Aug. 17, 1943. H. S. DANNER 2,327,023

SIDE WALL DRILLING AND SAMPLING TOOL

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Fig. 1

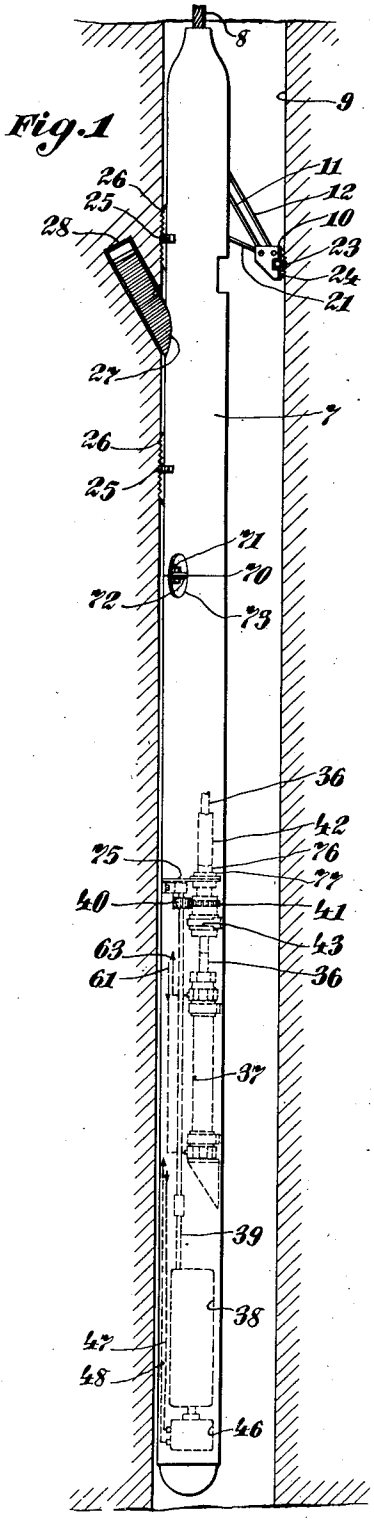



