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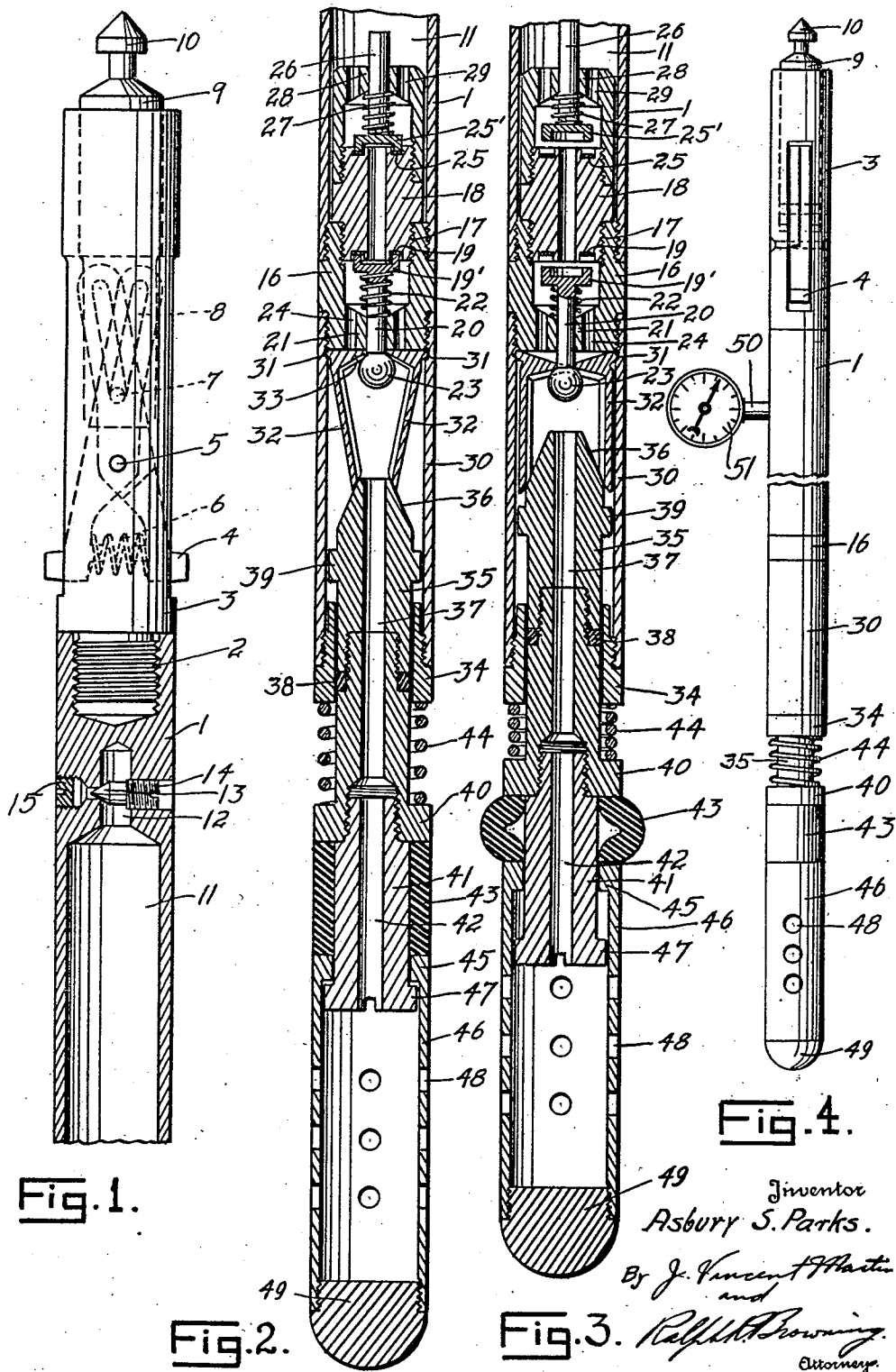
A. S. PARKS

