

Nov. 16, 1943.

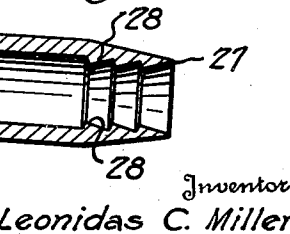
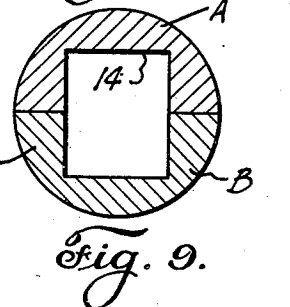
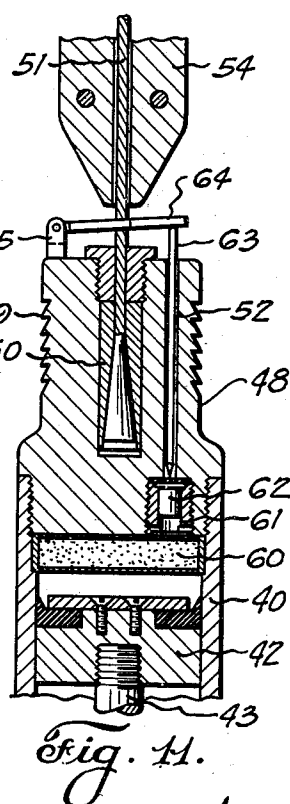
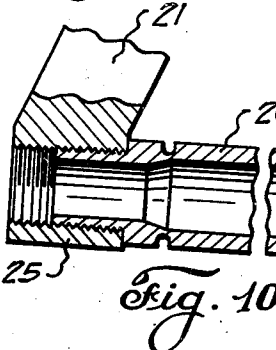
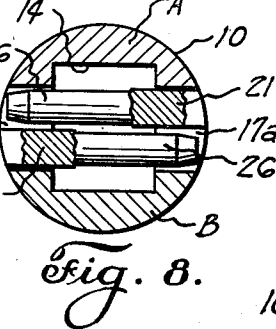
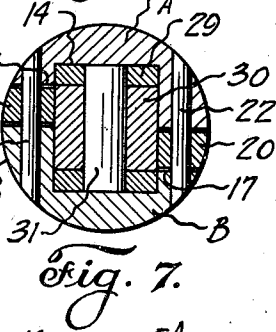
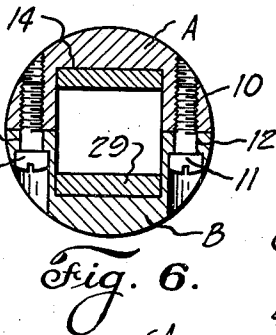
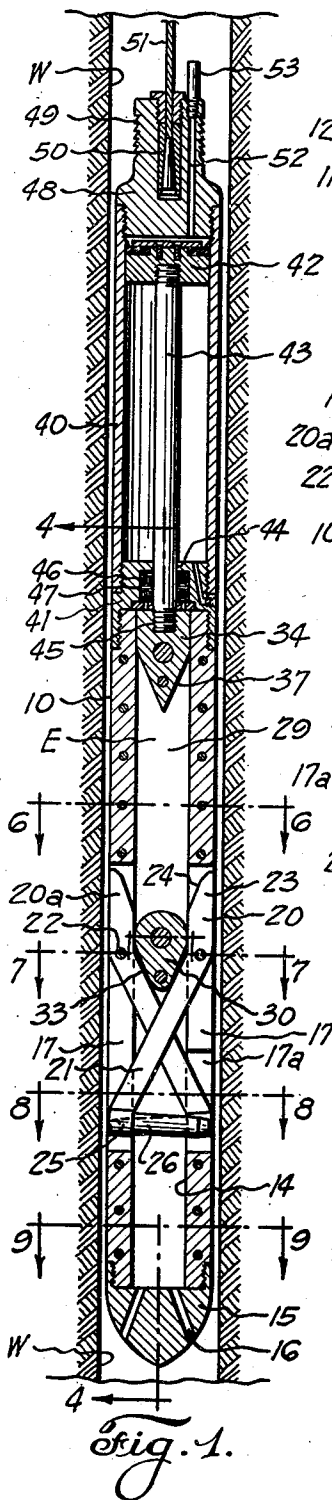
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2,334,428