Fig. 2

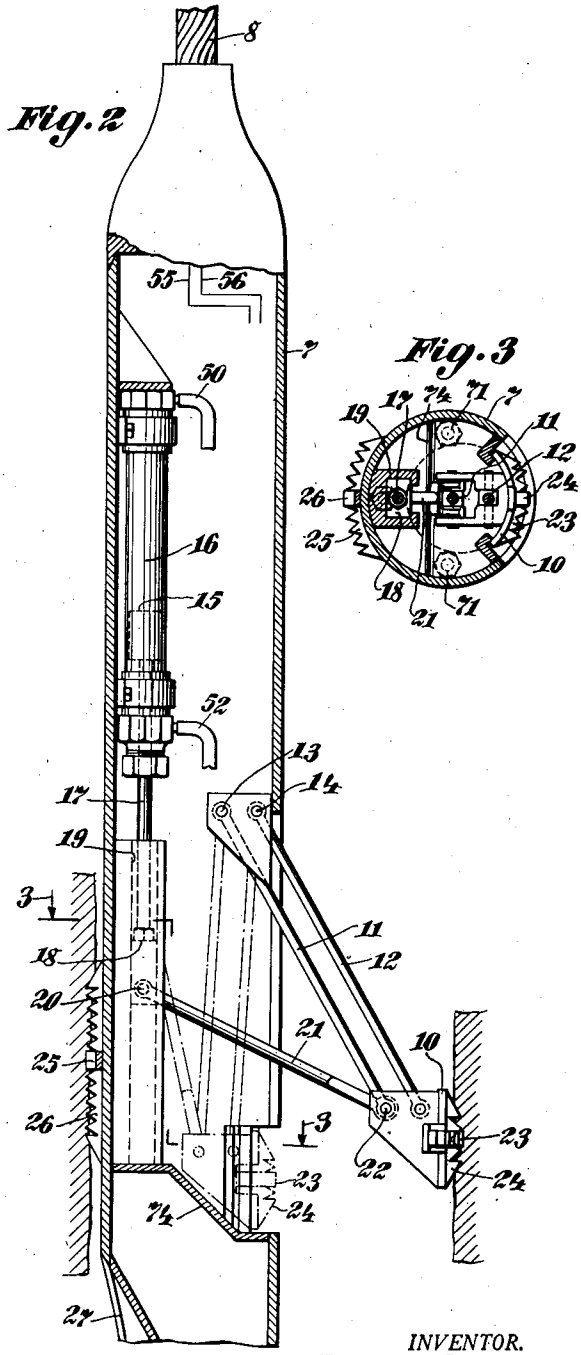



Fig. 3




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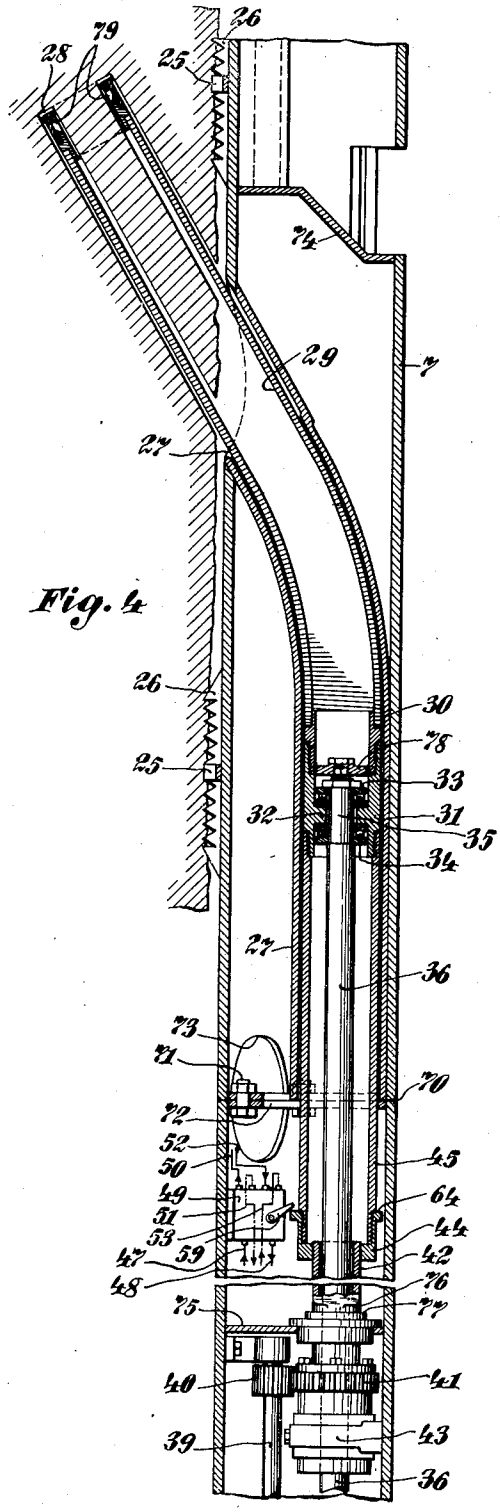



