July 7, 1936. D. THRIFT 2,046,798

METHOD AND APPARATUS FOR CORE DRILLING

Filed Sept. 25, 1935 2 Sheets-Sheet 1

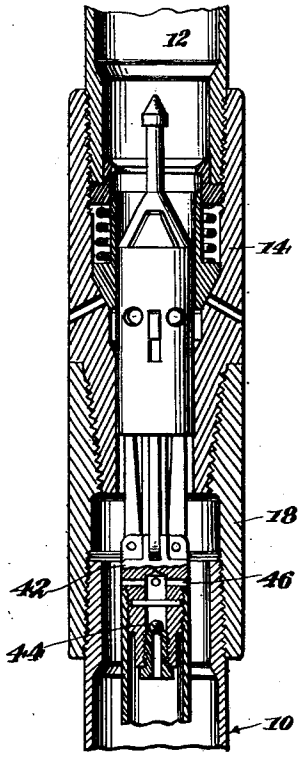


Fig. 1.

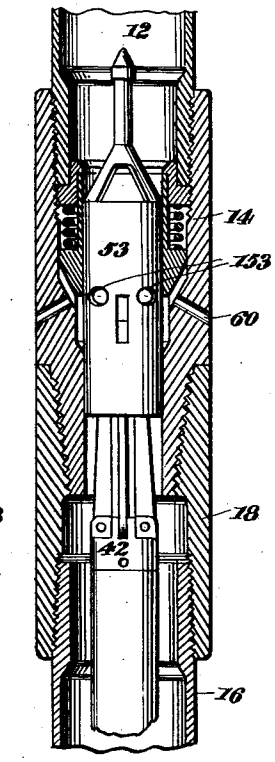


Fig. 2.

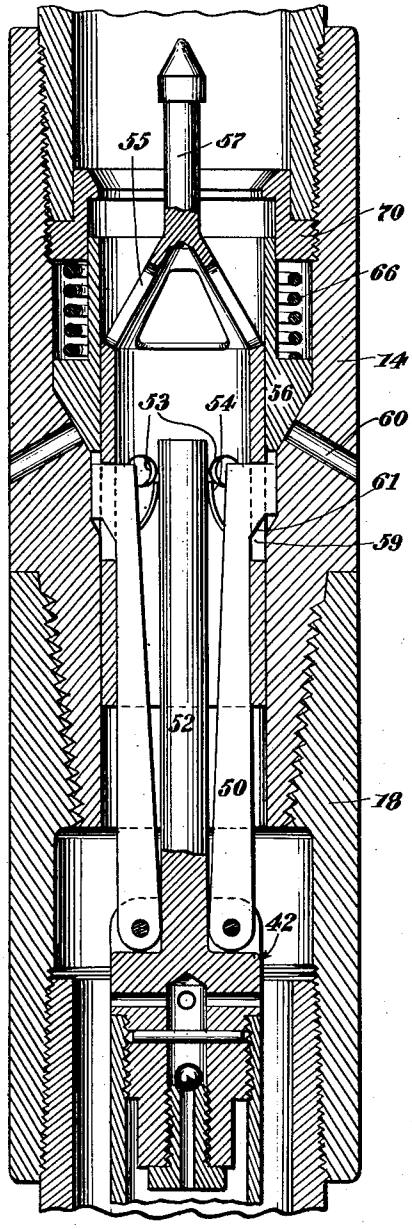
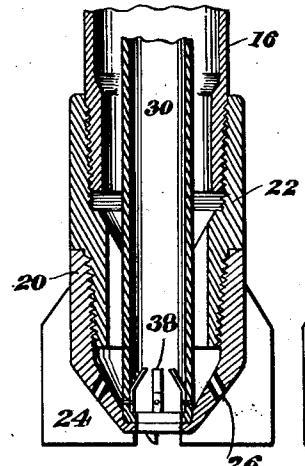
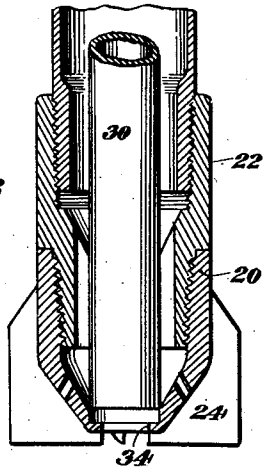


Fig. 3.





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Fig. 4.

