotating element or rotor 43, having an external radial flange 44 made integral with its central portion, is axially disposed within a cylindrical chamber formed by a pair of large arcuate recesses pre-formed within the shells of the body 15. An annular, bevelled groove or seat 45 is provided in each end of the rotor 43 as shown in Figures 7 and 9 and each groove is engaged by the balls of a ball bearing 46, whereby said rotor is rotatably supported within the recesses formed in the shells 16 and 17. For additional rigidity, an upset shoulder 47 is provided on the external surface of the rotor adjacent the flange 44 and said shoulder has a ball bearing 48 mounted thereon, as is clearly shown in Figures

1 and 2. The opposite side of the flange 44 is bevelled and is provided with radial teeth 49 (Figures 7 and 9) which are engaged by the teeth of the bevelled pinion 41, whereby the rotor may be revolved on its bearings 46 and 48 by the rotation of said pinion.

The inner or rear end of the cylindrical chamber, formed by the large, arcuate recesses of the shells 16 and 17 is reduced in diameter and is enclosed by a curved or arcuate plate 50 which overlies the same. The plate 50, having an axial opening 50', engages within a circular opening 11' formed in the housing 11 which opening surrounds the reduced end of the chamber. The plate is fastened within the opening by suitable bolts 51, whereby the external surface of the same is substantially flush with the exterior of the housing as shown in Figure 5. The outer or forward end of the chamber communicates with a cylindrical chamber of reduced diameter which chamber extends through the shells to the exterior of the body. An external, annular recess, formed by a circular opening 52 in the housing, surrounds the opening to the latter chamber and is adapted to receive the flange of a flanged collar 53 which is secured therein by suitable bolts 53'. It is pointed out that the bolts 51 and 53' of the plate 50 and collar 53, respectively, are screw-threaded into the shells of the body and tend to fasten or hold the latter together.

The bore of the cylindrical rotor 43 is provided with internal continuous screw threads 43' which are engaged by an externally screw-threaded sleeve or cylindrical pusher 54 disposed transversely therein. A pair of diametrically opposed opening or slots 55, being slightly curved or arcuate in vertical cross-section (Figure 9), extend longitudinally through the sleeve 54 and are arranged to receive a pair of rods or guides 56. The latter are positioned longitudinally within the bore of the rotor and project from either end thereof, whereby the ends of the same may extend through and be fastened to the plate 50 and collar 53. It is noted the rods are provided for the purpose of preventing the sleeve 54 from turning when the rotor 43 is revolved, whereby said sleeve will travel or move forwardly through the bore of said rotor as shown in Figure 7.

The sleeve 54 is internally screw-threaded at one end and is formed with an internal annular flange 57 at its opposite end. An externally screw-threaded plate or plug 58, having an axial opening 58', engages the internally screw-threaded portion of the sleeve. A cylindrical core container or removing element 59, having an external annular flange 59' formed on its inner end, is axially disposed within the rotor 43 and has its flange confined within the sleeve between the flange 57 and plug 58, whereby the core removing element is limited in its transverse movement by the travel or movement of said sleeve. The flange 59' of the core removing element is spaced from the flange and plug of the sleeve by a pair of ball bearings 60 which engage within annular bevelled channels or raceways 60' provided in the inner sides of the plug and flange of the sleeve. The core removing element is in this manner rotatably supported within the bore of the rotor.

A removable cap 61, having a plurality of grooves 61' formed in its periphery, is screw-threaded into the inner end of the element 59 so as to form a closure for the same. The grooves 61' are arranged to coincide or communicate with a plurality of longitudinal grooves or channels 62 provided in the bore of the element, whereby

well fluids or drilling mud may rapidly pass there-through without affecting the core sample within said element. It is manifest that the drilling mud and well fluids will also flow through the axial openings 58' and 50' of the plug 58 and plate 50, respectively, whereby the possibility of the core sample being affected by hydrostatic pressure is substantially eliminated. Obviously, the grooves 62 permit the well fluids to lubricate the core removing element while the same is boring into the side wall of the well bore. The forward or outer end of the element is provided with a reduced externally screw-threaded flange 63, whereby a cylindrical core bit 64 may be secured to said barrel as shown in Figure 10. The diameter of the bit 64 is substantially the same as the diameter of the element, whereby said bit forms a flush continuation of said element. A cutting edge in the form of a plurality of cutting teeth 65 are provided on the outer end of the bit, while a plurality of small core-retaining spring-pressed dogs or hooks 66 are provided within the bore of said bit. The internal channels 62 formed within the element are also provided within the bit.

