July 11, 1944. W. J. BARNHART 2,353,435

SIDE SAMPLER FOR DEEP WELLS

Filed June 16, 1941

Fig. 1

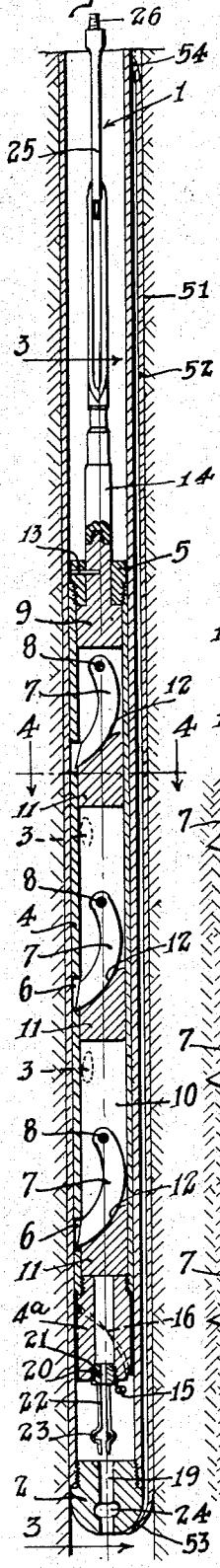


Fig. 2

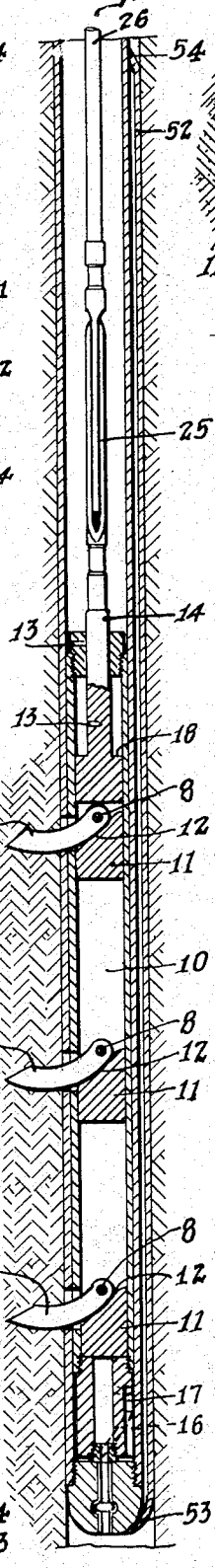


Fig. 4

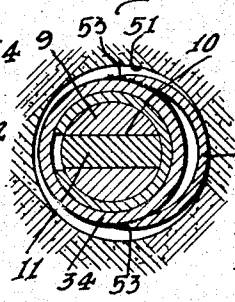


Fig. 3

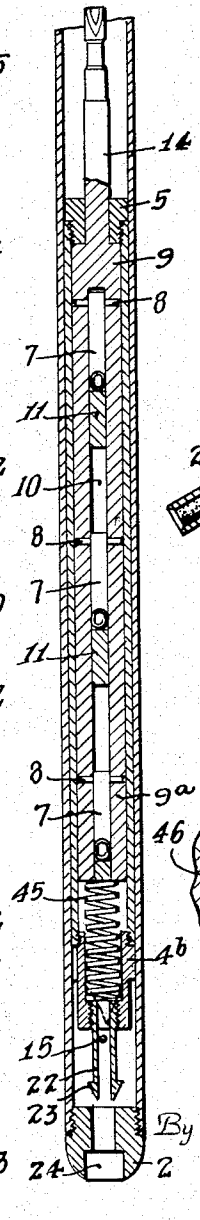


Fig. 6

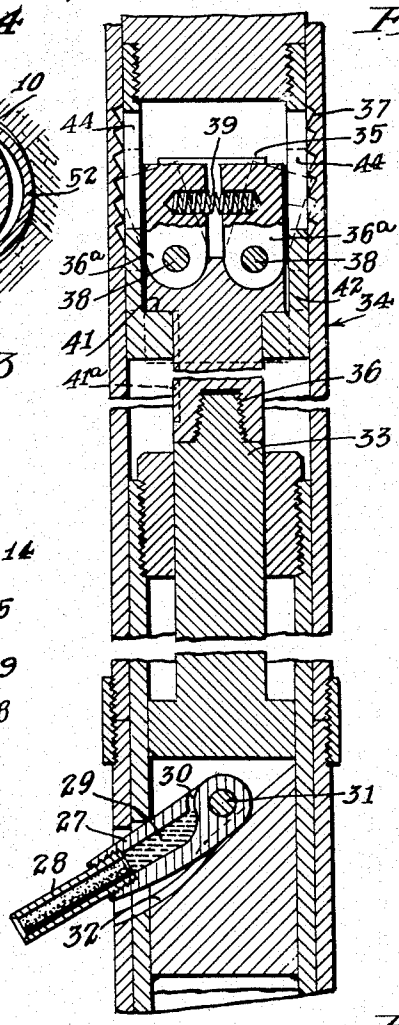
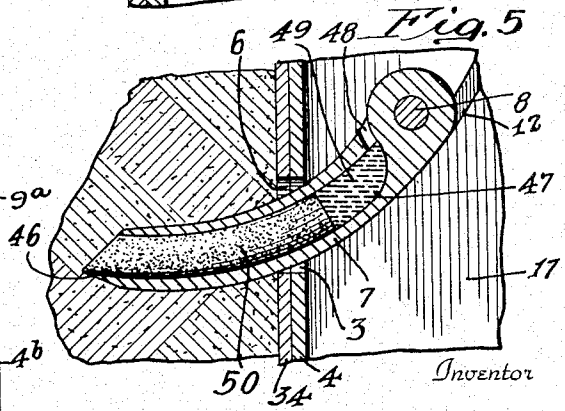


Fig. 5



Inventor

Walter J. Barnhart

By Lyon & Lyon

Attorneys

Patented July 11, 1944

2,353,435

UNITED STATES PATENT OFFICE

2,353,435

SIDE SAMPLER FOR DEEP WELLS

Walter J. Barnhart, Huntington Beach, Calif.

Application June 16, 1941, Serial No. 398,283

18 Claims. (Cl. 255—1.4)

This invention relates to apparatus for enabling samples to be taken from the wall of deep wells, such as oil wells. Apparatus for this purpose has recently been suggested to perform the function of the usual core-taking barrel which is attached to the lower end of a tool string, and which takes a core from the end of the bore.

One of the objects of the invention is to provide a sample-taking apparatus of simple construction, which can be operated in the hole on a sand line or, if desired, on a tubular tool string.

A further object of the invention is to provide a construction for the apparatus, which facilitates the use of a gang of sample-taking tools, all of which can be projected simultaneously in a lateral direction from the axis of the well, and into the earth and formation at the side wall of the well-bore.

In its preferred construction the apparatus includes a suspended sample-taking barrel or barrels, the lower ends of which are located in such a way that when relative movement in a longitudinal direction between parts of the tool takes place, the sample-takers will be projected outwardly; and one of the objects of the invention is to provide a construction in which the sample-taking tool or barrel is unconnected with the cam means that cooperates with the sample-taker to project it out into the side of the well-bore; also to provide a single point of connection of the sample-taker to its carrier, to facilitate the removal of the sample-takers after they have been pulled to the mouth of the well.

A further object of the invention is to provide a construction which facilitates the taking of a plurality of samples at different levels, and the construction involves the use of a plurality of different sample-takers, each cooperating with a cam face on a multiple cam against which the sample-takers are forced when they are being projected into their active position. The sample-takers are projected outwardly through the medium of a relative downward movement of their carrier with respect to the multiple cam; and one of the objects of the invention is to provide means for preventing the multiple cam from jamming on the tool-carrier, so that it would be pulled up with the carrier in spudding when the upward movement of the tool has started, to bring the tool out of the well.