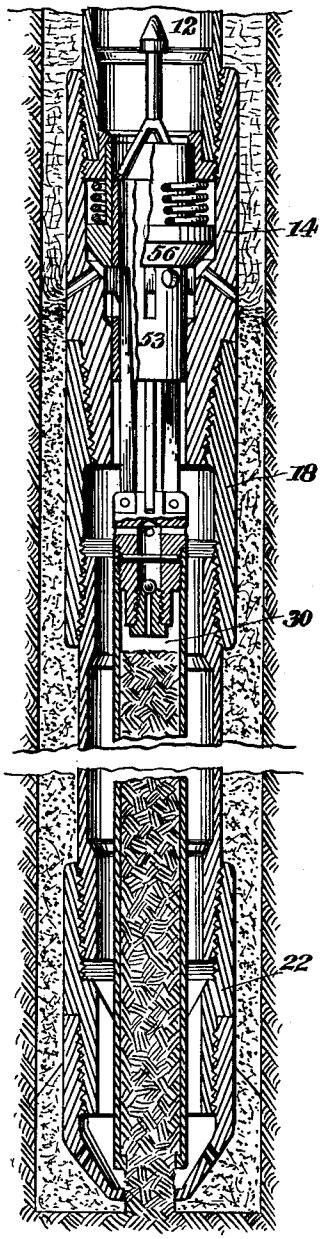


Fig. 5.

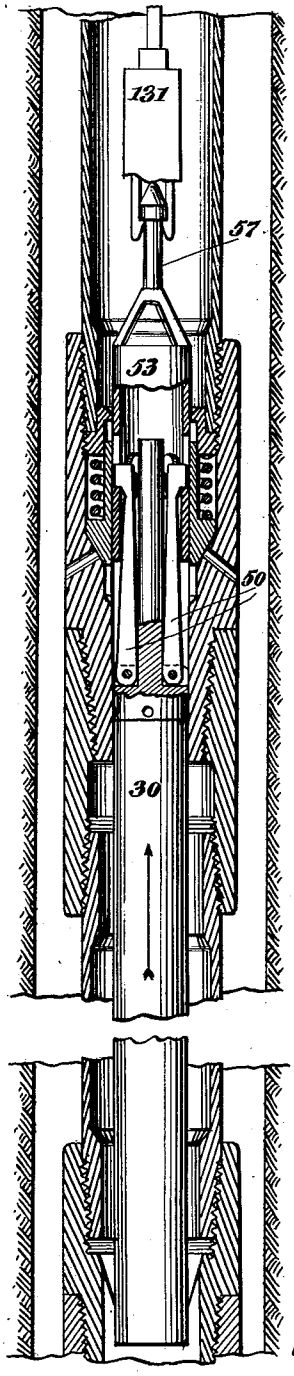
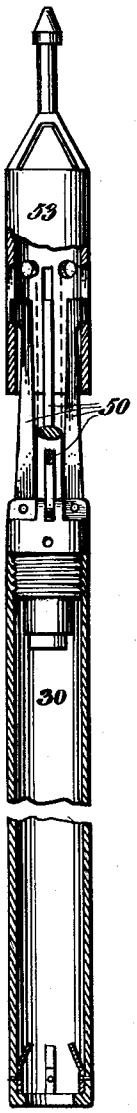


Fig. 6.



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Patented July 7, 1936 2,046,798

UNITED STATES PATENT OFFICE

2,046,798

METHOD AND APPARATUS FOR CORE DRILLING

Dean Thrift, San Antonio, Tex.

Application September 25, 1935, Serial No. 42,083

20 Claims. (Cl. 255—72)

This invention relates to a method of core drilling and to an improved core barrel for use in taking samples or specimens of formations encountered in drilling wells.

More particularly, the invention has reference to that type of core barrel employed in connection with rotary drilling tools, as distinguished from cable tools, and is designed to be introduced into the well and removed therefrom by way of the rotary drill stem, thereby avoiding the need of removing the drill stem for the purpose of taking the cores that are so important in determining the nature of the formations being encountered, such as a formation which serves as a marker or one of the kind which bears oil.

The value of frequent and generous coring during drilling is a matter of ever increasing appreciation not only in connection with the well being drilled but in indicating the probable formations to be encountered in surrounding locations, with the result that some large scale operators have come to the point where they core continuously for thousands of feet, in contrast to the more general practice of merely taking occasional cores during the progress of the drilling operation.

As in the case of other previously known core barrels, the invention contemplates a core barrel in which a cutter bit makes an annular cut which leaves intact a central core for entrance to a core retainer and one of the features of this invention will be found to reside in the provision of means by which the driller on the surface is notified or signalled when the core retainer has been filled with a core or when congestion has occurred at a point between the ends of the core retainer preventing the entrance of additional material into the core retainer and in either case calling for a halt in the core drilling equipment and the elevation of the core retainer to the surface.