2,113,856

WELL PRODUCTION TESTER

Filed April 16, 1936

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

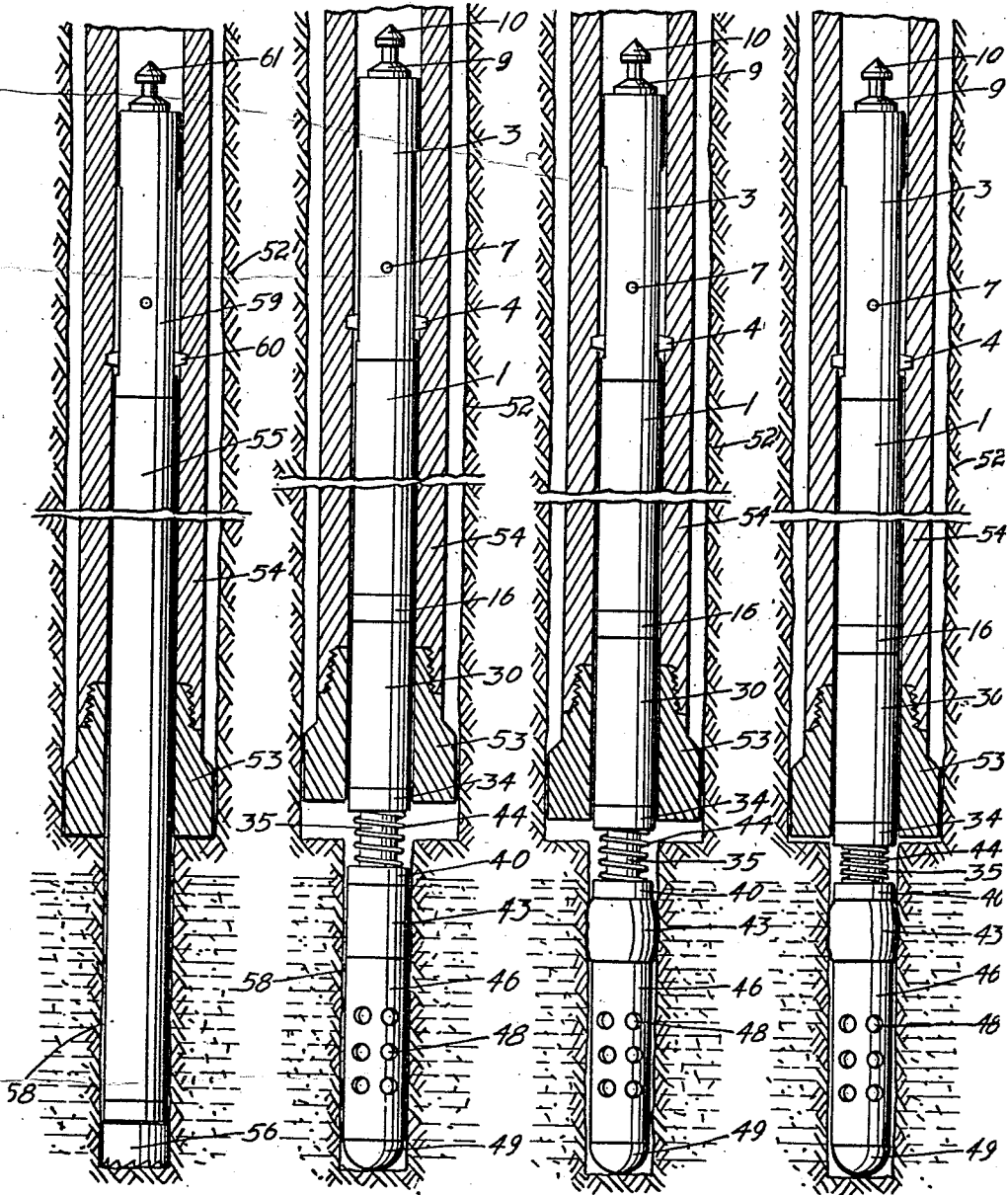


Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

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2,113,856

WELL PRODUCTION TESTER

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8 Claims. (Cl. 166—1)

This invention relates in general to sample taking methods and apparatus for use particularly in connection with the drilling of wells for the production of oil and other fluids, and has particular reference to a method and means for taking samples of the production of the formation at the bottom of a drilled hole.