In the preferred embodiment of the invention, the tool includes a housing carrying a multiple cam, and provided with side openings adjacent to which the lower ends of the sample-takers lie. The tool is operated with a tubular casing or drill string, which is also provided with openings through its wall, through which the sample-takers are to be projected; and one of the objects of this invention is to provide simple means for effecting an alignment of the openings in the housing with the openings in the tubular tool string before the sample-takers are projected outwardly.

In the operation of the tool, the carrier for the sample-takers is dropped downwardly so that the lower ends or under sides of the pendant sample-takers, strike against cam faces that deflect them laterally into the side of the well-bore. This operation may be carried on as a spudding operation, and this would be the usual procedure in taking samples from earthy formation. In a case where a sample-taker is to encounter considerable resistance, for example, in shale or harder formation, I force the sample-takers down by means of an inner core-tool string, and in that case I provide a locking head for connecting up the tool-carrier to a core-tool string. It is one of the objects of this invention to provide a device of this kind, in which the tool-carrier can be controlled so as to lock itself automatically as it were, to the core-tool string. This locking head involves the use of holding pawls cooperating with inclined rack teeth formed on the interior of the core-tool string; and one of the objects of the invention is to provide a mounting for these pawls, that will prevent them from being injured in operation, and at the same time, to provide means whereby they will automatically release themselves from the rack teeth when the sand line is pulled up to release the locking head.

Further objects of the invention will appear hereinafter.

The invention consists in the novel parts and combination of parts to be described hereinafter, all of which contribute to produce an efficient side sampler for deep wells.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

Fig. 1 is a vertical section through the lower end of a drill string, core barrel collar, with the sample-taking apparatus carried within the same, and in this view the parts are represented in their normal position, that is to say, the parts of the tool on the sand line are shown in the relation they have when they arrive at the well bottom, and before the sample-taking operation is started. In this view the upper portion of the

tool carrier, including a jar, is shown in elevation.

Fig. 2 is a view similar to Fig. 1, but showing the sample-taker tools in their active position and projected out into the earth at the side of the well-bore.

Fig. 3 is a vertical section through the apparatus taken about on the line 3—3 of Fig. 1, and particularly illustrating the construction of the tool-carrier and the means for mounting the core-takers or sample-takers in the same. But at its lower end this view illustrates a modification in the mounting of parts.

Fig. 4 is a horizontal section upon a larger scale taken about on the line 4—4 of Fig. 1, and particularly illustrating an abutment which is provided on the outer side of the housing at the point diametrically opposite to that at which the tools are projected outwardly.

Fig. 5 is a fragmentary view and is an enlarged section taken through the apparatus at one of the sample-takers, and passing through the sample-taker. This view particularly illustrates the preferred form of one of the sample-takers, and illustrates also how mud at the back of the sample, finds exit from the bore of the sample-taker.

Fig. 6 is a vertical section taken through the upper portion of the tool-carrier and through a reaction head or back-stop device which I employ, where spudding is impossible, and the tool-carrier is connected up to a tool string to enable the core-takers to be forced down. This view shows the holding pawls in their released position.

Referring more particularly to the parts, and especially to Figs. 1 to 3, 1 indicates a tool string in the well-bore, the lower end of the tool string being provided with a bottom head or shoe 2, and this tool string is provided at suitable points with openings 3 through its wall, through which the sample-takers are to be projected. The inner portion of the apparatus includes a tubular housing 4, the upper end of which carries a guide head 5 threaded into the same. At suitable points, depending on the number of samples that the tool is to take, and also on the difference in level for the different sample-takers, the wall of the housing 4 is provided with openings 6 which are capable of registering with the openings 3 in the tool string when the sample-takers 7 are to be projected outwardly. These sample-takers 7 are hollow "core barrels" which are all supported on their corresponding supporting pins 8 on a tool carrier 9. This tool carrier is an elongated mandrel preferably provided with a longitudinal vertical slot 10 in which the sample-carriers 7 hang. The sample-carriers are preferably curved into arcuate form as indicated in Fig. 1, and below each sample-carrier a cam 11 is provided, each cam consisting of a block or web extending acros the bore of the housing and rigid within the same. Each cam 11 presents a cam edge 12 on its upper side, to exert a cam action on the sample-takers when they move downward relative to the cams 11.