By way of further brief preliminary reference to this important feature of the invention, it is pointed out that when the core retainer has become filled or when a congestion of material occurs within the core retainer and prevents the filling of the same, a movement takes place which allows of the free by-passing or flow of drilling fluid and this in turn is indicated by a greatly diminished pressure at the surface so that the driller is instantly advised of the need of stopping the core drilling equipment and of the need of the removal of the core retainer to the surface.

Another major advantage of the invention resides in the fact that when the core retainer has been filled or has become clogged, further substantial advance on the part of the core bit is automatically stopped so as to protect the operator from unknowingly drilling through an important formation. That is to say, when the core retainer is filled or becomes clogged when only partially filled, the principal flow of the drilling fluid is diverted through one or more passages located substantially above the level of the core bit so that the pressure of drilling fluid not only drops to notify the driller but at the same time the flow of the drilling fluid to the core bit practically ceases and thus prevents further progress on the part of the core bit because without the benefit of a constant and forceful flow of fluid to carry away the cuttings, the core bit is interfered with by an accumulation of such cuttings to the point where cutting progress is arrested.

Thus, it will be seen that the invention provides a dual safeguard against substantial core drilling after the core retainer has become filled or clogged, the first of these safeguards being the notice given the driller and the second the diversion of the drilling fluid away from the core bit so that the resulting accumulation of cuttings will arrest substantial progress on the part of the core bit.

Also, the invention provides for the accurate observation of the rate of feed of the core barrel and for the accurate control of such rate of feed during the actual progress of the coring operation so that the driller may feed at the rate dictated by the requirements of the formation being cored. This is an important consideration because, for example, when drilling through a sandy formation, the rate of feed must be rapid to protect the core against being washed away by the immediately surrounding drilling fluid, while in taking cores from formations of gumbo or shale, the rate of feed should be relatively slow to protect the core retainer against congestion when partially filled, it being observed in this latter connection that some shaly formations are known to be sticky and highly prone to congestion not only when taking cores but in ordinary drilling.

In addition, the invention provides for the accurate and convenient regulation of the length of the core to be taken so that when approaching oil bearing formations or formations likely to bear oil, the driller may proceed with the caution that is so important at this stage and, for example, may take a core as short as one foot or less in a core retainer having a vastly greater length.

Another object of the invention is to provide a core barrel which is simple, possessed of but few moving parts and which has the ruggedness necessary to withstand the adverse conditions encountered by such tools.

Other objects and advantages will be apparent during the course of the following description.

In the accompanying drawings, forming a part of this application and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a fragmentary vertical sectional view through the improved core barrel atached to the lower portion of a rotary drill stem and in position for taking a core,

Figure 2 is a similar view with the parts in the relative positions occupied after the core retainer has been filled or after congestion has taken place in the core retainer,

Figure 3 is an enlarged fragmentary sectional view through the core barrel with the parts positioned as shown in Figure 1 and on an enlarged scale,

Figure 4 is a fragmentary sectional view of the improved core barrel in use with the parts in the positions occupied as a result of the filling of the core retainer or congestion therein,

Figure 5 is a fragmentary sectional view disclosing the core barrel with the parts in the positions occupied during the removal of the core retainer,

Figure 6 is a fragmentary sectional view through the core retainer and associated parts removed from the barrel.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of the invention, the numeral **10** generally designates the improved core barrel which is suspended from the usual rotary drill stem **12** through the intervention of a member **14** which functions not only as a tool joint but as a valve cage. As is customary, the drill stem is rotated and advanced from the surface and acts as a conductor for a pressure fluid by which the cuttings are carried to the surface.

More specifically, the core barrel embodies a tubular housing **16** connected at the upper end thereof to the member **14** through the medium of a coupling **18** while the lower portion of the housing **16** has connection with a core bit **20** by means of a second coupling **22**, these parts forming what might be said to be a drill head. As is not unusual, the core bit **20** is shown to be provided with radial or other cutting blades **24** and with water courses or jets **26**. Clearly, the drilling fluid furnished under pressure through the drill stem **12** is directed through the previously mentioned members **14**, **18**, **16**, **20** and **22** and discharges through the water courses **26** into the immediate region of the blades **24** so as to carry off the cuttings.

That is to say, the fluid discharged under pressure through the water courses **26** picks up the cuttings and conducts the same up to the surface exteriorly of the drill stem, thereby avoiding an accumulation of cuttings about the core bit that would promptly and inevitably arrest the progress of the coring operation.

It is shown in Figures 1 and 2 that the blades **24** are spaced about the longitudinally central portion of the core barrel so as to make an annular cut and thereby leave a central unbroken portion of the formation which constitutes the core that is picked up and removed to the surface to indicate the nature of the formation being drilled.