For imparting rotation to the element 59, a cylindrical rotator or sleeve 67 is disposed transversely within the body 15 in axial alignment with the rotor 43 of said element. The rotator 67, having a plurality of internal radial ribs or projections 68, is arranged to surround the outer end of the element and the bit 64 when the same are in their retracted position and has its ribs engaging within longitudinal grooves or channels 69 formed on the exterior of said element and bit, whereby said rotator is slidably secured to the latter as shown in Figure 9. The outer end of the rotator is supported within the collar 53 by a plurality of balls 70 which are confined within a race formed by a pair of bevelled, annular grooves 71 provided in the adjacent surfaces of said rotator and collar. A worm wheel 72, having a concave periphery, is made integral with the inner end of the rotator 67 and is adapted to be engaged by a worm gear 73, as is clearly shown in Figure 6.

The worm gear 73 is formed on a depending shaft 74 which is suitably supported at its ends by ball bearings 75. A bevelled ratchet gear 76 is mounted upon the upper end of the shaft 74 and meshes with a bevelled pinion 77 carried upon one end of the horizontal shaft 36, whereby rotation of the latter shaft is imparted to the depending shaft. The ratchet gear includes the usual internal ratchet wheel 78 and spring-pressed pawls 79 as shown in the Figure 8, whereby rotation of said gear in clockwise direction will turn the shaft 74 and worm gear 73 in the same direction. However, when the gear is rotated in a counter-clockwise direction, the pawls 79 will ride or slide over the teeth of the ratchet wheel 78 so as to prevent counter-clockwise movement of the shaft and worm gear. Thus, the rotator 67 will only be turned in one direction and will not be turned at all when the rotation of the ratchet gear is reversed.

When it is desired to obtain a sample of any particular sub-surface formation, the sampling device 10 is lowered into the well bore A to the desired depth. The device is suspended by a wire line (not shown) and its core removing element 59 is within the housing 11 in a retracted position as shown in Figure 1. The electric motor 20 is then started by closing a switch (not shown) at the surface of the well, whereby

its drive shaft will turn the vertical shaft 22 and its gear 25 which will drive the gear 26, carried by the horizontal shaft 27, in a clockwise direction. The cog 29 will turn with the shaft 27 so as to rotate the cog 30 and its vertical shaft 31 in the same direction. The horizontal shaft 36 with its gear 38 and pinion 77 will be revolved in a clockwise direction due to the engagement between the helical gear 35 of said shaft and the worm gear 34 of the shaft 31. Since the pinion 39 meshes with the gear 38, the shaft 40 and its lower pinion 41 will be rotated in a similar direction.

Due to the fact that the radial teeth 49 of the flange 44 of the rotor 43 are engaged by the teeth 15 of the pinion 41, said rotor will also be driven in a clockwise direction by said pinion. As a result of such motion, the internal screw threads 43' of the rotor and the externally screw-threaded surface of the sleeve 54 will cause said sleeve to move or travel forwardly within the bore of said rotor as shown in Figure 7. Of course, it is manifest that the rods or guides 56 having their ends secured within the plate 50 and collar 53, will prevent the sleeve from rotating, whereby the latter must travel forwardly when the rotor is revolved in a clockwise direction. Since the element 59 is attached to the sleeve by means of the flange 59', it is apparent that said element will be pushed outwardly through the bore of the rotor. Thus, the element is ejected from the collar 53 into the well bore A. Continued outward movement of the sleeve 54 will cause the teeth 65 of the bit 64 of the element to contact and bite into the side wall 35 of the bore.

While the gear 38 is rotating the pinion 39 and shaft 40, the pinion 77 on the opposite end of the shaft 36 is driving the ratchet gear 76 and depending shaft 74 in a clockwise direction. Since the worm wheel 72 of the rotator 67 engages the worm gear 73 of the shaft 74, said rotator will be revolved in a similar direction. The revolving or turning of the rotator, which is connected to the element 59 and bit 64 by means of the ribs 68 and grooves 69, will rotate said element and bit, whereby the same are rotated and ejected from the rotor simultaneously. Thus, the element and its bit will bore into the wall of the well bore to cut or obtain a sample core from the formation thereof. It is pointed out that the rotator revolves at a greater or higher speed than the rotor because of the greater diameter of the latter, whereby the element and bit are moved slowly outward while being 55 rotated at the high speed of the rotator so as to provide the proper arrangement for the cutting of a core.

When full penetration is reached, the outer end of the sleeve 54 will abut the inner end of 60 the rotator, whereby further outward movement of said sleeve is prevented. At this time, the direction of rotation of the electric motor 20 is reversed by a suitable switch (not shown), whereby the rotative direction of the herein- 65 before set forth gears, shafts and elements will be reversed to retract the core removing element. As the latter is retracted, the core-retaining dogs 66 will be forced inwardly into engagement with the core (not shown) so as to grip and break the 70 same from the wall of the bore, whereby said core is retained within the element. It is noted that the element and bit are not rotated upon being retracted into the rotor due to the provision of the ratchet gear 76. Upon reverse or counter- 75

clockwise rotation of the shaft 36 and the pinion 77, the pawls 79 of the ratchet gear will ride over the teeth of the ratchet wheel and thereby fail to revolve the shaft 74, worm gear 73 and worm wheel 72 as hereinbefore set forth. Thus, the element and bit will slide through the rotator upon being retracted and will not be rotated.

