

Sept. 30, 1952

N. A. NELSON

2,612,346

DEVICE FOR OBTAINING SAMPLES FROM WELL BORES

Filed June 27, 1951

2 SHEETS—SHEET 1

FIG. 2.

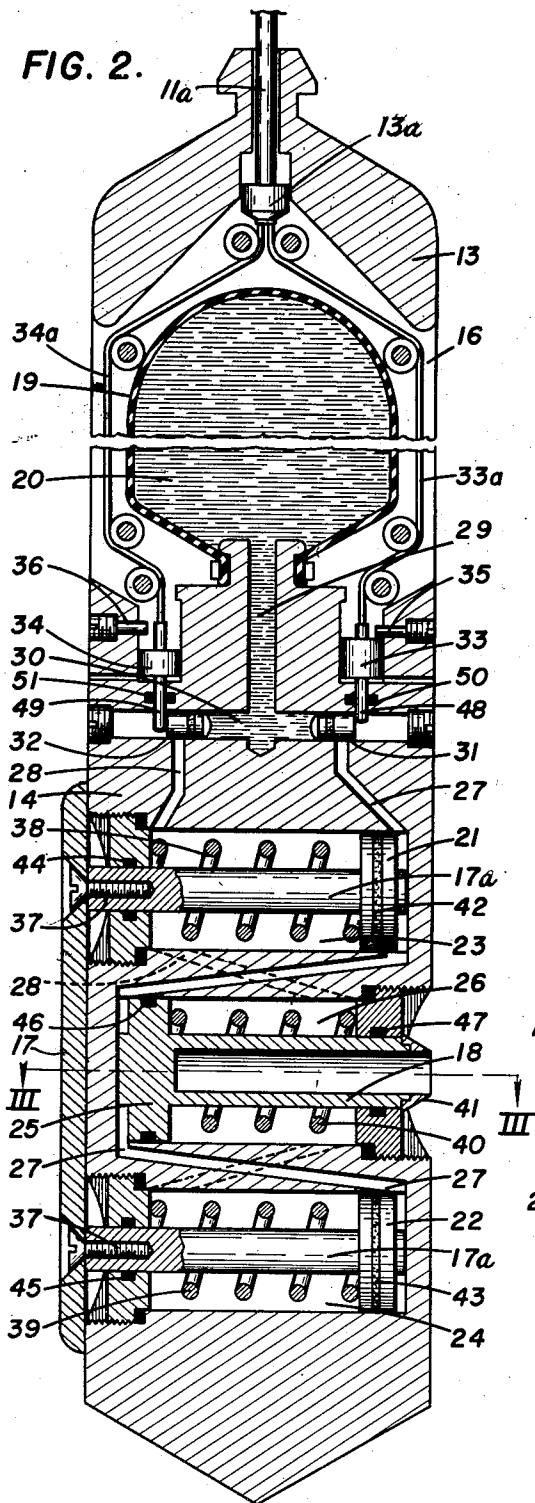


FIG. 1.

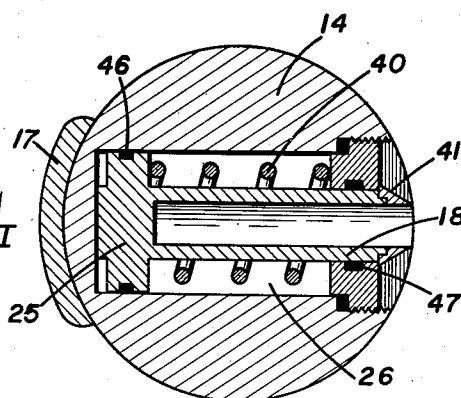
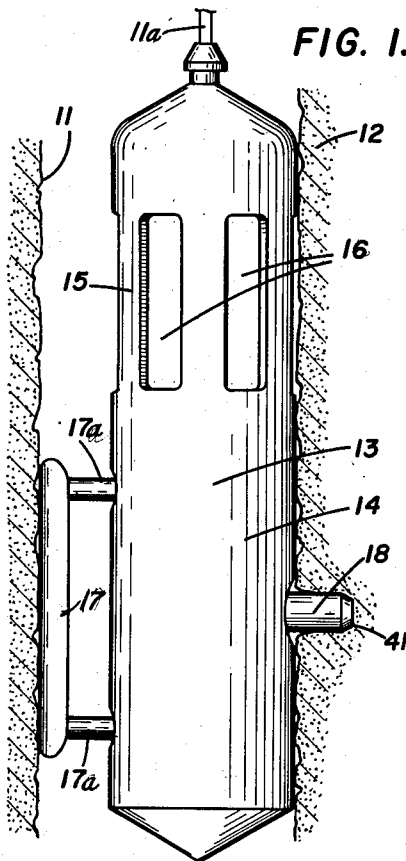


FIG. 3.