The core thus formed is received within a centrally located core retainer **30** of tubular form. It is clearly illustrated in Figure 1 that the core retainer **30** is intended to rest upon an inwardly flanged or rabbeted portion **34** of the core bit **20**. The lower portion of the core retainer **30** is also flanged inwardly and rests upon the rabbeted inner surface of the core bit **20** with the result that the openings in these two parts are held closely together and in longitudinal alignment for the easy entrance of the core.

The lower or inlet portion of the core retainer **30** may be provided with spring fingers **38** having the upper portions thereof directed inward and being free for restraining engagement with the core upon entrance to the retainer. Thus, during the elevation of the core retainer to the surface, the members **38** assist in preventing the loss of the core.

The core retainer **30** is joined at its upper portion to a combined valve cage and header **42**. Within the member **42** there is positioned an upwardly opening check valve **44**. It is believed to be clear that upon the entrance of material into the retainer **30**, the air or other fluid previously within the retainer is discharged by way of the check valve **44** and the ports **46**. If during the elevation of the core to the surface there is a tendency for the same to drop out of the member **30**, the resulting partial vacuum will cooperate with the fingers **38** in preventing the loss of the newly taken core.

Referring now to Figure 3, it will be seen that the member **42** has pivotal connection with a plurality of dogs or valve opening means **50**. The arms **50** are shown to be mounted about a centrally located stem **52**. The stem **52** extends upward from the member **42** and constitutes a backing or contact means for a plurality of leaf or other springs **54** by which the upper portions of the dogs **50** are urged outward.

Further reference to Figure 3 will reveal that the upper portions of the dogs **50** are provided with lateral or radial projections located beneath and in position to unseat a conical valve **56**. The face or sealing area of the valve **56** engages a complemental seat of the surrounding valve cage **14** and thus closes an annular series of radial relief ports **60** in such valve cage. In other words, the pressure relief unit embodies an outer ported relief element **14** and an inner closure element **56**, the latter being positioned to be engaged by the dogs **50**.

With the valve **56** in closed position as disclosed in Figures 1 and 3, the relief ports **60** are closed with the result that the flow of drilling fluid is through the tubular housing **16** and communicating parts of the core barrel and out through the water courses **26** so as to carry off the cuttings by the core bit.

On the other hand, when the valve **56** is unseated in a manner to be explained and as shown in Figure 2, the principal flow of pressure fluid employed in core drilling is diverted through the ports **60** with the result that, first, there is an immediate and definite drop in the pressure of such fluid and, second, the flow of such fluid to the core bit practically ceases and thereby arrests further substantial progress on the part of the core bit.

In explaining the changed situation due to the unseating of the valve **56**. it is pointed out

that the aggregate area of the ports 60 may be substantially greater than the aggregate area of the water courses 26 so that when the valve 56 is unseated, there will be alloyed a free and generous flow of drilling fluid out through the ports 60 for return to the surface and this, of course, results in a definite and immediate reduction in the pressure of the drilling fluid and an immediate increase in the speed of the engine for operating the pump for such fluid. From these changed conditions on the surface, the driller is instantly notified of the unseating of the valve 56.

Also, since the uncovering of the relief ports 60 allows of the free flow of pressure fluid at a point substantially above the blades 24, there will be but a minor, if any, flow of pressure fluid in the region of the blades 24, with the result that the prompt accumulation of cuttings about the core bit will cause such congestion as will interfere with further substantial progress of the bit.

An expansion spring 66 is shown to be confined between an annular retainer 70 and a shouldered portion of the valve 56 and acts to hold the valve 56 upon its seat until such valve is unseated through action of the arms 50.

In carrying out the invention, the annulus 70 may be threaded into the upper portion of the tool joint 14 and may be formed with a counterbore for the reception of the sleeve-like upper portion of the valve 56 so as to guide the valve in its longitudinal travel.

The arms 50 are shown to be embraced by or positioned within a cylindrical shell 53 which functions as a means of connecting the core retainer to a wire line and as a means for moving the arms 50 inward and out of line with the valve 56 preparatory to the removal of the core retainer to the surface. The upper portion of the shell 53 is shown to have a spider-like or skeleton head 55 and a shank 57 extends upward from this head for connection with a tool, such as an overshot 131 employed in elevating the core retainer. Of course, the shank 57 may be diametrically enlarged at the upper portion thereof to afford a good grip for the overshot.