The rotation of the rotor 43 is continued until it is certain that the element has been completely withdrawn or retracted to its original position. With the element retracted and completely within the housing 11, the entire sampling device may be raised to the surface for the purpose of removing and inspecting the sample core. After the device has been removed from the well, the plate 50 is taken off by unscrewing the bolts 51, whereupon the plug 58 may be screwed out of the sleeve 54 so that the element may be pushed outwardly through the inner or rear end of the element, whereby the sample core may be readily removed from said element by pushing it out through the inner end. It is pointed out that the core may be removed from the forward end of the element by unscrewing the bit therefrom. By replacing the elements in their original positions and repeating the hereinbefore described operation at different depths within the well bore, samples of the various formations may be obtained.

It is noted that suitable bushings or packing rings 80 may be disposed around the vertical shafts 40 and 77 to prevent the passage of well fluids upwardly through the body 15, whereby it is substantially impossible for said well fluids to reach the motor 20. The present invention has been described and illustrated with the core removing element disposed in a horizontal plane with respect to the well bore. However, it is manifest that the invention is not limited to any such arrangement. A device of this character may be employed to take cores not only at right angles to the well bore but also at oblique angles or even from the bottom of the bore in the direction of such axis.

Various changes, alterations and modifications may be made in the size, shape and arrangement of the herein described elements, within the scope of the appended claims.

What I claim and desire to secure by Letters Patent is:

1. A device for obtaining core samples including, a housing, a cylindrical member rotatably mounted within the housing, a core removing element within the cylindrical member, means within said member fixed against rotation for ejecting the element when the member is rotated, and ratchet means for rotating said element only while the same is being ejected, whereby said element may be retracted without being rotated.

2. A device for obtaining core samples including, a housing, a core removing element mounted within the housing, means for ejecting the element, a rotatable sleeve surrounding the outer end of said element and having connection therewith for rotating the same, the sleeve being fixed against axial movement, whereby said element slides therethrough, and means including a ratchet for preventing rotation of said element as it is retracted.

3. A device for obtaining core samples includ-

ing, a housing, a core removing element mounted within the housing, a motor mounted within said housing, means operatively connecting the motor to the element for ejecting the same, a rotatable sleeve actuated by said motor and surrounding the outer end of said element, the sleeve having connection with the element for rotating the same and being fixed against axial movement, whereby said element slides therethrough, and means including a ratchet for preventing rotation of said element as it is retracted.

4. A device for obtaining core samples including, a housing, a cylindrical member rotatably mounted within the housing, a core removing element supported within the cylindrical member, means within said member fixed against rotation for ejecting the element when the member is rotated, a rotatable sleeve surrounding the outer end of said element and having connection therewith for rotating the same, the sleeve being fixed against axial movement, whereby said element slides therethrough, and means for preventing rotation of said element as it is retracted.

5. A device for obtaining core samples including, a support adapted to be lowered into a well, a motor carried by said support, a laterally movable core drill mounted in the support, a cylindrical rotor surrounding the drill and internally screw-threaded, a pusher mounted to move longitudinally in the rotor and having screw-threaded transverse engagement therewith, the inner end of the bit being journaled in said pusher, stationary elements extending longitudinally through the rotor and pusher, whereby the pusher is held against rotation, a rotating element keyed on the drill, whereby the drill is rotated while sliding therethrough, means for revolving the rotor, and means for revolving the rotating element.

6. A device for obtaining core samples as set forth in claim 5 and means for interrupting the transmission of motion to the rotating element when the bit is retracted, whereby rotation of said bit is eliminated upon retraction of the same.

7. A device for obtaining core samples as set out in claim 5, and a ratchet connected in the means for driving the rotating element, whereby when the driving means is reversed the rotating element will not be rotated.

8. A device for obtaining core samples as set forth in claim 5 wherein the bit is keyed to the rotating element by a plurality of elongate ribs in the bore of said element engaging in grooves extending longitudinally in the outer surface of said bit.

9. As a sub combination in a device for obtaining core samples, a cylindrical rotor, a ring gear surrounding said rotor, the inner surface of said rotor being externally screw-threaded, a pusher having external screw-threads and fitting within the rotor, a bit having one end rotatably held within the pusher, a rotating element keyed to the bit by a plurality of elongated ribs in the bore of said element engaging in grooves extending longitudinally in the outer surface of said bit, and means located near the outer end of said bit for holding a core within said bit when the same is being retracted from a formation.