Heretofore it has been customary in drilling wells for the production of fluid to utilize what is known as a core bit and from time to time in the course of drilling to take from the formation at the bottom of the drilled hole an unbroken sample of the formation just as it naturally occurs. In this well known practice, the drill cuts an annular path, leaving the center of the bottom of the hole uncut. This central portion is forced upwardly into a receptacle held by the drill, which receptacle is ordinarily known as a core barrel.

When a formation is found which appears to be such as will produce the fluid being sought, it is customary to make what is known as a drill stem test to determine as nearly as possible just what the formation will produce. The making of a drill stem test is a highly specialized and laborious operation, and in some instances is very dangerous. In all cases it must be conducted by one who is thoroughly trained for the purpose.

It is an object of this invention to provide a method and means whereby a sample of the fluid production of the formation being drilled may be obtained without the difficulty and danger ordinarily attendant upon a so-called drill stem test.

It is an object of this invention that the means shall be of a type capable of use with a conventional core bit, and may be employed therein immediately after a core has been taken and the core barrel withdrawn, occupying the same space as was occupied by the core barrel.

It is an object of this invention to provide a means whereby samples may be taken of the fluid production of a given formation at the bottom of a hole with the least possible contamination of the sample by substances other than those produced by the formation itself.

It is a further object to provide in a device of this type a means whereby the natural pressure at the bottom of the hole may be taken simultaneously with a sample of the production.

One other object is to provide a device of this type which shall be mechanically simple, both in its construction and operation, and capable of carrying out all of the functions above set forth with the least amount of attention and cost.

With the foregoing and other objects in view,

which will become more apparent from the following description and the accompanying drawings, this invention consists of the various parts and combinations therein set forth. It is to be distinctly understood, however, that the same is by way of illustration and example only, and is not to be taken as in any way a limitation upon the scope of this invention. Such limitation is to be only by the prior art and by the terms of the appended claims.

Referring to the drawings on which like numerals indicate corresponding parts throughout:

Figure 1 is an elevation of the upper portion of a device constructed in accordance with this invention the lower portion of this figure being in vertical cross-section.

Figure 2 is a view similar to Figure 1 but showing the lower part of the device in vertical cross-section, the various movable parts in this instance being shown in the position they occupy when being lowered into or raised from a well.

Figure 3 is a view similar to Figure 2 but illustrating the parts in position for receiving a sample.

Figure 4 is an elevation of the device illustrating the manner of observing the pressure existing in the formation from which a sample has been taken.

Figure 5 is a view showing a vertical cross-section of a core bit during the preparation of a hole for the purpose of taking a sample of the production.

Figure 6 is a similar view illustrating the device of this invention immediately after it has been lowered into place within the drill bit.

Figure 7 is a view similar to Figure 6 but illustrating the packing of this device in expanded position.

Figure 8 illustrates the device in position for taking a sample.

With reference to Figure 1 of the drawings, the numeral 1 designates the body portion of a sample taking device formed at its upper end with a threaded socket adapted to receive the threaded lower end 2 of a latching means such as indicated at 3. The numeral 4 indicates one of the bolts of this latching means, these bolts being pivoted within the member 3 as at the point 5, and being urged apart at their lower ends by means of a spring 6. The bolts 4 may be forced inwardly by means of a pin 7 which rides in slots 8 formed in the upper ends of the bolts respectively, the pin 7 being carried by a sliding member 9 having at its upper end a connection 10 for an overshot.