In explaining how the shell 53 acts to move the members 50 inward out of line with the valve 56, attention is invited to Figure 3 in which it is shown that the shell 53 is formed with radial, longitudinally extending ports or openings 59 of a length greater than that of the laterally projecting upper portions of the arms 50 so as to allow of the spacing of the lower ends of such openings from the cam-like shoulders 61 of the arms.

Thus, when the shell is in what might be said to be the lower position thereof, as suggested in Figures 1 and 3, the arms 50 are allowed to remain in the outer positions thereof. On the other hand, upward movement of the shell 53 will result in engagement of the lower ends of the openings 59 with the cam-like shoulders 61, thereby causing the dogs 50 to move in out of line with the valve 56 to permit of the removal to the surface of the core retainer and associated parts.

In use, the housing 16 and parts rigidly associated therewith are lowered into the well by the drill stem 12 so as to bring the core bit 20 into cutting engagement with the bottom of the well or with the bottom of a previously made extension thereof. Following this, the core retainer 30 is introduced into the well so as to engage the lower end of the same with the seat 34 of the core bit. With the core retainer thus positioned in the housing 16 and rigidly associated parts, the valve 56, of course, remains in sealing engagement with the relief ports 60 so that with the supply of drilling fluid to the drill stem and the core barrel, such drilling fluid will travel through the shell 53, the parts 16, 18 and 22 and out through the water courses 26 so as to pick up the cuttings as the same occur and conduct such cuttings to the surface.

By reason of the weight of the core retainer and parts carried thereby, the same will remain in the seated position as shown in Figure 1 during the progress of the coring operation or until congestion occurs within the member 30. In other words, the core retainer advances simultaneously and coextensively with the core bit until the core retainer is filled with material or until such congestion takes place within the core retainer as will prevent the admission of additional material to the core retainer.

With the core retainer thus filled or congested, further advance of the same is arrested while a limited further advance of the core bit is, of course, allowed. That is to say, the core bit and the parts rigidly associated therewith will continue to advance after the core retainer has become filled or clogged, which leads to the statement that this relative advance on the part of the core bit and rigidly associated parts advances the valve 56 into engagement with the arms 50. This, of course, unseats the valve 56 and thereby allows of the flow of drilling fluid through the relief ports 60 and up to the surface. The ports 153 of the sleeve 53 are shown to be in feeding relation to the ports 60.

As previously brought out, diversion of the drilling fluid results in an immediate drop in the pressure of such fluid and this, of course, is noticeable not only by the gages on the surface but in an immediately accelerated speed on the part of the engine employed to operate the pump for creating such pressure.

When the driller is thus notified of the opening of the valve 56 and hence of the need to remove the core retainer to the surface, he should immediately halt operation of the coring equipment.

However, after the opening of the relief ports 60, further substantial progress on the part of the core bit 20 is interferred with by the cuttings which accumulate about the blades 24. This is true because with the diversion of the pressure fluid through the relief ports 60, the flow of such fluid through the water courses 26 practically or entirely ceases and the resulting accumulation of cuttings about the blades 24 prevents further material progress on the part of the core bit. Hence, the driller is prevented from drilling unknowingly through a tell-tale or an oil bearing stratum, and, as brought out in the opening paragraphs of the specification, this constitutes one of the major features of the invention and so far as I know, is new.

In other core barrels in general use, there is nothing to prevent substantial progress on the part of the drill after the core retainer has become filled or congested and because of this, it is not infrequent that important marker formations or oil bearing formations are drilled through and entirely missed.

Thus, it will be seen that there is provided a dual safeguard against unintentional advance of the core barrel after the core retainer has been

filled or has become congested, the first safeguard being the notice given the driller by the diminished pressure on the part of the drilling fluid. The second safeguard is automatic in that the filling of the core retainer or the congestion of the core retainer when only partly filled results in the diversion of a substantial flow of drilling fluid from the core bit and in the prompt accumulation of a sufficient amount of cuttings to arrest further material progress on the part of the core bit.

In practice, the drill stem may be advanced at any desired rate during the progress of the core drilling operation so that the driller may feed at the rate dictated by the requirements of the formation being cored. This is an important consideration because different rates of feed are required for different formations. For example, when drilling through a sandy formation, the rate of feed must be rapid so as to protect the core against being washed away by the immediately surrounding drilling fluid. On the other hand, when coring formations of gumbo or shale, the rate of feed must be relatively slow to protect the core retainer against congestion when only partially filled. It might be explained that formations of shale and gumbo are known to be sticky and prone to cause such congestion within the core retainer as will interfere with the complete filling of the core retainer. This calls for a slow feed.