Fig. 4

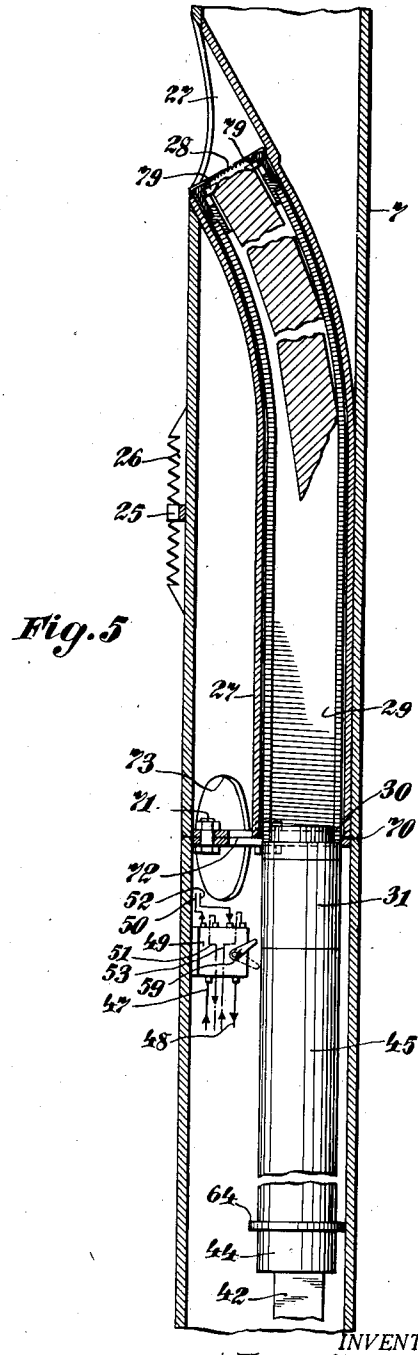



Fig. 5

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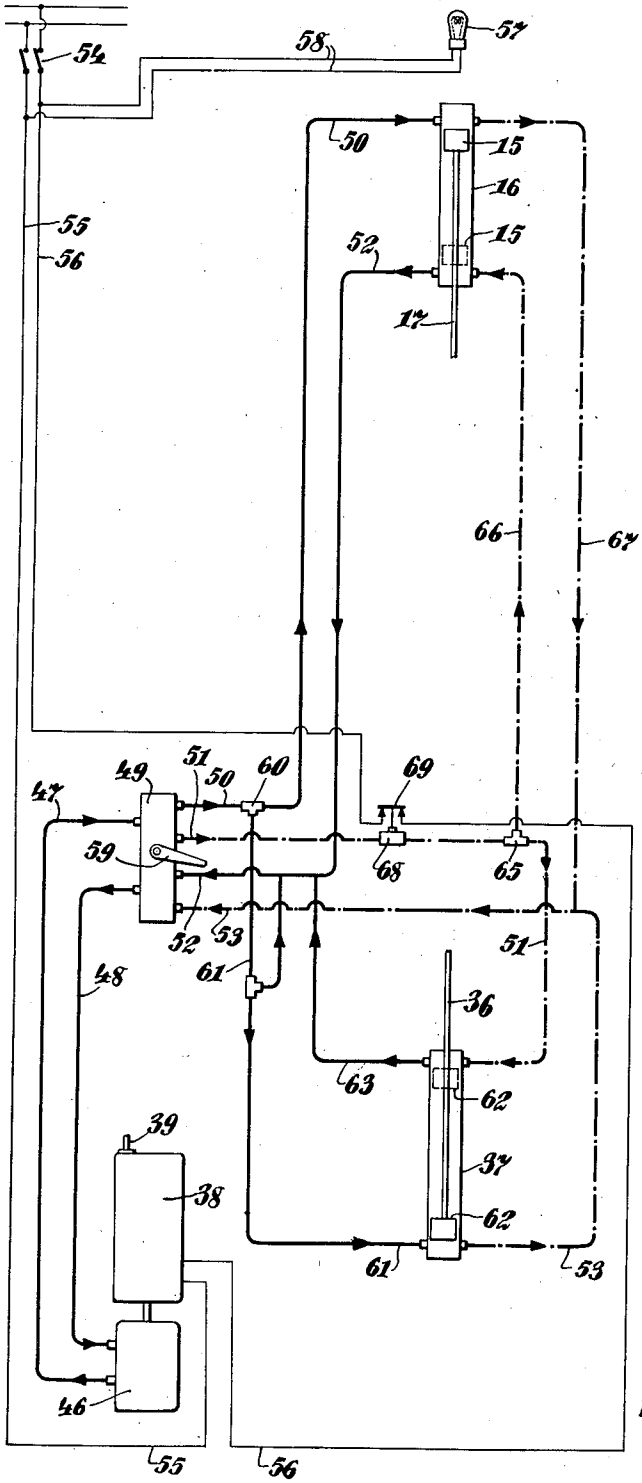



Fig. 6

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2,327,023

## SIDE WALL DRILLING AND SAMPLING TOOL

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15 Claims. (Cl. 255—1.4)

The invention here disclosed relates to apparatus for taking samples and drilling into the side walls of drill holes.

Special objects of the invention are to provide apparatus for these purposes, which will be capable of taking cores of considerable length and capable of retaining the full core length.

Other purposes of the invention are to provide a tool of the character outlined, which will be of relatively simple, sturdy construction, adapted to be lowered in the hole to the desired level and adapted there to be firmly set and actuated to cut the core or drill the side hole and then to automatically take the core, or retract the drill and release itself so that it may be lifted out of the hole.

Other desirable objects will appear as the specification proceeds and the novel features of invention by which all objects are attained are set forth and broadly covered in the claims.

The drawings accompanying and forming part of the specification illustrate a present preferred embodiment of the invention, but structure may be modified and changed as regards the present disclosure, all within the true intent and broad scope of the invention, as will be apparent from the following specification and claims defining and covering the invention.

Fig. 1 is a side elevation of the tool as in operation taking a core from the side of a drill hole.