However, in lowering the tool down the well, this relative movement cannot occur on account of a frangible pin 13 which connects the guide head 5 of the housing to the reduced shank 14 of the tool-carrier 9. But when the tool arrives at the bottom of the well, this pin 13 is finally sheared, and the shank slides through the guide head 5. The seating of the tool at the bottom of the drill string 1 effects the alignment of the openings 3 and 6, and after this alignment takes place, the pin 13 shears and the sample-takers 7 are cammed outwardly on the cam faces 12.

The means for effecting the alignment of the openings 3 and 6 preferably includes a pin 15 projecting inwardly at the lower end of the drill string 3, the lower end of the housing 4 being provided with a cam edge 16 to cooperate with this pin to rotate the housing or orient it on its longitudinal axis to bring the openings 6 into alignment with the openings 3. When this occurs the pin 15 will lie in a sort vertical slot 17 into which the cam edge 16 will have guided the pin. After this alignment of the openings occurs, then the continued downward movement of the tool-carrier 9 will break the pin 13 and project the sample-takers out through the aligning openings.

In considering the operation of this apparatus, it will be evident that it is necessary to provide means for preventing any possibility of the parts jamming themselves in the relation in which they are shown in Fig. 2. In other words, it is necessary to provide means for insuring that when the sand line is pulled upwardly to pull up the tool-carrier 9, the cams 11 and the housing 4 which carries them, will remain relatively fixed to permit the shoulder 18 at the upper end of the tool-carrier to move up to the under face of the guide head 5. For this reason I provide a check device or anchor device to hold back the housing when the upward movement begins. For this purpose I prefer to provide a central opening 19 in the shoe 2 to cooperate with a yielding, or spring, mandrel 20. This mandrel is threaded at its upper end into the bore 21, of a thick-walled tubular plug 4a, that forms the extreme lower end of the housing 4. This spring mandrel is formed of a plurality of spring tongues 22 that will enter the central opening 19. These tongues 22 have outward offsets or rounded shoulders 23, and when the spring mandrel 20 passes into the opening or socket 19, these shoulders 23 engage in an annular enlarged groove 24 near the lower end of the socket 19. This will yieldingly lock these parts together so that when the tool-carrier 9 starts back, the housing 4 will be held down temporarily. Of course, as soon as the shoulder 18 of the tool-carrier comes against the guide head 5, then the housing will be brought back to the relation illustrated in Fig. 1. The continued upward movement of the tool-carrier will, of course, take the housing with it and the spring tongues 22 will release themselves from the socket 19.

The upper end of the tool-carrier above the shank 14 is jointed to a jar device 25, carried on a sand line 26. In operating the apparatus illustrated in Fig. 1, the jar is used to break the shear pin 13, and after the pin is broken, the sample-takers 7 are spudded by means of the jar device 25. During this spudding operation, of course, the drag device including the resilient mandrel 20 and its cooperating socket 19, hold the housing 4 in a fixed position while the tool-carrier 9 is moving up and down.

In Fig. 6 I illustrate another type of sample-taker in which the sample-taker is not curved. In this case the sample-taker includes an upper body portion 27 and a lower end or core barrel portion 28 that may be threaded into the lower end of the body 27, the body being cored out to form a duct 29 at its upper end through which mud can pass upwardly when the sample is being taken, and such mud would find an outlet through a relief opening 30 near the hub, and adjacent to the supporting pin 31. The under

side of the body 27 may be slightly curved if desired, to cooperate with the cam face 32. And the cam face 32 is preferably curved in transverse cross-section about as indicated. This form of sample-taker has the advantage over the form of sample-taker shown in Figs. 1 and 2, in that the barrel 28 can be unscrewed to remove a substantial part of the sample.