The body 1 of this device is provided with a

hollow portion 11 within which the sample to be taken is received. At the upper end of this hollow portion there is a reduced hollow extension 12 having lateral openings therefrom. These lateral openings are normally closed by means of a needle valve 13 threaded at 14 into one of the openings and projecting across the hollow extension 12 to close the other opening. This second opening is normally closed by means of a plug 15 which is threaded into the opening.

At its lower end, the body member 1 is internally threaded to receive the upper end of a valve guide member 16. This valve guide member is open at its upper end and is internally threaded at 17 to receive a valve block 18. This valve block is provided with a bore therethrough and with a valve seat 19 at its lower end. The valve 19' cooperates with the valve seat 19 and is guided by its valve stem 20 which fits within a guide portion 21 of the member 16. A spring 22 surrounds the valve stem 20 between the guide portion 21 and the valve 19' and normally holds the valve in closed position against the valve seat 19. At its lower end below the guide means 21, the valve stem 20 is formed with an enlargement 23, the purpose of which will presently be explained. The guide means 21 is also provided with openings 24 extending therethrough at positions spaced from the valve stem.

At its upper end, the valve block 18 is provided with a second valve seat 25 adapted to receive a valve 25'. This valve 25' is similarly provided with a valve stem 26 which is surrounded by a spring 27 similar to the spring 22. A second valve guide member 28 is threadedly secured to the upper end of the valve block 18 and serves to hold the upper end of the spring 27 and to form a guide for the valve stem 26. This guide member 28 is provided with openings 29 similar to the openings 24 in the guide member 16.

On the lower end of the guide member 16 there is mounted a tubular member 30 having seats 31 formed in its inner walls adjacent its upper end for the purpose of receiving and fulcruming the valve operating levers 32. These levers 32 are in the form of bell cranks and have portions 33 arranged to fit around the enlargement 23 on the valve stem 20 so that when the lower ends of these bell cranks are forced apart or away from each other the upper ends 33 will serve to draw the enlargement 23 downwardly and open the valve 19'.

Threaded into the lower end of the tube 30 is a bushing 34 adapted to slidably receive a plunger 35. This plunger is formed with a tapered upper end which may be of conical or other suitable shape and which engages between the lower ends of the levers 32 so that upon sliding upward movement of the plunger 35 the levers 32 will be forced apart to open the valve 19'. This plunger 35 is provided with a bore 37 through its center and is surrounded intermediate its ends by means of a washer 38 or other similar packing. This packing may be of any suitable design but is so formed as to permit the passage of fluid downwardly along the plunger walls but so as to prevent the passage of fluid upwardly. The downward movement of the plunger 35 is limited by an enlarged portion 39 adjacent its upper end which comes in contact with the upper end of the bushing 34. The plunger 35 may be formed in two parts the lower of which is threaded into the upper as illustrated in the drawings, and the packing ring or washer 38 may be carried between these parts. The lower end of the lower part is

formed with a head 40 internally threaded to receive a bushing 41. This bushing 41 is provided with a bore 42 similar to the bore 37 through the plunger 35, and surrounding the bushing 41 is a packing ring 43 normally of the same outer diameter as the body 1, the tube 30, and the head 40. Between the head 40 and the bushing 34 is a compression spring 44 normally maintaining the plunger 35 in its lower position. The end of the packing 43, which is opposite the head 40, engages with the upper end 45 of a screenlike member 46. This screenlike member 46 extends inwardly at its upper end and is held in place by the outward extension of the head 47 on the lower end of the bushing 41. The screen is provided in a well known manner with openings 48 through which the sample to be taken may enter. The lower end of the screen 46 is preferably closed by a plug 49 or any other similar member.

Referring particularly to Figure 4, there is illustrated the method of observing the pressure existing in the formation at the bottom of the hole from which a sample has been taken. In making this observation, the plug 15 is first removed and a nipple 50 is substituted therefor. Carried on this nipple is a pressure indicator 51. After this is in place, the needle valve 13 is opened by means of a screw driver or the like, so as to allow the pressure existing within the space 11 to actuate the indicator 51, which actuation may be observed.