Fig. 2 is an enlarged broken sectional view of the upper, anchoring portion of the tool.

Fig. 3 is a cross-sectional detail on substantially the line 3—3 of Fig. 2.

Fig. 4 is a broken vertical sectional view of the middle portion of the tool including the upwardly extensible cutter, illustrating the latter in the extended relation.

Fig. 5 is a similar view showing the cutter retracted to carry the core or sample back into the tool.

Fig. 6 is a diagrammatic view of the hydraulic and electrical connections.

The body of the tool is shown in the form of an elongated cylindrical barrel or casing 7, adapted to be lowered by cable 8, into the drill hole 9.

To set the device at the desired level and hold it firmly against the side of the bore, there is provided a shoe or sprag 10, pivotally hung on the lower ends of parallel links 11, 12, pivoted at their upper ends within the casing at 13, 14.

This holding and anchoring element is projected and retracted by a piston 15, operating in cylinder 16, and having a rod 17, connected to a cross head 18, operating in vertical guide 19, said cross head carrying the pivot 20, for the inner end of the thrust link 21, which is shown pivotally engaged at its outer end over the pivot 22, for the lower end of the inner suspension link 11.

The supporting and anchoring shoe 10, is shown as arcuate in form to readily adapt itself to the wall of the bore and to drop back within the outline of the casing, in the retracted position, indicated in broken lines, Fig. 2, and it is shown as having horizontally extending teeth 23, and vertically extending teeth 24, to take firm hold in the formation.

The opposite side of the casing is shown as having horizontally and vertically extending rows of teeth 25, 26, and, as shown in Figs. 1 and 4, these toothed projections may be provided both above and below the cutting tool passage 27, in the side of the casing.

A particularly important distinguishing feature of the invention is that the cutter operates vertically upwardly and laterally, instead of downwardly or transversely, as in prior machines. This allows for a greater length of stroke and enables the tool, in the case of the core cutter, to collect and retain all the core pieces.

In the illustration, the cutting tool is shown in the form of an annular bit 28, removably mounted on the upper end of a length of strong flexible tubing 29, operating in the vertically and laterally extending guide passage 27.

This flexible tubular cutting tool is removably coupled at the lower end at 30, to a rotating head or collar 31. This collar is shown as having an inwardly extending annular flange 32, extending in between upper and lower thrust bearings 33, 34, mounted on the upper end of the vertically operating rod 35, forming part or a continuation of the piston rod 36, operating in hydraulic cylinder 37.

Rotary motion is imparted to the tool from motor 38, operating through enclosed reduction gearing, the vertically extending shaft 39, carrying pinion 40, in mesh with gear 41, on the lower end of the tubular drive shafting 42, journalled at 43, in position about the vertically operating rod 36, said shafting being of externally square or other polygonal cross-section and slidingly engaged by the correspondingly shaped bushing 44, on the lower end of the surrounding rigid sleeve member 45, attached to the thrust collar 31.

The motor 38, in addition to driving the drill or cutting member, operates a pump 46, for circulating the actuating fluid to the power cylinders 16 and 37.

While the connections may vary, one practical

hookup is illustrated in Fig. 6, with pressure and return lines 47, 48, running from the pump to a reversing valve 49, and pressure lines 50 and 51, extending from this valve to the upper ends of cylinders 16 and 37 and return lines 52, 53, extending from the lower ends of said cylinders back to the reversing valve.

To follow the action more readily, the connections used in setting the tool and cutting the core are indicated in full lines and those in service for withdrawing the cutter and releasing the tool are indicated in broken lines.

The motor may be controlled from the surface by a simple "on" and "off" switch 54, controlling supply of current to the motor through the leads 55, 56, which may be incorporated in the suspension cable 8. A pilot light 57, is shown connected across the motor circuit at 58, so as to show at the surface when the motor is "on" or "off."

In operation, the tool is lowered to the point where the sample is to be taken or the side wall cut is to be made, the supporting and anchoring member 10, being then in the retracted position inside the casing, indicated in broken lines in Fig. 2. The control switch 54, is then closed to start the motor 38. Operation of the motor imparts rotation to the flexible cutting tool through gearing 40, 41, and the extensible sliding drive connections 42, 44, 45, and direct drive of the pump 46.