In addition, the length of the core taken may be accurately regulated by the driller on the surface through regulated advance of the drill stem and in this way, I am permitted to take a core as short as possibly a foot or less in a core retainer having a vastly greater length. Thus, when aproaching an oil bearing formation or a formation likely to bear oil, the driller may proceed with the caution that is so important at this stage.

From the foregoing, it will be seen that the method of core drilling outlined herein provides for the expeditious recovery of cores and for a positive protection against such injudicious operation of the core barrel as would cause the bit to advance through what might happen to be an important formation without a deposit of that formation in the core retainer. That is to say, the various steps of the method look to the uninterrupted recovery of the cores as distinguished from other methods in which the core bit is allowed to advance through an important formation without actually taking core.

As brought out in the opening paragraphs of this specification, core drilling is important not only in connection with the well being drilled but in determining the probable formations to be encountered when drilling in surrounding locations. Such knowledge is known to be exceedingly important because it is useful in determining whether to drill or not to drill in surrounding locations and in this way provides for the relatively economical production of oil.

It is to be understood that the form of invention herewith shown and described is to be taken merely as a preferred example of the same and that such changes in arrangement and construction of parts may be made as will remain within the spirit of the invention and the scope of what is claimed.

Having thus described the invention, what is claimed is:

1. The herein described method of core drilling wells which consists in longitudinally feeding a cutting element into the formation being encountered so as to define a core; feeding a core retainer in consonance with the advance of the cutting element and in the same direction to receive the core being formed; furnishing a circulating flow of pressure fluid to the immediate region of the cut being made to carry off the newly created and loose cuttings; and diverting the major flow of pressure fluid away from the immediate region of the cut being made when the advance of the core retainer in consonance with the advance of the cutting element is interrupted due to the filling of the core retainer or congestion therein so that the resulting accumulation of newly created cuttings arrests further substantial progress on the part of the cutting element to the end that the cutting element is inhibited from advancing through an important formation without a simultaneous reception of a portion of that formation in the core retainer.

2. The herein described method of core drilling wells which consists in longitudinally feeding a cutting element into the formation being encountered so as to define a core; furnishing a circulating pressure fluid to the immediate region of the cut being made and observing the approximate pressure of such fluid; feeding a core retainer into the formation in consonance with the advance of the cutting element; and diverting and relieving the major flow of such pressure fluid away from the immediate region of the cut being made to diminish the pressure of such fluid when the continued advance of the core retainer is interrupted due to filling of the core retainer or congestion therein so that the diminished pressure of such fluid may be observed on the surface to signal the filling of the core retainer or congestion therein and so that the resulting accumulation of newly created cuttings in the immediate region of the cutting element arrests further substantial progress on the part of the cutting element to the end that a dual protection is provided against core drilling through an important formation after the core retainer has been filled or after congestion has taken place therein.

3. The herein described method of core drilling wells which consists in feeding a cutting element into the formation being encountered so as to define a core; feeding a core retainer into the formation in consonance with the advance of the cutting element and in the same general direction to cause the newly formed core to enter the core retainer; furnishing a circulating pressure fluid to the immediate region of the cut being made to carry off the newly created cuttings; and then, upon the failure of the core retainer to advance in consonance with the cutting element due to the filling of the core retainer or congestion therein, by-passing a substantial portion of the pressure fluid in a path removed from the cut being made so that the resulting accumulation of cuttings arrests further substantial progress by the cutting element until the core retainer is prepared for further advance.

4. The herein described method of core drilling wells which consists in feeding a cutting element into the formation being encountered so as to define a core; feeding a core retainer in consonance with the advance of the cutting element to cause the newly formed core to be received within the core retainer; furnishing a circulating pressure fluid to the immediate region of the cut being made to carry off the newly created

cuttings and then upon congestion within the core retainer or the filling of the core retainer causing a substantial and noticeable variation in the pressure of such fluid so that the core drilling may be temporarily halted for the removal of the core retainer.

5. In a core barrel for use in connection with rotary drilling, a core retainer for the reception of a portion of the formation being cored, a housing receiving said core retainer and having means for rigid association with a rotary drill stem to turn and advance therewith, a core bit rigidly associated with said housing and formed with water courses communicating with the housing and drill stem for the passage of a pressure fluid employed in drilling, there being relief ports associated with said housing at a point substantially above said water courses and adapted for communication with the interior of the drill stem, a valve carried by said housing and normally closing said relief ports, and means carried by said core retainer and positioned in the path of travel of said valve for engaging and unseating said valve when the valve is carried forward by the forward movement of said housing and core bit with respect to the core retainer thereby diverting the major flow of pressure fluid from said water courses and thus arresting further substantial progress on the part of the core bit.