At the upper part of Fig. 6, I illustrate the reaction device which interlocks the upper end of the tool-carrier 33, with the tool string 34 corresponding to the tool string 1 illustrated in Figs. 1 and 2. This reaction head indicated generally by the numeral 35, is intended to be interchangeably attached to the upper end of the carrier through the medium of a tool joint connection 36. This reaction device 35 is formed into a head preferably carrying two oppositely disposed pawls 36a, and the tips of these pawls ride adjacent to circumferentially formed rack teeth 37 on the inner face of the tool string 34. These pawls extend upwardly from their pivot pins 38 that attach them to the reaction head, and are normally pressed to the rack teeth 37 by a coil spring 39 set in sockets between the pawls. In other words, the reaction head 35 carries these pawls ready to move outwardly and normally riding off of the teeth. The upper end of the head 35, however, is supported on a shoulder 41 on a tubular hanger 42 that is suspended on the sand line, with clearance permitting relative downward movement of the hanger. In the position shown in Fig. 6, the wall of the hanger holds the pawls back, but when the sand line is slackened, the hanger will move down so that slots 44 will permit the spring 39 to move the pawls out against the rack teeth, as indicated in dotted lines in Fig. 6. This will lock the head 35 to the tool string so that by lowering the core-tool string 34, the tool-carrier 33 will be forced down and will project the sample-takers outwardly. When the driving head 42 is pulled up, the lower ends of the slots will "cam" the pawls in, out of contact with the rack teeth. A feather connection 41a keeps the slots in alignment with the pawls 36.

Instead of employing a shear pin such as 13 for holding up the core barrel carrier to prevent premature operation of the core takers in running into the hole, I may employ a coil spring 45 in the plug 4b (see Fig. 3), the bore of the plug being enlarged to form a spring barrel. This spring thrusts up against the lower end of the core tool carrier 9a.

In Fig. 5, I illustrate in detail the construction of one of the sample-takers 7 illustrated in Figs. 1 and 2. This tool is preferably of hard tough steel formed at its mouth 46 into a cutting edge. The rear end of the chamber 47 in the tool is provided with a relief opening 48 through which mud 49 back of the core or sample 50, can find exit.

In Fig. 2 I illustrate the relation of the parts while the housing 4 is anchored to the shoe 2. The position of the parts illustrated, might correspond to an assumed position during a spudding operation.

During the spudding operation, it should be understood that the sand line is only pulled up far enough to bring the shoulder 18 nearly up to the guide head 5, but not to strike and pull up the guide head in such a way as to loosen the anchorage of the housing 4. In this way the anchorage for the housing will hold the cam webs 11 down in their proper position while the spudding operation proceeds.

Of course, after the spudding has progressed sufficiently to insure that the core-takers have taken satisfactory samples, then the sand line can be pulled up, which will of course, pull the anchor mandrel 20 out of the socket 19 and this, of course, will throw the openings 6 out of line with the openings 3 in the tool string 1. This feature is of assistance in enabling the core-takers to keep their cores intact until the mouth of the well is reached.

In practice, the outside diameter of the tool string 1 is, of course, considerably less than the bore of the hole 51 in the earth. Hence it is necessary to provide means for preventing the reaction that occurs from pushing the tool carrier over to the opposite side of the hole, and thereby interfering with the efficiency of operation of the core-takers, that is to say, reducing their penetration into the side of the hole. In order to overcome this difficulty, I prefer to provide an outwardly projecting abutment 52 (see Fig. 4) which is in the form of an elongated dished sheet that is secured to the outer face of the tool string 1 by welds 53 along its edges. The lower end of this abutment may be turned in against the lower face of the shoe 2, and the upper end can be turned in and welded as indicated at 54, to the side of the tool string in the vicinity of the jar device 25, or just below the same.