With the trigger 59, of the reversing valve 49, in the position shown in Fig. 6, the flow of actuating fluid will be through pressure line 50, to the top of cylinder 16, thus to drive the piston 15, downward and thrust the shoe 10, outward into holding engagement with the side of the bore. The thrust of this shoe has the effect of setting the case 7, of the tool solidly over in engagement with the opposite side of the formation.

In the pressure line 50, there is provided an automatic relief or bypass valve 60, which at the predetermined pressure required for holding the tool properly seated, opens to pass the fluid through the line 61, to the bottom of cylinder 37, below the piston 62, therein. Pressure under this piston, through the rod 36, and the lower thrust bearing 34, starts the upward feed of the cutting tool, which is projected upwardly and laterally into the formation under the more or less steady pressure furnished by the pump.

The upwardly and laterally extending passage 27, serves as a guide for directing and steadying the flexible body portion 29, of the cutting tool.

During these operations, the return flow line 52, is open from the bottom of cylinder 16, to the reversing valve and similarly, a return flow line 63, is open from the top of cylinder 37, to the reversing valve by the connection 52.

At the top of the stroke, a flange 64, on the drive sleeve bushing 44, engages and shifts the trigger 59, into the upper position shown in Fig. 4. In this position, the reversing valve directs flow through the pressure line 51, to the top of cylinder 37, above piston 62, which through the lowering of piston rod 36, retracts the cutter, with the core therein as indicated in Fig. 5. As piston 62, reaches the bottom of its stroke and flow through return line 53 stops, the pressure builds up in the line 51, and effects the opening of a pressure belief valve 65, which bypasses the pressure fluid through line 66, into the bottom of cylinder 16, below piston 15, return flow from the top of this cylinder then being effected through the line 67, 53.

By the automatic pressure relief form of control described, the anchorage mechanism by which the tool is held in place is not released and withdrawn until after the cutting tool has been fully retracted.

After taking the sample as described, the machine is automatically shut off, in the illustration, by a maximum pressure relief valve 68, provided in the pressure line 51, and which with the build-up of pressure resulting from the full retraction of the cutting tool followed by complete retraction of the anchorage device, operates a master switch 69, to open the motor circuit.

The shell of the machine is shown in Figs. 1, 4 and 5, as separable at 70, and with the parts held together by bolts 71, through flanges 72, such fastenings being accessible through hand-hole openings 73. These openings provide access to interior parts, for instance, to the trigger or operating lever of the reversing valve, which must be placed in the starting position shown in Fig. 6, before the machine is lowered in the hole.

A partition 74, is shown in the casing, separating the upper compartment, containing the anchorage mechanism, from the intermediate chamber in which the tool guide passage is located and another partition is shown at 75, separating the latter compartment from the lower chamber containing the motor, pump and tool controlling cylinder. To enable the lower chamber being fully sealed, the square tubular drive shafting 42 is shown as having a cylindrical lower portion 76, engaged by a stuffing box 77, in the partition 75.

While a coring bit is illustrated having fingers 79, for catching the core, it will be understood that the form of the cutter may vary to suit different purposes to which the machine is adapted, such as cutting drainage passages through casing, channeling and the like. Also, while hydraulic cylinders are illustrated as the power means for setting the machine and advancing and retracting the drilling element, these having special adaptation for automatically effecting the sequential operations required, it is contemplated that other forms of power mechanism, such as of a purely mechanical nature, may be employed.

The upwardly acting flexible tubular form of cutting tool automatically collects and retains the cuttings as well as fragments of the core. This tool is readily uncoupled from the thrust member of the drive sleeve when the casing is separated and, if desired, may be suitably sealed, as by a cap substituted for the removable bit, to serve as a certified container for the sample taken from the formation. The bottom or end coupling of the tool is shown as having a plug or closure 78, which may be removed by a key wrench especially adapted to that purpose.

What is claimed is:

1. A side wall sampling tool, comprising an elongated casing adapted to be lowered in a drill hole, said casing having a passage extending upwardly and opening outwardly through the side of the same, a cutting tool having a flexible tubular body operating in said passage and extensible upwardly therefrom, power means in said casing for rotating, upwardly projecting and downwardly retracting said cutting tool, means projectible from said casing for anchoring the same in a drill hole and controllable means for effecting sequential operation first of said anchoring means and then said first mentioned power means.

