Sept. 15, 1964 A. M. L. CAUCHOIS 3,148,740

APPARATUS FOR CUTTING OUT LATERAL CORES

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FIG. 1

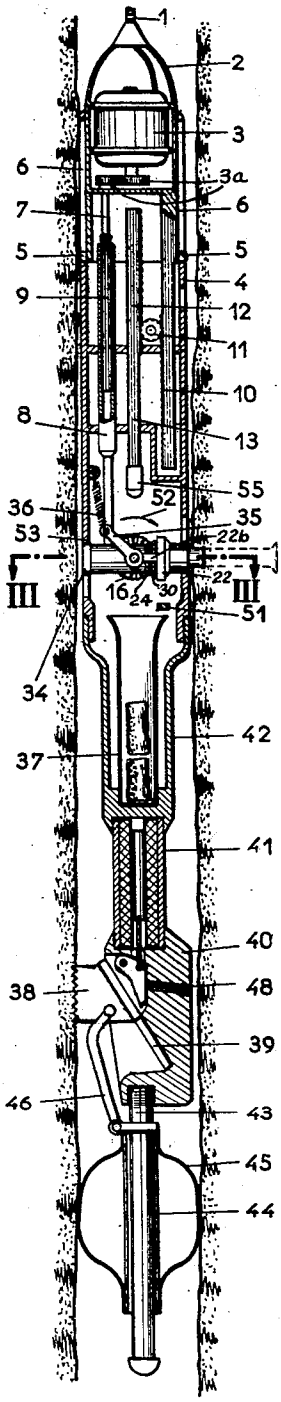

FIG. 2

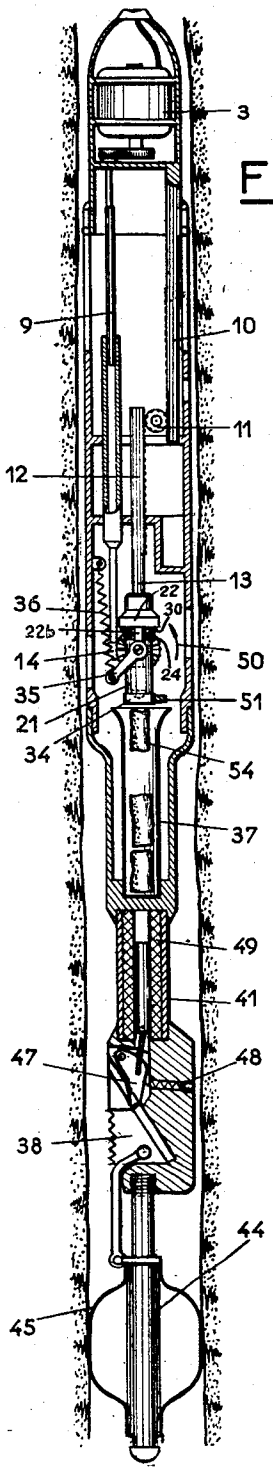

FIG. 4

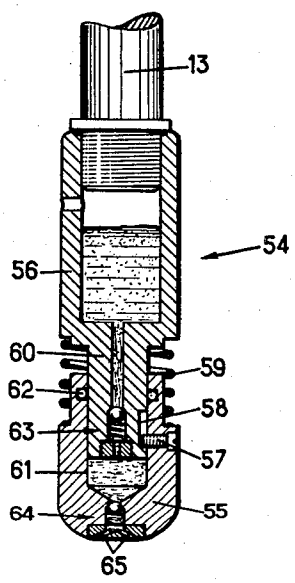

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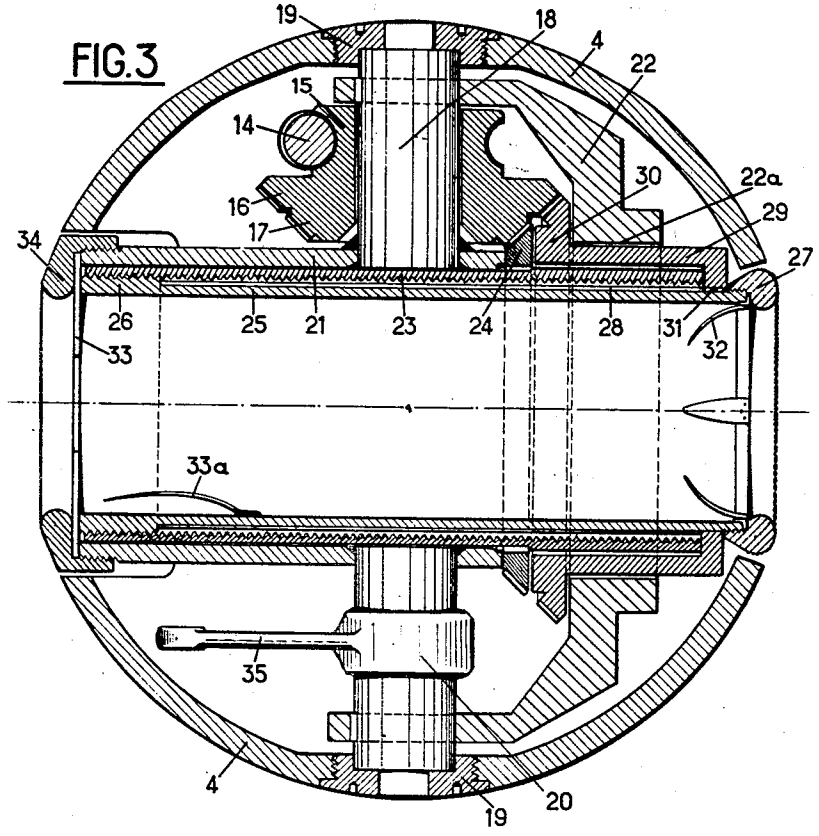
FIG.3



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APPARATUS FOR CUTTING OUT LATERAL CORES

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In the course of earth boring operations, whether for geological exploration or oil well drilling, it is always essential to know the nature of the earth through which the drill bit is passing. None of the known means for determining from the surface the nature and position of the successive subsurface layers has been able to satisfactorily replace the direct examination and analysis of specimens thereof. This necessitates the frequent stopping of the drilling process and withdrawal of all the rods which have been sent down, so that a core-cutter and the necessary rods for carrying it may be sent down instead—all of this to secure a single "core."

In order to avoid much of this extra work, which seriously slows down the drilling process, it has been proposed to drill a long bore without stopping to take samples, and then to cut out a number of lateral cores at different depths, thus saving considerable time in the completion of the operation. Unfortunately, the devices for cutting out lateral cores are usually capable of securing only one core at each descent of the core cutter, or a very small number of cores, which are too small to be capable of yielding the information required.

The purpose of the present invention is to provide a device for cutting out lateral cores which permits the removal of cores which are as large as possible in both length and width, and sufficient in number to reduce the total drilling time lost to a minimum.