6. In a core barrel for use in connection with rotary drilling, a core retainer for the reception of a portion of the formation being cored, a housing receiving said core retainer and having means for rigid association with a rotary drill stem to turn and advance therewith, a core bit rigidly associated with said housing and formed with water courses communicating with the housing and drill stem for the passage of a pressure fluid employed in drilling, there being relief ports associated with said housing at a point substantially above said water courses and adapted for communication with the interior of the drill stem, a valve carried by said housing and normally closing said relief ports, means carried by said core retainer and positioned in the path of travel of said valve for engaging and unseating said valve when the valve is carried forward by the forward movement of said housing and core bit with respect to the core retainer thereby diverting the major flow of pressure fluid away from said water courses and thus arresting further substantial progress on the part of the core bit, and a member for lifting engagement with the said valve actuating means and having a head for engagement by a lifting tool.

7. In a core barrel for use in connection with rotary drilling, a core retainer, a core bit having rigid association with a drill stem and having water courses for the passage of a pressure fluid employed in drilling, said core bit being movable forwardly independently of the core retainer and having means supporting the core retainer, a valve cage in rigid association with said core bit and having relief ports for the passage of the pressure fluid, a valve movable forwardly with said valve cage and normally closing said ports, and means associated with said core retainer and positioned in the path of forward travel of said valve for engaging and unseating the valve when the valve is carried forwardly so as to uncover said relief ports and thereby divert the major flow of the pressure fluid away from said water courses and thus arrest further substantial progress on the part of the core bit after the core bit moves a predetermined distance with respect to the core retainer.

8. In a core barrel for use in connection with rotary drilling, a core retainer for the reception of a portion of the formation being cored, a core bit associated with said core retainer and movable forwardly in consonance with the core retainer and also movable forwardly independently thereof, said core bit being formed with water courses for the passage of a pressure fluid employed in drilling, a valve cage having relief ports a substantial distance rearward of said water courses for the passage of the pressure fluid, a valve within said cage and having means for closing said ports, and means for unseating said valve and thereby uncovering said ports for the free flow of the pressure fluid therethrough when the core bit advances a predetermined distance without a corresponding movement on the part of the core retainer.

9. In a core barrel for use in connection with rotary drilling, a core retainer for the reception of a portion of the formation being cored, a core bit associated with said core retainer and movable forwardly in consonance with the core retainer and also movable forwardly independently thereof, said core bit being formed with water courses for the passage of a pressure fluid employed in drilling, a valve cage having relief ports a substantial distance rearward of said water courses for the passage of the pressure fluid, a valve within said cage and having means for closing said ports, means for unseating said valve and thereby uncovering said ports for the free flow of the pressure fluid therethrough when the core bit advances a predetermined distance without a corresponding movement on the part of the core retainer, and a member to move the said valve actuating means out of operative relation with the valve preparatory to the removal of the core retainer to the surface.

10. In a core barrel for use in connection with rotary drilling, a core retainer for the reception of a portion of the formation being cored, a core bit associated with said core retainer and movable forwardly in consonance with the core retainer and also movable forwardly independently thereof, said core bit being formed with water courses for the passage of a pressure fluid employed in drilling, a valve cage having relief ports for the passage of the pressure fluid, a valve within said cage and having means for closing said ports, means for unseating said valve and thereby uncovering said ports for the free flow of the pressure fluid therethrough when the core bit advances a predetermined distance without a corresponding movement on the part of the core retainer, and a housing in rigid association with said core bit and said valve cage and embracing said core retainer.

11. In a core barrel for use in connection with rotary drilling, a core retainer for the reception of a portion of the formation being cored, a core bit associated with said core retainer and movable in consonance therewith and also movable independently of the core retainer, said core bit being formed with water courses for the passage of a pressure fluid employed in drilling, and means effective upon a predetermined independent movement of the core bit with respect to the core retainer to divert the major flow of the pressure fluid away from said water courses.

12. In a core barrel for use in connection with rotary drilling, a core retainer for the reception of a portion of the formation being cored, a core

bit associated with said core retainer and movable forwardly in consonance therewith and also movable forwardly independently of the core retainer, said core bit being formed with water courses for the passage of a pressure fluid employed in drilling, and means effective upon a predetermined independent forward movement of the core bit with respect to the core retainer to divert the major flow of the pressure fluid away from said water courses and to cause a reduction in the pressure of such fluid.

13. A core drill having in combination, a core retainer; a core drill head receiving the core retainer and movable relative thereto; a fluid conduit in communication with the head and adapted to receive fluid under pressure; and fluid pressure relief means operative upon a predetermined downward movement of the core drill head with respect to the core retainer to indicate such movement by relief of fluid pressure in said conduit.