WELL DEVICE

Filed July 15, 1940

2 Sheets-Sheet 1



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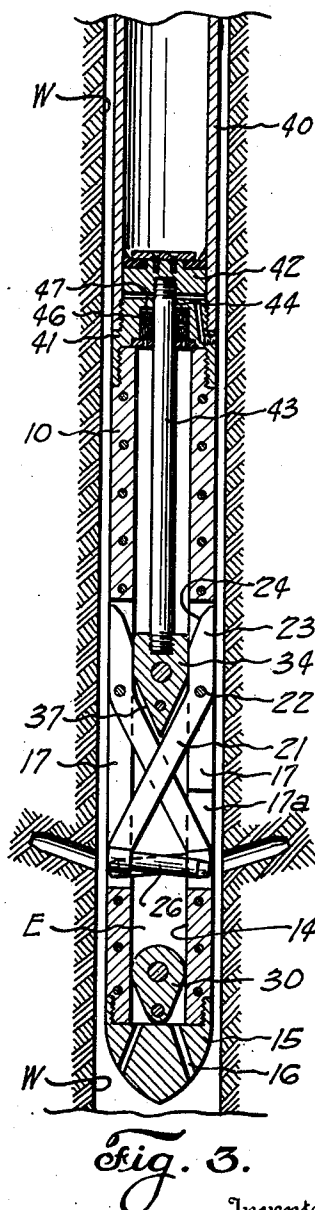
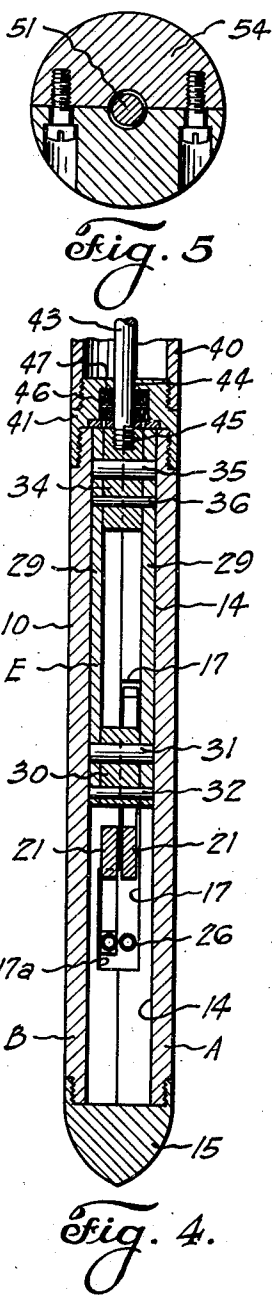
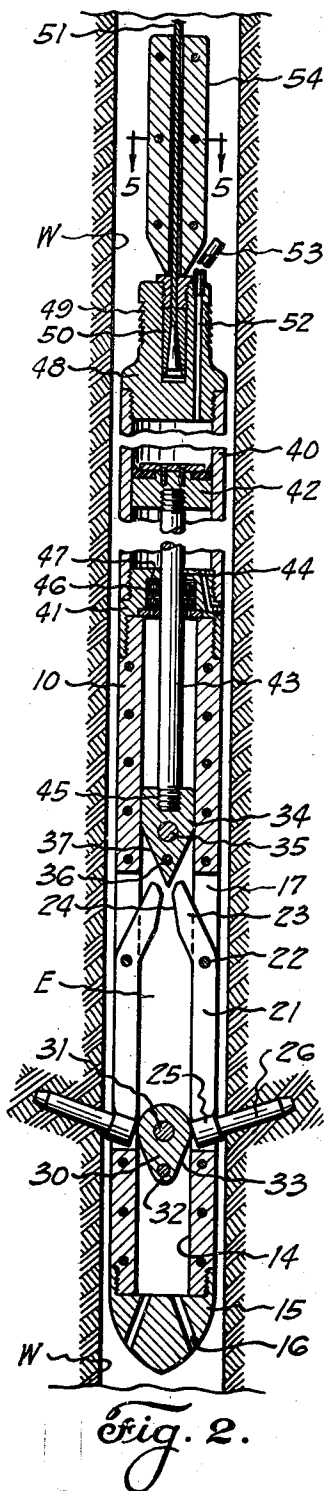
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2,334,428

WELL DEVICE

Filed July 15, 1940

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,334,428

WELL DEVICE

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Application July 15, 1940, Serial No. 345,469

7 Claims. (Cl. 255—1.4)

This invention relates to new and useful improvements in well devices.