As illustrated in Fig. 3, the core-takers or sample-takers 7 are sufficiently wide to substantially fill the slot 10 in the tool-carrier in which they operate, allowing of course, sufficient clearance for easy movement. In this way the side walls of the slot 10 brace the tools 7 and reduce the strain on their suspending pins 8. The suspending pins 8 are, of course, loose in their bores or sockets, and are easily driven out when the tool has been pulled up to the mouth of the well, to enable the sample-takers to be removed and carried to a laboratory.

Many other embodiments of the invention may be resorted to without departing from the spirit of the invention.

What I claim is:

1. In a sampling tool for taking a sample from the side of a well-bore, the combination of a tubular tool string having an opening in its wall, a tubular housing within the tool string having an opening through its side wall, capable of aligning with the first named opening, a tool-carrier, a sampler-tool movably supported in the carrier and having its receiving mouth at its lower end, and cam-means unattached to the sample-taker but lying in the path of the sample-taker for deflecting the same outwardly through the openings when the tool-carrier is moved longitudinally in the housing, to force the mouth of the sample-taker into the earth and formation alongside the well-bore.

2. In a sampling tool for taking a sample from the side of a well-bore, the combination of a tubular tool string having an opening in its wall, a tubular housing within the same having an opening through its side wall, normally out of line, but capable of aligning with, the first named opening, a tool-carrier, a sampler-tool movably supported in the carrier and having its receiving mouth at its lower end, and lying opposite the said opening in the housing, means for effecting the alignment of the said openings, and cam-means unattached to the sample-taker but lying in the path of the sample-taker for deflecting the

same outwardly through the openings when the tool-carrier is moved longitudinally in the housing to force the mouth of the sample-taker into the earth and formation alongside the well-bore.

3. A sampling tool to be used in a deep well for taking a sample from the side of the well bore, comprising in combination, a tubular housing having an opening through its wall, a tool-carrier within the housing and capable of moving longitudinally within the same, a sampler tool movably supported on the carrier and having its receiving mouth at its lower end lying adjacent the said opening, cam-means rigid with the housing lying in the path of the sample-taker for deflecting the same outwardly through the said opening when the tool-carrier is moved longitudinally in the housing, and frangible means normally preventing relative longitudinal movement of the tool carrier and the housing.

4. Sampling apparatus to be used in a deep well for taking a sample from the side of a well bore, comprising in combination, a housing, a tool-carrier within the housing and capable of moving longitudinally within the same, frangible means connecting the tool-carrier and the tubular housing, a sample-taker movably supported on the carrier and having its receiving mouth at its lower end, a tool string for supporting the tool-carrier with means associated therewith for enabling the carrier to break said frangible means and enable the tool-carrier to move longitudinally with respect to the housing, and cam-means rigid with the housing lying in the path of the sample-taker for deflecting the same outwardly and into the earth at the side of the well bore.

5. Sampling apparatus to be used in a deep well for taking a sample from the side of a well bore, comprising in combination, a housing, a tool-carrier within the housing and capable of moving longitudinally within the same, frangible means connecting the tool-carrier and the tubular housing, a sample-taker movably supported on the carrier and having its receiving mouth at its lower end, a tool string for supporting the tool-carrier with a jar device associated therewith, for spudding through the tool-carrier, and cam-means rigid with the housing lying in the path of the sample-taker for deflecting the same outwardly and into the earth at the side of the well bore.

6. Sampling apparatus to be used in a deep well for taking a sample from the side of a well bore, comprising in combination, a housing, a tool-carrier within the housing and capable of moving longitudinally within the same, frangible means connecting the tool-carrier and the tubular housing, a sample-taker movably supported on the carrier and having its receiving mouth at its lower end, a tool string for supporting the tool-carrier with means associated therewith for enabling the carrier to break said frangible means and enable the tool-carrier to move longitudinally with respect to the housing, cam-means rigid with the housing lying in the path of the sample-taker for deflecting the same outwardly and into the earth at the side of the well bore, and means for locking the housing against upward movement when the tool string is pulled upwardly.