In operation, the hole is drilled into the formation 52 in the usual manner by a core bit 53 secured to the lower end of the drill collar 54 or the like. When it is desired to take a sample, there is lowered into the drill stem a pilot drill having a body 55 and a bit 56 at its lower end. This bit 56 extends below the lower end of the drill 53 and is adapted to cut a so-called "rat hole" 58 into the formation to be tested. To the upper end of the body 55 is secured a latching device 59 which may be provided with bolts 60 and an over-shot connection 61 in all respects similar to that previously described and shown in Fig. 1 of the drawings. These bolts 60 are adapted to engage with openings formed in the inner wall of the drill collar just above the bit 53. With this device in place, the "rat hole" 58 is drilled as illustrated in Fig. 5.

The bit 56 is now withdrawn from the hole through the drill stem and in its place there is lowered the device shown and illustrated in Figures 1 to 4, inclusive. Before this device is permitted to reach the bottom of the hole, however, the drill 53 must be drawn up a short distance so that the plug 49 will not come in contact with the bottom of the "rat hole" until after the bolts 4 have engaged the openings provided for that purpose. When these bolts are engaged, the device appears as illustrated in Figure 6 of the drawings with the drill 53 spaced from the bottom of the main hole and with the plug 49 resting on the bottom of the "rat hole".

The drill stem and the drill 53 are then lowered so as to compress the packing ring 43 between the head 40 and the upper end 41 of the screen 46. This causes the packing 43 to be expanded and to seal with the sides of the "rat hole" and shuts off that portion of the "rat hole" below the packing 43. When the device is lowered into the hole, the various parts occupy the positions illustrated in Figure 2 of the drawings, and due to the strength of the spring 44 the downward pressure exerted when the drill stem is lowered causes the packing 43 to be com-

pressed and to expand laterally before the spring 44 will be materially compressed. Once the packing 43 is expanded, however, the spring 44 will be compressed and the plunger 35 will move upwardly with respect to the tube 30 and the bushing 34. When fluid which may be trapped within the tube 30 will be allowed to pass downwardly past the packing ring 38, the upward movement of the plunger will, as previously stated, cause the opening of the valve 19', and will thus make it possible for the pressure existing in the formation below the packing 43 to force the production of this formation through the openings 48 in the screen 46, upwardly through the bores 42 and 37, through the openings 24 and past the valve 19' to open the valve 25'. The production from this formation will then pass into the space 11 which is provided in this device for receiving the sample of the production.

As soon as the sample has had time to pass into the chamber 11, the process is reversed and the drill stem raised so as to (1) allow the valve 19' to close, and (2) permit the packing 43 to expand longitudinally and contract laterally. The sample taking device may then be removed from the drill and drill stem by means of an overshot in the well known manner. No mud from the hole can pass into the sample chamber because of the valve 19', and the sample in the sample chamber cannot get out because of the valve 25'. Upon reaching the surface, the bottom hole pressure may be obtained as previously described, and upon draining the sample chamber 11 the exact nature of the production of the formation at the bottom of the well may be determined.

It will readily be appreciated that there has by this invention been provided a method and apparatus capable of carrying out all of the objects and advantages hereinbefore expressed.

The device which has been described is especially adapted for use with what is known as a wire line core bit. As in the practice of taking cores with such a bit, the device above described is simply dropped into the well through the drill stem and latched in the bit while the sample is being taken. It is then drawn out by means of a wire line having an overshot on its lower end for engagement with the connection 10.

It is very noteworthy that in the method made possible by this device, a sample of the production may be taken without the slow and costly operation of pulling the drill and drill string out of the well and running it in again, as has been necessary in the past. It is only necessary to raise the drill a few inches and to lower it again after the sample taking device is in place, as above described.