One object of the invention is to provide an improved device having expansible and retractible elements which are arranged to be moved radially outwardly to penetrate the wall of the well bore or of the tubing, if a tubing is employed; the device being adapted for use either as a sampling device for taking a core or as a tubing perforator.

One object of the invention is to provide an improved device which is particularly adapted for use as a sampling device and which may be lowered into a well bore, said device having means for taking a sample or core of the subsurface formation from the wall of the well bore, whereby said core or sample may be readily obtained at any desired elevation and at any time subsequent to the drilling of said bore.

An important object of the invention is to provide an improved well device wherein an expansible element, which is normally in a retracted position to permit lowering of the device through the well bore, is arranged to be expanded or moved radially outwardly to penetrate the wall of the bore, after which it is returned to its retracted position; the expansion and retraction of the element being controlled by a single operating member which is so constructed that complete operation of the element is effected upon movement of the operating member in one direction only, whereby reciprocation of the operating member is unnecessary to accomplish expansion and retraction of said element.

Another object of the invention is to provide an improved sample obtaining device, which may be run into, and removed from the well bore on a flexible line or cable, whereby the time required for obtaining the sample at any desired elevation is minimized.

A particular object of the invention is to provide an improved device, of the character described, having radially movable core-taking elements, together with a single operating member movable between said elements, said member having means co-acting with the elements for expanding the same and having additional means spaced from the first means and also co-acting with said elements for retracting the same, whereby movement of the operating member between the elements in one direction results in an expansion and retraction of said elements; the arrangement facilitating the operation of the device since it is only necessary

that the operating member move in one direction.

A further object of the invention is to provide an improved device, of the character described, which is so arranged that the single operating member may be actuated by any desired method, that is, it may be actuated by pressure, by mechanical means, or by firing an explosive charge.

A still further object of the invention is to provide an improved sampling device, which is simple in construction and which has its housing split so as to facilitate assembly and disassembly; the core-taking tubes also being removably mounted to permit the cores which have been obtained from the formation to be easily removed from the device.

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

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

Figure 1 is a transverse, vertical, sectional view of a sidewall sampling device, constructed in accordance with the invention, and showing the core-taking elements retracted during lowering of the device,

Figure 2 is a similar view, with said elements expanded,

Figure 3 is a view, similar to Figures 1 and 2, and illustrating the elements retracted after a core has been taken,

Figure 4 is a transverse, vertical, sectional view, taken on the line 4—4 of Figure 1,

Figure 5 is an enlarged, horizontal, cross-sectional view, taken on the line 5—5 of Figure 2,

Figures 6 to 9 are enlarged horizontal, cross-sectional views, taken on the respective lines indicated in Figure 1,

Figure 10 is an enlarged, sectional detail of one of the core-taking tubes, and

Figure 11 is a view of the upper portion of the operating cylinder, illustrating another method of imparting movement to the single operating member.

In the drawings, the numeral 10 designates an elongate casing or housing which is slit longitudinally, whereby two sections A and B are provided. The sections are secured together by a plurality of bolts 11 which pass through openings 12 in the section B and which are threaded into the other section A, as is clearly shown in Figure 6. The outer end of each opening 12 is

counter-bored, whereby the head of each bolt is countersunk or disposed within the area of the casing 10. When the sections A and B are secured together, they provide an elongate casing or housing which is substantially cylindrical in cross-section.

The casing is provided with a vertically extending bore 14 and this bore is illustrated as being square in cross-section. The bore extends throughout the length of the casing and has its lower end closed by a rounded plug 15, which is threaded onto the lower end of the casing. The plug may be provided with reduced ports or passages 16 to establish communication between the interior and exterior of the casing.

A pair of slots 17 are formed in the wall of the casing 10 and are disposed diametrically opposite each other and said slots extend vertically of the casing. The upper portion of each slot is relatively narrow in transverse width and is disposed at one side of the plane in which the vertical axis of the casing lies. The lower portion of the slots is increased in width, such increase being double the area of the upper portion of said slots. As is clearly shown in Figure 4, the lower enlarged portion 17A of each slot has its central portion in a plane substantially aligned with the plane of the vertical axis of the casing.