The object of the present invention is to provide a new article of manufacture which consists of a laterally acting core cutter, characterized by the fact that it comprises a core-cutter which is rotated and driven forward by a coaxially positioned differential screw jack which is supported by a cradle which oscillates about a horizontal axis so that it can swing from the horizontal position, in which it cuts out the core, to a vertical position in which the cores which have been removed may be vertically discharged by means of a plunger in to a magazine coaxial with the device.

In a preferred embodiment of the invention, the differential screw is driven by a double pair of bevel gears, the two driving gears of each pair being fixed together and turning around the axis of oscillation of the cradle, a motor driving there gears in such manner as to produce in the desired order, first the turning of the cradle about its axis, then the rotation and advance or withdrawal of the core cutter. The vertical plunger which discharges the cores is independently actuated by pulling on the supporting cable and is withdrawn when tension thereon is released. An anchoring device, which may be locked in its inactive position, then hold the device stationary in the well. The apparatus may also comprise means for automatically marking the cores.

In order that the object of the invention may be better understood, one embodiment thereof will now be described, purely by way of example. This embodiment is illustrated on the accompanying drawing, in which:

FIG. 1 shows a vertical cross-section taken through the device in working position;

FIG. 2 is a like vertical cross-section taken through the device in its non-acting position in which it may be moved up and down in the bore;

FIG. 3 is a transverse cross-section taken along the line III—III of FIG. 1; and

FIG. 4 is an axial cross-section through the marking device.