7. A sampling tool to be used in a deep well for taking a sample from the side of the well-bore, comprising in combination a housing, a tool-carrier within the housing and capable of moving longitudinally within the same, said tool-carrier having a longitudinal slot therein, a sampler-tool pivotally supported on the carrier in the said slot and having its receiving mouth at its lower end, a transverse web within the housing received in the slot and having a cam face disposed toward the sampler-tool and lying in its path for deflecting the sample-taker outwardly to project the same into the side of the well-bore.

8. In a sampling tool for taking a sample from the side of a well-bore, the combination of a tubular tool string having an opening in its wall, a tubular housing within the same having an opening through its side wall, normally out of line, but capable of aligning with, the first named opening, a tool-carrier, a sampler-tool movably supported in the carrier and having its receiving mouth at its lower end, and lying opposite the said opening in the housing, said tool-string and said housing having correlated means brought into action by a movement of the housing relative to the tool string for effecting the alignment of the said openings, and cam-means lying in the path of the sample-taker for deflecting the same outwardly through the openings when the tool-carrier is moved longitudinally in the housing.

9. In a sampling tool for taking a sample from the side of a well-bore, the combination of a tubular tool string having an opening in its wall, a tubular housing within the same having an opening through its side wall, normally out of line, but capable of aligning with, the first named opening, a tool-carrier, a sampler-tool movably supported in the carrier and having its receiving mouth at its lower end, and lying opposite the said opening in the housing, said tool-string and said housing having correlated means brought into action by a movement of the housing relative to the tool-string for effecting the alignment of the said openings, cam-means lying in the path of the sample-taker for deflecting the same outwardly through the openings when the tool-carrier is moved longitudinally in the housing, said tool-string having a bottom shoe with an opening therein, and resilient means carried by the lower end of the housing for engaging in the opening in the said bottom shoe to hold the housing down when the tool string is pulled upwardly after the sample-taker has taken the sample.

10. A sampling tool to be used in a deep well for taking a sample from the side of the well bore, comprising in combination, a tubular housing having a side wall with an opening through the same, a tool-carrier within the housing having a longitudinal slot therein, a plurality of sample-takers pivotally supported in the slot to swing in substantially the same plane but at different levels on the tool-carrier, said housing having a transverse web corresponding to each sample-taker and located below the same so that when the tool-carrier is moved downwardly within the housing, the sample-takers will be swung outwardly by the action of their corresponding cams so as to project them into the side of the well-hole, and a longitudinally extending abutment carried on the side of the tool string substantially diametrically opposite to the side at which the sample-takers are projected outwardly.

11. In a deep well tool for taking samples from the side of the hole, the combination of a tubular tool string, a housing movable within the same, a core barrel carrier associated with the housing, a sand line supporting the carrier, a core barrel supported in the core barrel carrier, cam means to cooperate with the core barrel upon a relative downward movement of the carrier to project the core barrel outwardly from the housing, and means associated with the core barrel car-

rier and controlled by the sand line to lock the carrier to the tool string to enable the tool string to exert a downward thrust on the core barrel carrier, and thereby project the core tool outwardly into the side of the hole.

12. In a deep well tool for taking samples from the side of the hole, the combination of a tubular tool string, a housing movable within the same, a core barrel carrier associated with the housing, a sand line supporting the carrier, a core barrel supported in the core barrel carrier, cam means to cooperate with the core barrel upon a relative downward movement of the carrier to project the core barrel outwardly from the housing, and a locking head associated with the core barrel carrier and controlled by the sand line to lock the carrier to the tool string to enable the tool string to exert a downward thrust on the core barrel carrier, and thereby project the core tool outwardly into the side of the hole.

13. In a deep well tool for taking samples from the side of the hole, the combination of a tubular tool string, a housing within the same, a core barrel carrier associated with the housing, a sand line, a core barrel supported in the core barrel carrier, cam means to cooperate with the core barrel upon a relative downward movement of the carrier to project the core barrel outwardly from the housing, said tool string having rack teeth formed thereon, constituting a rack, a locking-head attached to the core tool carrier, pawls carried thereby to cooperate with the rack teeth, means supported by the sand line, and supporting the tool carrier for controlling the outward movement of the pawls into engagement with the rack teeth to lock the locking head to the inner tool string so that a downward movement of the tool string thereafter will enable the core barrel to cooperate with the cam means and force the core barrel out into the formation at the side of the hole.