A pair of core-taking elements 20 and 20A are pivotally mounted within the slots 17 and are adapted to be moved radially outwardly and inwardly relative to the casing 10, the lower portions of said elements moving through the enlarged lower ends 17A of the slots 17. Each core-taking element includes an angular bar 21 which has its upper portion pivoted on a transverse pin 22, which pin extends across the upper reduced portion of one of the slots 17. As illustrated, the angular bar 21 includes a short arm 23, which is disposed above the pivot pin 22. The inner surface of the extreme upper end of the bar 23 is bevelled or inclined, as shown at 24. The lower end of the bar 21 is provided with an internally screw-threaded collar 25 (Figure 10), which is preferably made integral with the bar and this collar is adapted to receive a core-taking tube 26. The tube 26 has its outer end tapered or reduced and is formed with a sharpened edge 27, which facilitates its entry into the formation, as will be explained. In order to retain a core or sample which has entered the tube 26, the bore of said tube is provided with a plurality of serrations or teeth 28, as is clearly shown in Figure 10.

As explained, the upper portion of each slot 17 is offset from the plane of the vertical axis of the casing and since the upper end of each core-taking element is pivoted within this portion of its slot, the bar 21 of each element is offset from the center of the casing. As is clearly shown in Figure 7, the upper portions of the slots 17 are located on opposite sides of the plane of the vertical axis of the casing, which offsets or misaligns the core-taking element. When the core-taking elements 20 and 20A are in a retracted position, as shown in Figure 1, the short arm 23 at the upper end of each element extends substantially vertical within the upper portion of its slot 17. Due to the inclination of the bar 21 of each element, said bar extends transversely across the bore 14 of the casing, with the result that the collar 25 is disposed within the enlarged portion 17A of the opposite slot. Therefore, the core-taking tube 26 is disposed entirely within the casing with its outer end located within the

enlarged portion of the slot immediately below the pivot pin 22. With the elements 20 and 20A in this position, as shown in Figure 1, said elements are entirely within the casing 10 and said casing may be lowered within the well bore W to any desired elevation therein.

Due to the pivotal mounting of the elements 20 and 20A, it will be obvious that when a force is exerted on the bars 21 below the pivot pin 22, the lower ends of said bars will be swung outwardly to the position shown in Figure 2, whereby the core-taking tubes 26 are moved radially outwardly into the wall of the well bore. The outward swinging of the lower ends of the bars 21 will result in an inward, radial movement of the short arms 23 above the pivot pin 22, whereby the upper ends of said arms are moved inwardly towards the center of the bore 14 of the casing 10. When the tubes 26 move outwardly into the bore, a sample or core of the formation opposite the casing 10 enters the tubes 26 and is retained therein by the serrations or irregularities which are formed within said bore. When the arms 23 on the bars 21 are again swung outwardly into the slots 17, it will be obvious that the lower ends of the bars 21 are again moved inwardly into the bore of the casing 10, whereby the core-taking tubes 26 are retracted from the formation. The core or sample which has entered the bores of the tubes is held therein and upon removal of the device, said cores may be examined.

For actuating the core-taking elements 20 and 20A to accomplish expansion and retraction thereof, an operating member E is disposed within the bore 14 of the casing and is movable vertically therein. This element includes a pair of vertically extending sidebars 29, which bars are spaced from each other and engage the vertical side walls of the bore 14. The lower ends of the bars are connected together by means of a wedge 30 which is disposed between said bars and which is secured thereto by means of pins 31 and 32. The lower end of the wedge 30 is tapered or inclined as illustrated at 33 and it is preferable that the inclined surfaces be rounded at their lower ends so as to merge with each other. The upper ends of the bars 29 are connected to each other in spaced relation by an upper wedge 34, which is secured thereto by pins 35 and 36. The lower end of the wedge 34 is tapered to a point by the provision of inclined surfaces 37, as is clearly shown in Figure 1. Since the lower wedge 30 is disposed at the lower ends of the bars 29 and the upper wedge 34 is located at the upper ends of said bar, it will be manifest that the wedges are spaced from each other, the spacing being controlled by the length of the bars 29. It is pointed out that the wedges 30 and 34 span the space between the bars 29, whereby said wedges are movable through the bore 14 of the casing 10.