The device shown on FIG. 1 is suspended at the end of a cable 1, into which electrical conductors are incorporated. It comprises a housing 2 which carries an electrical reversible motor 3. This housing 2 is made of a cylindrical steel body which is axially slidable, but not rotatable, in the main body 4. At its upper end the housing arches inward to avoid getting stuck in the hole when being pulled up. The housing 2 contains the motor 3, mounted on suitable brackets therein, together with gears 3*a*, and is fluid-tight so as to exclude dirt and mud from the interior thereof. The housing is provided with pins 5 which slide in slots 6 in the cylindrical main body 4. Thus the distance which the housing can slide within the body is determined by the length of the slots 6, and when the body 4 is stopped, the weight of the housing 2 will tend to drop it relative to the body 4 until the pins 5 reach the lower ends of the slot 6.

During this movement the shaft 8 of the core cutter is driven from the eccentrically positioned output shaft 7 of the motor 3 through a sliding key 9. At the same time, the vertical movement of the housing 2 with respect to the body 4 moves a rack 10 fixed to said casing, and thus, through a reversing pinion 11, drives in the opposite direction a rack 12 fixed to the rod 13 which ejects the cores.

The core-cutting mechanism, shown in cross-section on FIG. 3, comprises a worm screw 14 at the end of the shaft 8 which is tangent to and drives the gear 15 fixed to a bevel gear comprising two sets of teeth 16 and 17. The shaft 18 passes through the single member which carries the sets of teeth 15, 16 and 17, and turns in a bearing 19 fixed to the body 1. On the opposite side there is a shaft 20 in alignment with the shaft 18 and likewise turning in a bearing 19. Between the two inner ends of the shafts 18 and 20 is a perpendicularly positioned tubular sleeve 21. The two outer ends of the shafts 18 and 20 carry a member 22, which may be made in one piece or in a plurality of parts, and the purpose of which is to prevent the gear 30 from becoming disengaged from the gear 16. The member 22 is provided with a bore 22*a* in which the member 29 turns freely, and also comprises arms 22*b* which are bored to receive the shafts 18 and 20. These arms are keyed to the latter shafts in a position such that the bore 22*a* is coaxial with the tubular sleeve 21.

A sleeve 23 turns inside the tubular sleeve 21, and is internally threaded and fixed to a bevel gear 24 engaging the teeth 17. Inside the threaded sleeve 23 is the core cutting tube 25 which is provided with a threaded end 26 which screws into the tubular sleeve 23 and a core bit 27 at the opposite end. Between the members 26 and 27, the core cutting tube 25 is provided with one or more longitudinal grooves 28. Finally, a tubular member 29 turns in the bore 22*a* and is fixed to a bevel gear 30 in engagement with the teeth 16 and provided at its other end with complementary grooves 31 by means of which the member 25 is rotated but which also permit it to slide axially.

The gear sets 17 and 24 on the one hand and 16 and 30 on the other hand, have ratios which are almost, but not quite, identical. They may differ, for example, by a single tooth. In like manner, the rotation of the screw 14, which is driven by the motor 3 and drives the gear 15 and sets of teeth 16 and 17, drives the core bit 27 at a suitable speed, through the gear 30 and the member 29, and at the same time slowly advances this tool because the threaded part turns at substantially the same speed as the screw 23 and only the slight difference in speed between the gears 24 and 30 advances this threaded part in the threaded sleeve 23.

The bit 27 is of the customary type, that is to say, made of a very hard metal, and may comprise tungsten carbide or diamond inserts. Inside the core-cutting tube 25 and at the end provided with the tool 27 are a certain number of resilient claws 32 which serve to extract the cores during the retraction of the tube 25. Finally, at the opposite end, there is a core holding device consisting, for example, of a rubber disc 33 fixed to the tubular sleeve 21 by a screw 34, or of leaf springs 33*a* fixed to the wall of tube 25, or of both of these means together.

The shaft 20 also carries a lever 35, to the end of which a vertical spring 36 is connected.