2. A side wall sampling tool, comprising an elongated casing adapted to be lowered in a drill hole and having a passage extending upwardly

and opening outwardly through the side of the same, a cutting tool having a flexible tubular body operating in said passage and extensible therefrom, a power means in said casing for rotating, projecting and retracting said cutting tool, including a motor, a hydraulic pump operated thereby, a power cylinder connected with said pump, connections from said power cylinder for advancing the cutting tool, connections from said motor for imparting rotation to the tool in such advancing movement, anchoring means projecting from and retractible into said casing, a power cylinder connected with said pump and operating connections from said power cylinder to said anchoring means.

3. A side wall sampling tool, comprising an elongated casing adapted to be lowered in a drill hole and having a passage extending upwardly and opening outwardly through the side of the same, a cutting tool having a flexible tubular body operating in said passage and extensible therefrom, power means in said casing for rotating, projecting and retracting said cutting tool, including a motor, a hydraulic pump operated thereby, a power cylinder connected with said pump, connections from said power cylinder for advancing the cutting tool, connections from said motor for imparting rotation to the tool in such advancing movement, anchoring means projecting from and retractible into said casing, a power cylinder connected with said pump, operating connections from said power cylinder to said anchoring means and an automatic reversing valve interposed in said pump connections and operable on the advance of said tool to effect retraction of said tool and of said anchoring means.

4. A side wall formation sampling and drilling tool, comprising an elongated casing adapted to be lowered in a drill hole and having a guide passage extending upwardly and opening outwardly through the side of the same, a cutting tool having a flexible tubular body operable in said passage, power means in said casing for rotating and projecting said cutting tool upwardly in said guide passage, remote control means for said power means, said power means including a power cylinder located below and in line with the upright portion of said guide passage and drive connections therefrom to said cutting tool, including an upwardly acting piston rod having a thrust bearing connection with the lower end of said cutting tool, an upwardly extending drive sleeve about said piston rod, a sleeve extension dependent from the lower end of said cutting tool and having a sliding driven engagement over said upwardly extending drive sleeve, a motor for imparting rotation to said upwardly extending drive sleeve and a pump operated from said motor and connected with said power cylinder.

5. A side wall sampling tool, comprising an elongated casing adapted to be lowered in a drill hole, said casing having a longitudinal guide passage therein opening upwardly through the side of the same, a rotary cutting tool having a flexible tubular body operating in said longitudinal passage and adapted to be projected upwardly into the formation at the side of said opening in the casing and power means in said casing for rotating, projecting said rotary cutting tool into the side wall formation to a predetermined extent and for then automatically withdrawing said cutting tool downwardly into the casing and stopping rotation of the same, projectible and retractible anchoring means carried by said casing, power mechanism for projecting and retracting said anchoring means and means automatically controlling said power mechanism to effect projection of said anchoring means prior to the projection of the cutting tool and for effecting retraction of said anchoring means after the withdrawal of said cutting tool.

6. A side wall sampling tool, comprising an elongated casing adapted to be lowered in a drill hole, said casing having a longitudinal guide passage therein opening upwardly through the side of the same, a rotary cutting tool having a flexible tubular body operating in said longitudinal passage and adapted to be projected upwardly into the formation at the side of said opening in the casing and power means in said casing for rotating, projecting said rotary cutting tool into the side wall formation to a predetermined extent and for then automatically withdrawing said cutting tool downwardly into the casing and stopping rotation of the same, projectible and retractible anchoring means carried by said casing, power mechanism for projecting and retracting said anchoring means, means automatically controlling said power mechanism to effect projection of said anchoring means prior to the projection of the cutting tool and for effecting retraction of said anchoring means after the withdrawal of said cutting tool, said power means including a motor and said automatic control means including switch mechanism automatically operable to stop said motor upon completion of said operations.

7. A side wall formation sampling and drilling tool, comprising an elongated casing adapted to be lowered in a drill hole, means in said casing for effecting drilling of side wall formation and means for anchoring said casing in the drill hole, including a side wall engaging shoe, parallel links pivoted at their upper ends in said casing and pivoted at their lower ends to said shoe, a link for thrusting said shoe outwardly and for withdrawing said shoe inwardly in respect to said casing and power means connected with said last mentioned link.

8. In a side wall formation sampling and drilling tool, an elongated casing, and upwardly acting cutting tool projectible from said casing and exerting downward thrust on the casing, a formation engaging anchoring and supporting shoe for the casing, linkage pivotally connected at the upper end with the casing and pivotally connected at the lower end with said shoe and adapted to support said shoe in condition to swing laterally outwardly into engagement with the formation or inwardly into retracted position in the casing and power means for so swinging said anchorage shoe.