When the core-taking elements 20 and 20A are in a retracted position, as shown in Figure 1, the lower wedge 30 is disposed between the arms 23 of said element, whereby said arms are prevented from moving inwardly into the bore 14 of the casing. Thus, the lower wedge 30 acts to lock the elements 20 and 20A in their retracted position and prevent unintentional expansion or outward movement of said element. At the time that the wedge 30 is disposed between the arms 23 of the elements 20 and 20A, the upper wedge 34 is located in the upper end of the bore 14 of the casing.

When it is desired to move the core-taking

tube 26 outwardly into the formation to obtain a core or sample, the operating member E is moved downwardly, whereby the inclined surfaces 33 of the lower wedge 30 engage the edges of the inclined bars 21 of the elements 20 and 20A. As explained, the bars 21 extend across the bore of the casing 10, and are, therefore, in the path of the wedge 30. As downward movement of the operating member E continues, the wedge 30 acts to force the inclined bars 21 outwardly, such bars swinging on their pivot pins 22. As the arms 21 move radially outwardly, the core-taking tubes 26 are forced into the formation adjacent the lower portions of the slots 17, whereby the core or sample of such formation is forced into the bores of said tubes. Downward movement of the operating member E continues until the wedge moves opposite the core-taking tubes 26, as shown in Figure 2 and in this position, the core-taking elements 20 and 20A are in their fully extended position. By this time, the core or sample has entered the bores of the tubes 26 and the arms 23 at the upper ends of the elements have been swung inwardly into the bore 14 of the casing.

Continued downward movement of the operating elements E causes the wedge 30 to pass below the core-taking tubes 26 and also causes the upper wedge 34 to move downwardly into contact with the inclined portions 24 of the arms 23, which are located at the upper ends of the elements 20 and 20A. As the upper wedge 34 moves between the arms 23, its inclined surfaces 37 act to spread the arms 23 and to move them radially outwardly. Such outward movement of the arms 23 causes the lower ends of the elements 20 and 20A to move inwardly towards the center of the bore of the casing, whereby the tubes 26 are retracted from the formation. By the time that the operating element E has completed its vertical movement within the bore, that is, by the time that the lower wedge 30 strikes the plug 15 on the lower end of the casing, the upper wedge 34 has moved to the position shown in Figure 3, whereby the arms 23 have been returned to their original position within the outer portions of the slots 17. The return of the arms to their original positions has resulted in a complete retraction of the tubes 26, whereby said tubes are again disposed wholly within the bore of the casing 10.

From the foregoing, it will be obvious that the movement of the operating member E from its uppermost position within the bore 14 to its lowermost position within the said bore results in an expansion and retraction of the core-taking elements 20 and 20A. The member E moves in one direction only, that is, downwardly, to accomplish both the expansion and retraction. After the operating element has reached its lowermost position, as shown in Figure 3, the upper wedge 34 is disposed between the arms 23 of the core-taking elements, and therefore, it is impossible to swing the arms inwardly to effect an outward movement of the core-taking tube. It is only when the operating member E is again raised so as to move the upper wedge 34 from between the arms 23 that an outward movement of the core-taking tube can be accomplished.

Movement may be imparted to the operating member E in any suitable manner but it is preferable that a fluid pressure means such as shown in my co-pending application, Serial No. 264,363, filed March 27, 1939, be employed for this purpose. In Figures 1 to 3, the upper ends of the casing 10 have been illustrated as connected with a

pressure cylinder 40, such connection being through a suitable coupling member 41. A piston 42 is reciprocable within the cylinder 40 and has a piston rod 43 depending therefrom. The piston rod 43 extends through an axial opening 44 which is formed in the coupling member 41 and the extreme lower end of said rod is threaded or otherwise secured within an opening 45 provided in the upper wedge 34 of the operating member E. Manifestly, with this arrangement, the movement of the piston 42 within its cylinder 40 will result in a movement of the operating member E. For packing off around the piston rod 43 adjacent the opening 44 within the coupling 41, a plurality of packing rings 46 are provided. These rings encircle the piston rod and are mounted within an annular recess 47 in the coupling, said recess being provided for the reception of the packing.

The upper end of the cylinder 40 is closed by a cap member 48 which has a fishing neck 39 extending upwardly therefrom and preferably made integral therewith. A cable socket 50 is formed within the fishing neck, whereby a flexible line or cable 51 may be attached thereto in the usual manner. The cable 51 is, of course, employed for lowering and raising the entire unit within the well bore W.