As seen on FIGS. 1 and 2 a tube 37 is positioned below the core-cutting device and serves as a magazine for receiving cores which have been cut out. The lower end of the device is provided with means for holding it at a desired position in the drill hole, said means comprising a gripping shoe 38 slidable along an inclined slide 39, which is carried by the member 40 fixed to the casing 4 of the apparatus by means of a threaded tube 41 and connecting member 42. A cylindrical rod 43 extends downward from the member 40 and a tubular sleeve 44 slides thereon. The sleeve 44 carries about its periphery a certain number of leaf springs 45 which slide along the walls of the well. The tubular sleeve 44 is connected to the shoe 38 by a rod 46.

As seen on FIG. 1, when the apparatus as a whole is moved downward, the friction between the wall of the well and the leaf springs 45 causes the shoe 38 to rise along the incline until it comes into contact with the well wall. The braking effect produced tends to increase automatically due to the weight of the apparatus and thus holds the entire assembly in place. On the contrary, when the apparatus moves upwardly, the shoe 38 is released and falls to the position shown in FIG. 2. In this position a pawl 47 biased by a spring 48 latches the shoe 38 down to prevent it from rising again into a position which would prevent vertical movement of the apparatus. The pawl 47 may, however, be retracted by an electro-magnet 49 inside the tube 41, in order to permit the shoe to function as a brake.

When the direct control current travels in one direction the motor 3 tends to turn, if it can, in a direction such that it drives the gear 15 and the sets of teeth 16 and 17 in the direction shown by the arrow 50 (FIG. 2), the member 21 being then vertical and resting on a stop 51, and the ejection rod 13 being inside the core-cutting tube 25, as shown on FIG. 2. The electro-magnet 49 connected in series or in parallel with the motor 3 brings the pawl 47 to its release position. At this moment, if the device is permitted to descend slightly by paying out the cable 1, in succession, the shoe 38 is brought into its FIG. 1 position, in which it locks the apparatus against the wall of the well. When the cable is payed out a little further, only the housing 2 continues to descend and lifts the ejection rod 13 as shown in FIG. 1, the core-cutting device remaining vertical. The direction of flow of the current is then reversed, so that the motor turns in a direction which causes the gears 16–17 to turn in the direction of the arrow 52. It is easy to see that this rotation first causes the core-cutting device, which is carried in its cradle 21–22, to rotate about the axis 18–20. The spring 36 draws the lever 35 upwardly to assist in this movement. Once the cradle has swung into its horizontal position, the tube 21 or the member 34 abuts at 53 against the wall of the body 4, and only then does the core bit 27 begin to rotate and advance. The difference between the gear ratios 17–24 and 16–30 and the hands of the threads 26 and 23 are so chosen that rotation of the gears 16–17 in the direction of the arrow 52 advances the core-cutting tube 25 in the manner hereinbefore described.

Once this core-cutting tube 25 reaches the end of its path of travel, the threaded part 26 encounters the member 29 which locks the mechanism and thus stops the motor 3, which becomes immediately apparent at the surface by reason of a sudden increase in the current.

Another reversal in the direction of current flow will then withdraw the core-cutting tube 25, which extracts the core 54 by means of extracting claws 32, the cradle 21–22 being kept horizontal during this movement by the spring 36 and the fact that the tube 25 is inside the hole which has just been drilled into the ground. When the core-cutting tube 25 is completely withdrawn and returned to the position shown in FIG. 3, the base of the tool 27 encounters the end of the member 29 and locks the core-cutting mechanism, but the direction of rotation of the gear 15 being that indicated by the arrow 50, the assembly swings about the axis 18–20, stretching the spring 36. When the tube 21 or the nut 34 again encounters the stop 51, the current again increases abruptly, thus signalling the operator at the surface that the movement has terminated. A pull on the cable will then cause the descent of the ejection rod 13, which pushes into the magazine tube 37 the core 54 which has just been extracted, and has been held by the spring 33*a* and the rubber disc 33.

As the cable continues to rise, the shoe 38 retracts and assumes the position shown on FIG. 2. The relative slidability between the motor housing 2 and the main casing 4 has the additional advantage of permitting dislodgement of the shoe by a series of alternate jerks and releases of the cable in the event it should tend to stick to the wall of the well. Once the current has been cut off in this manner, the pawl 47 moves to lock this shoe in its retracted position and the core-cutting device is locked in its vertical position by the penetration of the ejection rod 13 into the core-cutting tube, and by the irreversibility of the drive between the worm screw 14 and gear 15. It is then possible to raise or lower the apparatus at will in order to cut out a new core at any depth desired. The magazine tube 37 may be as long as desired so as to permit the operator to collect as large a number of cores as necessary between trips of the apparatus to the surface.