14. A core drill having in combination, a core retainer; a core drill head receiving the core retainer and having water courses for the discharge of drilling fluid into the immediate proximity of the formation being drilled to carry off the cuttings; there being means for the advance of the core drill head with and independently of the core retainer; a conduit for the drilling fluid and having communication with the water courses to furnish drilling fluid thereto; and a pressure fluid relief and diverting mechanism substantially rearward of the water courses and having means responsive to a predetermined advance of the core drill head with respect to the core retainer to effect a noticeable reduction in the pressure of the drilling fluid in said conduit and to divert the major flow of such fluid away from said water courses to arrest further substantial progress on the part of the drill head.

15. A core drill having in combination, a core retainer; a core drill head receiving the core retainer and movable relative thereto; a fluid conduit in communication with the head and adapted to receive fluid under pressure; and fluid pressure relief means operative upon a predetermined downward movement of the core drill head with respect to the core retainer to indicate such movement by relief of fluid pressure in said conduit, said fluid pressure relief means embodying a valve controlled fluid by-pass movable with the drill head and a valve unseating member associated with the core retainer and disposed in the path of movement of the valve element of the by-pass to engage and unseat the valve element.

16. A core drill having in combination, a core retainer; a core drill head receiving the core retainer and movable relative thereto; a fluid conduit in communication with the head and adapted to receive fluid under pressure; fluid pressure relief means operative upon a predetermined downward movement of the core drill head with respect to the core retainer to indicate such movement by relief of fluid pressure in said conduit, said fluid pressure relief means embodying a valve element movable with the drill head and a valve unseating member associated with the core retainer and disposed in the path of movement of the valve element to engage and unseat the valve element; and means for disengaging said member from the valve element preparatory to the removal of the core retainer to the surface.

17. A core drill having in combination, a rotary core bit having cutters to cut a core; means furnishing a drilling fluid under pressure to the cut being made by the core bit; a core retainer having an inlet in receptive relation to the core defined by the core bit; there being means for the advance of the core bit with and independently of the core retainer; a relief valve for the drilling fluid and movable with the bit and having cooperating closure and relief elements; and means responsive to the advance of the core bit with respect to the core retainer to actuate one of said elements and thus open the valve for relief of the pressure of the drilling fluid.

18. A core drill having in combination, a rotary core bit having cutters to define a core; a housing having rigid connection with the core bit; a valve cage having rigid connection with the housing and having a passage for drilling fluid under pressure and also having relief ports for communication with said passage; a valve element controlling said relief ports; a core retainer in said housing; there being means for the advance of the core bit with and independently of the core retainer; and means carried by the core retainer and responsive to advance of the core bit with respect to the core retainer to unseat said valve element and thereby bring about the relief of the pressure of the drilling fluid.

19. A core drill having in combination, a rotary core bit having cutters to define a core; a valve cage having rigid association with the bit and having a passage for drilling fluid under pressure and also having a relief port for communication with said passage; a valve element controlling said relief port; a core retainer in receptive relation to the core defined by said bit; there being means for the advance of the core bit with and independently of the core retainer; means carried by the core retainer and responsive to advance of the core bit with respect to the core retainer to unseat said valve element and thereby bring about the relief of the pressure of the drilling fluid; and means snugly and slidably associated with said valve cage for moving said valve unseating means to an inoperative position preparatory to the removal of the core retainer to the surface.

20. A core drill having in combination, a rotary core bit having cutters to cut a core; means furnishing a drilling fluid under pressure to the cut being made by the core bit; a core retainer having an inlet in receptive relation to the core defined by the core bit; there being means for the advance of the core bit with and independently of the core retainer; a relief valve for the drilling fluid and movable with the core bit and having cooperating closure and relief elements; an actuating arm carried by the core retainer and positioned in the path of advance of one of said elements so that upon a predetermined advance of such element with the core bit the same is actuated to open the valve for the relief of the pressure of the drilling fluid; a movable sleeve surrounding said actuating arm; said sleeve and said arm being provided with cooperating portions for moving the arm out of valve operating position preparatory to removal of the core retainer; said sleeve being provided with a member for engagement by a lifting mechanism.

DEAN THRIFT.

DISCLAIMER

2,046,798.—*Dean Thrift*, San Antonio, Tex. METHOD AND APPARATUS FOR CORE DRILLING. Patent dated July 7, 1936. Disclaimer filed February 27, 1939, by the patentee.

Hereby enters this disclaimer to claim 4 in said Letters Patent.

[*Official Gazette March 21, 1939.*]