Any suitable pressure may be applied to the upper end of the piston 42 in order to move said piston downwardly to effect operation of the core-taking element through the medium of the operating member E. However, it is preferable to employ the hydrostatic head of fluid which is standing within the well bore for this purpose. For operating the piston by means of such pressure, the fishing neck and cap member are provided with a vertically extending passage 52 which has its lower end communicating with the upper end of the cylinder 40. This passage is normally closed by a frangible plug 53 which extends upwardly from the top of the fishing neck 49. When the device is assembled and set at the surface of the well, the interior of the cylinder 40 is under an atmospheric pressure, or under a pressure which is less than the pressure of the fluid within the well bore. The pressures across the piston 42 are equalized, whereby the frictional engagement of the piston with the wall of the cylinder, as well as the frictional engagement of the packing 46 with the piston rod 43, will hold said piston in its raised position. Therefore, when the device is assembled at the surface, the parts are in the position shown in Figure 1 and will remain in such position as the device is lowered through the well bore W by means of the flexible cable 51.

In operating the device, after the same has reached the elevation at which a core or sample is to be taken, a "messenger" or "go-devil" 54 (Figure 2) is dropped downwardly on the flexible line or cable 51. As is well known, this messenger is weighted and falls downwardly on the line of its own weight. Upon striking the upper end of the frangible plug 53, said plug is broken to establish communication between the well bore and the upper end of the cylinder 40. The breaking or fracturing of the plug 53 admits the pressure within the well bore W into the upper end of the cylinder and this pressure is the hydrostatic head pressure of the liquid which is standing within the bore. The admission of this pressure into the cylinder forces the piston 42 downwardly within its cylinder 40, whereby the operating member E is moved downwardly within the bore 14 of the casing 10.

As the operating member E moves downwardly, the lower wedge 33 moves downwardly between the bars 21 of the core-taking elements 20 and 20A and serves to swing the lower ends of said bars outwardly through the slots 17. As the bars are swung on their pivot pins 22, the core-taking tubes 26 move outwardly into the formation, as shown in Figure 2. As said tubes move outwardly into said formation, the short arms 23 at the upper ends of the elements 20 and 20A, move inwardly into the central portion of the bore 14 of the casing 10. By the time that the lower wedge 30 has moved from between the bars 21, the upper wedge 34 moves into contact with the inclined upper ends of the arm 23, which have been moved into the path of said wedge. A continued downward movement of the operating member E results in the upper wedge 34 spreading the arms 23, whereby the core-taking tubes are swung inwardly into the bore, as shown in Figure 3. The length of the piston rod 43 is such that when the piston 42 reaches the lower end of the cylinder, the upper wedge 34 has moved to the position shown in Figure 3 between the arms 23, whereby inward swinging of said arms is prevented. Thus, the device may be removed from the well bore without the danger of the tubes 26 moving outwardly into contact with the wall of said bore during such raising operation. The operating member E moves only in one direction, that is downwardly, and such movement accomplishes both the expansion and the retraction of the core-taking tube. It is only necessary to move the piston 42 from the upper end of the cylinder downwardly to the lower end thereof to accomplish the complete operation of the core-taking elements 20 and 20A.

As has been pointed out, any suitable means may be provided for imparting the vertical movement to the operating member E and in Figure 11, another form of imparting movement to this member is shown. In this form, a powder chamber 60 is disposed within the upper end of the cylinder 40. A cartridge chamber 61 is formed at the lower end of the vertical passage 52 which extends through the cap member 48 and this chamber receives a cartridge 62. A firing pin 63 extends through the opening or passage 52 and has its lower end engaging the cartridge 62. A pivoted lever 64 overlies the firing pin 63, being pivoted to upstanding ears 65 which are provided on the top of the fishing neck 49.

The operation of this form is obvious. When the messenger or go-devil 54 is dropped downwardly on the flexible line 51, said messenger strikes the pivoted arm 64 and moves the same downwardly, whereby the firing pin 63 discharges the cartridge 62. Discharge of the cartridge results in an ignition of the powder within the powder chamber 60 and the force of the resultant explosion forces the piston 42 downwardly within the cylinder. Obviously, other means for imparting a downward movement to the operating member E may be designed.