As a special improvement the apparatus comprises means for marking the cores, which is particularly useful when a large number are being secured and there is danger that they may not be properly differentiated if broken. For this purpose the end of the rod 13 is provided with a marking tip shown in detail on FIG. 4.

This comprises an end portion 55 which comes in contact with the core and a base portion 56, these two parts being relatively slidable over a distance limited by suitable stop means consisting, for instance of a screw 57 which cooperates with the recess 58. The spring 59 tends to bias the parts 55 and 56 apart.

The part 56 comprises an inner reservoir containing a marking fluid, such as an ink or a dense high viscosity paint, in alignment with a cylindrical part 60 which acts as a piston and extends into a bore 61 in the part 55. A sealing ring 62 prevents leakage. Two valves 63 and 64 are positioned in the parts 60 and 55 respectively, with their valve members so biased that they act as a suction pump which expels through the orifices 65, at each ejection of a core, a certain quantity of the marking fluid, determined by the relative stroke between the parts 55 and 56.

The apparatus according to the invention thus resolves the problem posed, since as will readily be seen on FIG. 3, it permits the operator to secure cores which are quite large and long in proportion to the diameter of the body 4. It also permits a large number of cores to be cut out, marked to show where one core ends and the next begins, and stored. Finally the apparatus is relatively simple, reliable, and easy to use.

It will of course be appreciated that the foregoing embodiment of the invention has been described purely by way of example, and may be modified as to detail without thereby departing from the spirit of the invention.

What is claimed is:

1. Core removing means comprising an elongated hollow casing formed with a longitudinal wall having an opening therein, said casing being adapted to be suspended in a well, annular carrier means pivotally mounted in said casing to swing about an axis substantially diametral of said casing into and out of alignment with said opening, a first internally threaded open-ended sleeve having a length less than the diameter of said casing and rotatably mounted in said annular carrier means, a second open-ended sleeve having external threads mating with the internal threads of said first sleeve and rotatably mounted in and projecting from said first sleeve, a core cutter carried at said projecting end of said second sleeve, reversible power transmission means in said casing for swinging said carrier means and sleeves as a unit in either direction about said axis between a first position in which said carrier means and sleeves extend longitudinally of said casing in alignment with said opening and a second position in which they extend transversely with respect to said casing, a stop in said casing positioned to prevent swinging movement of the carrier means past the said transverse position, said power transmission means being constructed and arranged to relatively rotate said sleeves at slightly different speeds when the carrier is in abutment against said stop, thereby gradually projecting the end of said second sleeve carrying said core cutter out of said first sleeve to cut a core and upon reversal of direction of said power transmission means withdrawing it into said first sleeve to retract a core, whereupon further reverse movement of said power transmission means returns said carrier and sleeves to said first position, a core holder mounted in said casing below said sleeves, a core ejecting plunger movably carried by said casing above said sleeves, and means carried by said casing for advancing said ejecting plunger into said second sleeve to eject a core therefrom into said core holder when said sleeves are in their first position.

2. A device as claimed in claim 1 comprising an anchoring shoe carried by said casing for engaging the wall of a well, means for advancing and retracting said shoe as said casing is lowered and raised, means for latching said shoe in its retracted position and means for releasing said latch.

3. A device as claimed in claim 1 in which the pivotal mounting for said carrier means comprises axle means positioned transversely of said casing and said means for rotating the sleeves comprises a first bevel gear carried by said first sleeve, and a second bevel gear carried by the projecting portion of said second sleeve, each of said bevel gears being connected to drive the sleeve by which it is carried together with a third bevel gear rotatably mounted on said axle means and provided with two sets of teeth, each of which meshes with the teeth of one of said first and second bevel gears, the gear ratios of the two sets of intermeshing gear teeth being slightly different, and means for driving said third bevel gear in either direction.

4. A device as claimed in claim 1 in which said core ejecting plunger comprises at its tip pressure responsive marking liquid ejecting means positioned to be actuated when said tip is brought into contact with a core.

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