14. In a deep well tool for taking samples from the side of the hole, the combination of a tubular tool string, a housing within the same, a core-barrel carrier associated with the housing, a sand line, a core barrel supported in the core-barrel carrier, cam means to cooperate with the core-barrel upon a relative downward movement of the carrier to project the core-barrel outwardly from the housing, a locking head associated with the core-barrel, said tool string having rack teeth formed thereon constituting a rack, pawls mounted on the locking head projecting upwardly at their free ends for engaging the rack teeth, a sleeve supported on the sand line and guided to slide on the locking head for engaging the pawls to hold the same in when the driving head is running down the hole, and capable of moving down when the sand line is slack, to enable the pawls to lock the locking head to the tool string, so that a downward movement of the tool string thereafter will enable the core-barrel to cooperate with the cam means and force the core-barrel outwardly into the formation at the side of the hole.

15. In a deep well tool for taking samples from the side of the hole, the combination of a tubular tool string, a housing within the same, a core-barrel carrier associated with the housing, a sand-line, a core barrel supported in the core-barrel carrier, cam means to cooperate with the core-barrel upon a relative downward movement of the carrier to project the core-barrel outwardly from the housing, a locking head associated with the core-barrel, a sliding sleeve carried on the sand-line supporting the locking head and capable of downward movement with respect to the same when the line is slack, said tool string having circumferential rack teeth formed thereon constituting a rack, pawls mounted on the locking head for engaging the rack-teeth, said sleeve having slots through which the pawls may move out to engage the rack teeth, resilient means to force the pawls outwardly to lock the locking head to the tool string so that a downward movement of the tool string thereafter will enable the core-barrel to cooperate with the cam means and force the core-barrel outwardly into the formation at the side of the hole, the upward movement of the sleeve operating to release the pawls from the rack.

16. In a sampling tool for taking a sample from the side of a well-bore, the combination of a tubular tool string having an opening in its wall, a tubular housing within the same having an opening through its side wall, normally out of line, but capable of aligning with, the first named opening, a tool-carrier, a sampler-tool movably supported in the carrier and having its receiving mouth at its lower end, and lying opposite the said opening in the housing, said tool-string and said housing having correlated means brought into action by a movement of the housing relative to the tool string for effecting the alignment of the said openings, cam-means lying in the path of the sample-taker for deflecting the same outwardly through the openings when the tool-carrier is moved longitudinally in the housing, and means for anchoring the cam-means against being pulled upwardly by the tool-carrier when the same is being reciprocated in spudding the sample-takers into the side of the hole.

17. A sampling tool to be used in a deep well for taking a sample from the side of the well bore, comprising in combination, a tubular housing having a plurality of openings through its wall, a tool-carrier within the housing and capable of moving longitudinally within the same, a plurality of sampler tools located respectively at different levels, and corresponding to said openings, each tool being pivotally supported on the carrier substantially on the central axis of the carrier, each of said sampler tools being suspended from above so that its receiving mouth at its lower end lies adjacent to its corresponding opening through the wall of the tubular housing, and cam means having an inclined face extending transversely across the space within the housing and rigid therewith, and lying in the path of each sample taker for deflecting the same outwardly through its corresponding opening when the tool carrier is moved downwardly in the housing, the lower end of said housing being supported on the well bottom when the tool carrier moves downwardly relative thereto, all of said parts cooperating so that the sampler tools are projected outwardly through their corresponding openings in a general horizontal direction.

18. A sampling apparatus constructed as defined in claim 17, in which there is only one sample tool supported at each of the said levels, and in which each sampler tool at each level is supported on a pivot pin extending transversely to the housing with the axis of the pivot pin substantially intersecting with the longitudinal axis of the tool carrier.

WALTER J. BARNHART.