From the foregoing, it will be seen that a very simple and efficient core-taking device is provided. The operating member is constructed so that its movement in one direction only will result in both an expansion and retraction of the core-taking element. After the elements have taken a core and have been removed to their retracted position, as shown in Figure 3, said elements are locked against unintentional outward movement during raising of the device in the bore. After the device is removed from the well, the

core tubes 26 may be readily removed from the bars 21, whereby the core or sample therein may be examined. In order to reset the device, it is only necessary to move the piston upwardly so that the parts assume the position shown in Figure 1. At this time, the frangible plug 53 is replaced and the device is ready for another run.

The device has been illustrated and described as a sampling device but it is apparent that the same may be employed as a tubing or casing perforator by merely substituting sharpened or perforating elements for the core-taking tubes.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

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

1. A device, of the character described including, a tubular body adapted to be lowered within a well bore, an element pivotally mounted within the body and having means for penetrating the wall of the bore when the element is swung, and an operating means movable within the bore of the body and co-acting with said element to expand and retract the element upon movement of the member in one direction within the bore.

2. A sidewall sampling device including, a tubular body having vertical openings in its wall and adapted to be lowered within a well bore, a pair of pivotally mounted core-taking elements extending across the bore of the body and arranged to be moved outwardly through the openings into engagement with the wall of the well, an operating member movable vertically within the bore of the body, and means on said operating member co-acting with the elements to expand and retract said elements when the operating member is moved downwardly within the bore of the body.

3. A sidewall sampling device including, a tubular body having vertical openings in its wall and adapted to be lowered within a well bore, a pair of pivotally mounted core-taking elements extending across the bore of the body and arranged to be moved outwardly through the openings into engagement with the wall of the well, an operating member movable vertically within the bore of the body, a wedge on one end of the operating member co-acting with the elements upon initial movement of the member within the bore to expand said elements outwardly into engagement with the formation, and a second wedge spaced from the first wedge and co-acting with the elements to retract the same upon continued movement of the member within the bore of the body.

4. A sidewall sampling device including, a tubular body having vertical openings in its wall and adapted to be lowered within a well bore, a pair of pivotally mounted core-taking elements extending across the bore of the body and arranged to be moved outwardly through the openings into engagement with the wall of the well, an operating member movable vertically within the bore of the body, a wedge on one end of the operating member co-acting with the elements upon initial movement of the member within the bore to expand said elements outwardly into engagement with the formation, a second wedge spaced from the first wedge and co-acting with the elements to retract the same upon continued movement

of the member within the bore of the body, and fluid pressure-actuated means for imparting movement to the operating member.

5. A sidewall sampling device including, a tubular body having openings in its wall and adapted to be lowered into a well bore, a pair of expandable core-taking elements pivoted within the body, each element being pivoted nearer its upper end and having its lower portion extending at an incline across the bore of the body, whereby the lower portions are in crossed relation when retracted, an operating member slidable within the bore of the body, means at the lower end of said member for moving between the elements to swing the lower ends thereof radially outwardly when the operating member is initially moved downwardly, such swinging of the elements causing the upper ends of the elements to move inwardly toward each other within the bore, and means at the upper portion of the member for moving between the upper ends of the elements upon continued downward movement of the member to return the elements to their retracted position.

6. A sidewall sampling device including, a tubular body having openings in its wall and adapted to be lowered into a well bore, a pair of expandable core-taking elements pivoted within the body, each element being pivoted nearer its upper end and having its lower portion extending at an incline across the bore of the body, whereby the lower portions are in crossed relation when retracted, an operating member slidable within the

bore of the body, means at the lower end of said member for moving between the elements to swing the lower ends thereof radially outwardly when the operating member is initially moved downwardly, such swinging of the elements causing the upper ends of the elements to move inwardly toward each other within the bore, means at the upper portion of the member for moving between the upper ends of the elements upon continued downward movement of the member to return the elements to their retracted position, pressure responsive means connected with the member for imparting movement thereto, and means for directing the pressure within the well bore against the pressure responsive means to affect movement thereof.

7. A sidewall sampling device including, a tubular body having vertical openings in its wall and adapted to be lowered within a well bore, a pair of pivotally mounted core-taking elements extending across the bore of the body and arranged to be moved outwardly through the openings into engagement with the wall of the well, an operating member movable vertically within the bore of the body, means on said operating member co-acting with the elements to expand and retract said elements when the operating member is moved downwardly within the bore of the body, and means for locking said elements in a retracted position after the operating member has been moved to actuate the elements and a core has been taken.

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