It is also noteworthy that the sample may be taken within a comparatively few minutes after the "rat hole" has been drilled out, the only time required being the time necessary to hoist the small bit 55 with a wire line and drop the sample taking device into position. Meantime, there is no removal of the large bit and no other operation which might cause foreign material from the upper wall of the hole or elsewhere to enter the test hole, and when the sample is taken, it is taken from a freshly cut hole in the formation to be tested.

In addition to the foregoing, when it is found desirable because of the conditions encountered, it is possible by the use of additional well known equipment for closing the top of the drill stem about the wire line, to maintain circulation while running the device herein described into a well,

taking a sample, and retrieving the device with a wire line. With methods of sampling which require removal of the drill stem, such as in the conventional testing method, it is obviously impossible to maintain circulation.

It will be seen therefore that the means and method set forth are capable of producing an improved result with a greatly reduced expenditure of time, labor and money, and without the hitherto attendant dangers.

Having described my invention, I claim:

1. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a sample receptacle adapted to be lowered into said drill stem and core drill, said sample receptacle having means connected with it and below it including a first and second valve, and means secured to said first means for projecting below said core drill and into a hole in the formation, said second means including a member for sealing off the bottom portion of said hole and a member for opening said first valve when said sealing member is set in the hole to permit a sample of the production of said formation to open said second valve and enter said sample receptacle, and latching means secured to and above said sample receptacle for latching said receptacle in position within the core drill.

2. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a main body portion having a sample receptacle therein adapted to be lowered into said drill stem and core drill, means connected to said main body portion adapted to be lowered into a hole in the formation for conducting a sample of the production of said formation to said receptacle, sealing means above said first mentioned means for sealing off the bottom portion of the hole, a spring pressed valve below said sample receptacle normally closing said receptacle against ingress of said sample, and means operable when said sealing means is set for forcibly opening said valve to establish communication between said receptacle and that portion of the hole below said sealing means.

3. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a main body portion having a sample receptacle therein adapted to be lowered into said drill stem and core drill, means connected to and below said receptacle adapted to be lowered into a hole in the formation to conduct a sample from said formation to said receptacle, sealing means above said last mentioned means for sealing off the bottom portion of the hole, said sample receptacle having means connected with it and below it including a first and second valve, the first valve being spring pressed and normally closing said receptacle against ingress of said sample, the second valve being spring pressed and normally closing said receptacle against egress of a sample therein, and means for opening said first valve when said sealing means is set in the hole to permit a sample of the production of said formation to open said second valve and enter said sample receptacle and latching means secured to and above said main body portion for latching said receptacle in position within the core drill.

4. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a main body portion having a sample receptacle therein adapted to be lowered into said drill stem and core drill, means connected to and below said receptacle adapted to

be lowered into a hole in the formation to conduct a sample from said formation to said receptacle, sealing means above said last mentioned means for sealing off the bottom portion of the hole, said sample receptacle having means connected with it and below it including a first and second valve, the first valve being spring pressed and normally closing said receptacle against ingress of said sample, the second valve being spring pressed and normally closing said receptacle against egress of a sample therein, a hollow plunger slidable with respect to said body portion for opening said first valve when said sealing means is set in the hole to permit a sample of the production of said formation to open said second valve and enter said sample receptacle, the means adapted to be lowered into the hole in the formation being hollow and slidable upwardly with respect to said hollow plunger, the sealing means being compressible between said hollow plunger and the last mentioned hollow slidable means.

5. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a main body portion having a sample receptacle therein adapted to be lowered into said drill stem and core drill, means connected to and below said receptacle adapted to be lowered into a hole in the formation to conduct a sample from said formation to said receptacle, sealing means above said last mentioned means for sealing off the bottom portion of the hole, said sample receptacle having means connected with it and below it including a first and second valve, the first valve being spring pressed and normally closing said receptacle against ingress of said sample, the second valve being spring pressed and normally closing said receptacle against egress of a sample therein, a hollow plunger slidable with respect to said body portion for opening said first valve when said sealing means is set in the hole to permit a sample of the production of said formation to open said second valve and enter said sample receptacle, the means adapted to be lowered into the hole in the formation being hollow and slidable upwardly with respect to said hollow plunger, a spring for urging said hollow slidable means to its lowermost position, the sealing means being compressible to a greater degree between said hollow plunger and the last mentioned hollow slidable means than said spring is compressible.

6. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a main body portion having a sample receptacle therein adapted to be lowered into said drill stem and core drill, means connected to and below said receptacle adapted to be lowered into a hole in the formation to conduct a sample from said formation to said receptacle, sealing means above said last mentioned means for sealing off the bottom portion of the hole, said sample receptacle having means connected with it and below it including a first and second valve, the first valve being spring pressed and normally closing said receptacle against ingress of said sample, the second valve being spring pressed and normally closing said receptacle against egress of a sample therein, a hollow plunger slidable with respect to said body portion for opening said first valve when said sealing means is set in the hole to permit a sample of the production of said formation to open said second valve and enter said sample receptacle, the means adapted to be lowered into the hole

in the formation being hollow and slidable upwardly with respect to said hollow plunger, a spring for urging said hollow slidable means to its lowermost position, the sealing means being compressible to a greater degree between said hollow plunger and the last mentioned hollow slidable means than said spring is compressible, and a second sealing means between and contacting both said hollow plunger and said main body portion.

7. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a main body portion having a sample receptacle therein adapted to be lowered into said drill stem and core drill, said receptacle having an opening therein adapted to receive a pressure gauge so that the pressure within said receptacle can be determined, means connected to and below said receptacle adapted to be lowered into a hole in the formation to conduct a sample from said formation to said receptacle, sealing means above said last mentioned means for sealing off the bottom portion of the hole, said sample receptacle having means connected with it and below it including a first and second valve, the first valve being spring pressed and normally closing said receptacle against ingress of said sample, the second valve being spring pressed and normally closing said receptacle against egress of a sample therein, a hollow plunger slidable with respect to said body portion for opening said first valve when said sealing means is set in the hole to permit a sample of the production of said formation to open said second valve and enter said sample receptacle, the means adapted to be lowered into the hole in the formation being hollow and slidable upwardly with respect to said hollow plunger, a spring for urging said hollow slidable means to its lowermost position, the sealing means being compressible to a greater degree between said hollow plunger and the last mentioned hollow slidable means than said spring is compressible, and a second sealing means between and contacting both said hollow plunger and said main body portion.

8. In a device for taking a sample of the production of an earth formation, a drill stem, a core drill thereon, a main body portion having a sample receptacle therein adapted to be lowered into said drill stem and core drill, said receptacle having an opening therein adapted to receive a pressure gauge so that the pressure within said receptacle can be determined, means connected to and below said receptacle adapted to be lowered into a hole in the formation to conduct a sample from said formation to said receptacle, sealing means above said last mentioned means for sealing off the bottom portion of the hole, said sample receptacle having means connected with it and below it including a first and second valve, the first valve being spring pressed and normally closing said receptacle against ingress of said sample, the second valve being spring pressed and normally closing said receptacle against egress of a sample therein, a hollow plunger slidable with respect to said body portion for opening said first valve when said sealing means is set in the hole to permit a sample of the production of said formation to open said second valve and enter said sample receptacle, the means adapted to be lowered into the hole in the formation being hollow and slidable upwardly with respect to said hollow plunger, a spring for urging said hollow slidable means to

its lowermost position, the sealing means being compressible to a greater degree between said hollow plunger and the last mentioned hollow slidable means than said spring is compressible, and a second sealing means between and contacting both said hollow plunger and said main body portion, a latching means secured to and above said main body portion for latching said receptacle in position within the core drill, and an overshot connection at the upper end of said body portion for handling said device.

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