9. In a side wall formation sampling and drilling tool, the combination of an elongated casing adapted to be lowered in a drill hole, side wall formation drilling means extensibly mounted in said casing, extensible and retractible anchoring means mounted in said casing, fluid pressure power cylinders mounted in said casing and connected to actuate said drilling means and anchoring means respectively and fluid pressure power connections to the respective power cylinders and including pressure relief valves for automatically providing sequential supply of actuating fluid first to one of said power cylinders and then to the other.

10. In a side wall formation sampling and drilling tool, the combination of an elongated

casing adapted to be lowered in a drill hole, side wall formation drilling means extensibly mounted in said casing, extensible and retractible anchoring means mounted in said casing, fluid pressure power cylinders mounted in said casing and connected to actuate said drilling means and anchoring means respectively, and fluid pressure power connections to the respective power cylinders and including pressure relief valves for automatically providing sequential supply of actuating fluid first to one of said power cylinders and then to the other, a reversing valve in said fluid pressure connections for controlling flow of actuating fluid to opposite ends of said power cylinders and a trigger for actuating said reversing valve positioned for operation by the projection of said drilling means.

11. In a side wall formation sampling and drilling tool, the combination of an elongated casing adapted to be lowered in a drill hole, side wall formation drilling means extensibly mounted in said casing, extensible and retractible anchoring means mounted in said casing, fluid pressure power cylinders mounted in said casing and connected to actuate said drilling means and anchoring means respectively, and fluid pressure power connections to the respective power cylinders and including pressure relief valves for automatically providing sequential supply of actuating fluid first to one of said power cylinders and then to the other, a pump for furnishing the fluid under pressure, a motor for driving said pump and a fluid pressure operated switch for controlling said motor and disposed in said fluid pressure supplying connections.

12. In a side wall formation sampling and drilling tool, the combination of an elongated casing adapted to be lowered in a drill hole, side wall formation drilling means extensibly mounted in said casing, extensible and retractible anchoring means mounted in said casing, fluid pressure power cylinders mounted in said casing and connected to actuate said drilling means and anchoring means respectively and fluid pressure power connections to the respective power cylinders and including pressure connections to the anchor cylinder, a branch connection from said last mentioned connections to the drilling means advancing cylinder and a pressure relief valve normally closing said branch connection but automatically opening under increased pressure in said pressure connections to said anchor cylinder.

13. In a side wall formation sampling and drilling tool, the combination of an elongated casing adapted to be lowered in a drill hole, side wall formation drilling means extensibly mounted in said casing, extensible and retractible anchoring means mounted in said casing, fluid pressure power cylinders mounted in said casing and connected to actuate said drilling means and anchoring means respectively and fluid pressure power connections to the respective power cylinders and including pressure connections to opposite ends of the anchor cylinder, branch connections from said pressure connections to opposite ends of the drilling means advancing cylinder, pressure relief valves automatically controlling flow through said branch connections and a reversing valve governed by operation of said drilling means for controlling flow through said connections to opposite ends of said power cylinders.

14. A side wall formation sampling and drilling tool, comprising an elongated casing adapted to be lowered in a drill hole, said casing having a longitudinally extending guide passage opening upwardly through the side of the same, a cutting tool having a flexible tubular body operable upwardly and downwardly in said passage, a power cylinder below said guide passage, a piston in said power cylinder having a piston rod reaching upward toward said passage, a rotating thrust connection between said piston rod and the lower end of the flexible tubular body of said cutting tool, a tubular tool rotating member journalled about said piston rod and a longitudinally extensible slip drive connection between said tubular tool rotating member and the lower end of said tubular tool body.

15. A side wall formation sampling and drilling tool, comprising an elongated casing adapted to be lowered in a drill hole, said casing having a longitudinally extending guide passage opening upwardly through the side of the same, a cutting tool having a flexible tubular body operable upwardly and downwardly in said passage, a power cylinder below said guide passage, a piston in said power cylinder having a piston rod reaching upward toward said passage, a rotating thrust connection between said piston rod and the lower end of the flexible tubular body of said cutting tool, a tubular tool rotating member journalled about said piston rod and a longitudinally extensible slip drive connection between said tubular tool rotating member and the lower end of said tubular tool body, including a tubular upward extension of said tool rotating member of angular cross section and a dependent tubular extension of the tool body having a sliding driven engagement with said angular cross section upward extension.

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