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2 SHEETS—SHEET 2

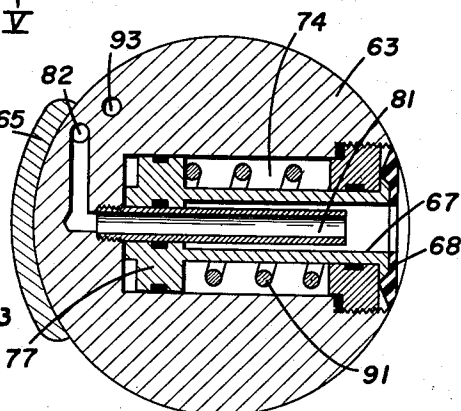
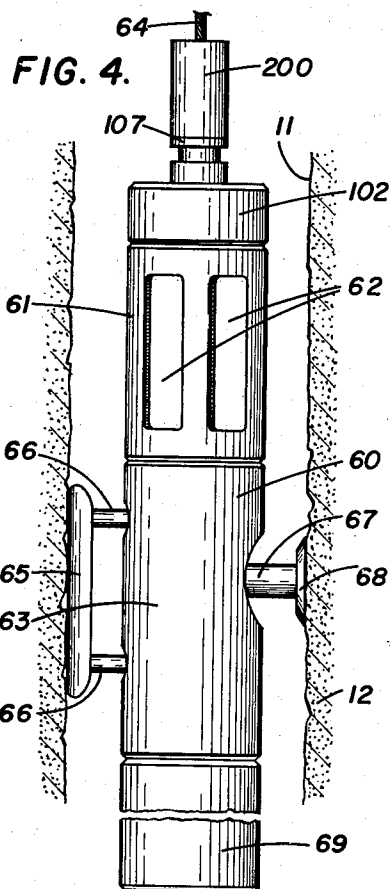
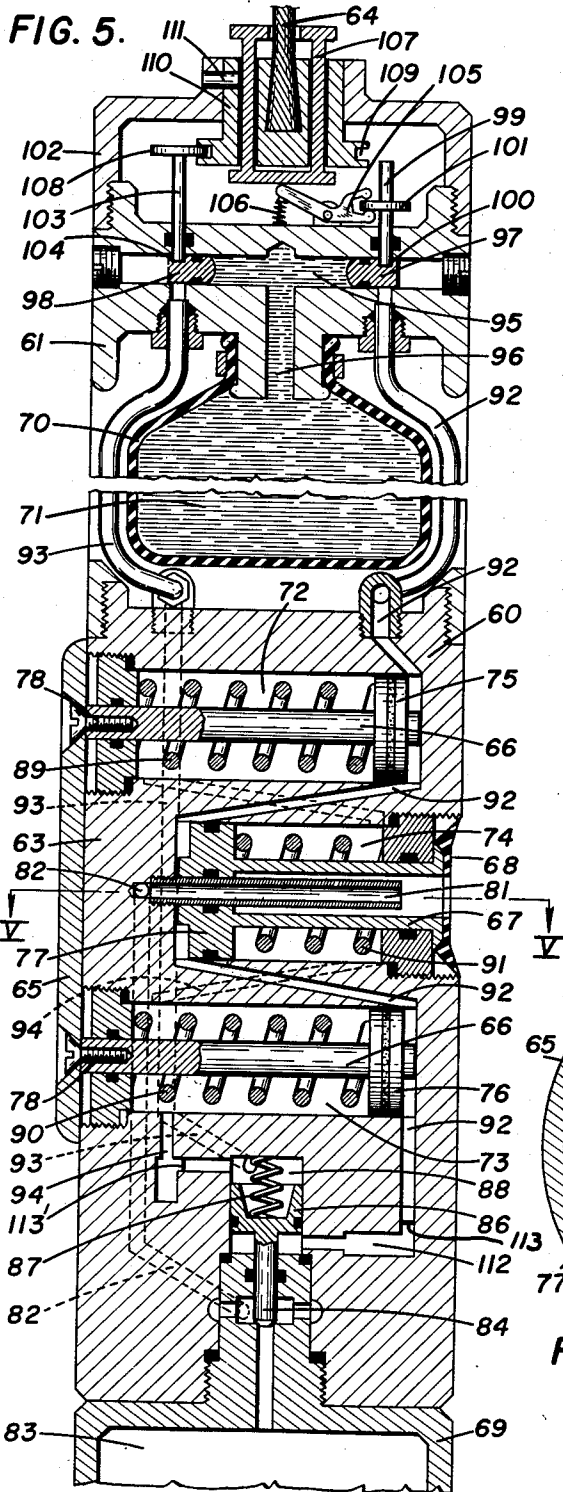


FIG. 6.

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DEVICE FOR OBTAINING SAMPLES FROM WELL BORES

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Application June 27, 1951, Serial No. 233,773

8 Claims. (Cl. 255-1.4)

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The present invention is directed to apparatus for obtaining a sample from the wall of a well bore. More particularly, the invention is directed to apparatus for obtaining a core or a fluid sample from the wall of a well bore.

The present invention may be described briefly as involving a tool for obtaining samples in a well bore which comprises, in combination, a housing having a cage therein in which is arranged a pressure responsive member adapted to be subjected to fluid pressure of a well bore when the tool is lowered therein. Arranged in the housing is at least a first piston in a horizontal piston cylinder defined by the housing which is vertically spaced from the cage. An external shoe is attached to the first piston through an opening to an exterior surface of the housing and is adapted to position the housing against the wall of the well bore. A second piston is arranged in a second horizontal piston cylinder defined by the housing which is spaced vertically from the cage and the first piston cylinder and is provided with a sample tube adapted to be projected through an opening in the housing to obtain a sample from the wall of the well bore. The pressure responsive member communicates fluidly with the pistons through first and second passageways defined by the housing. The first and second passageways have arranged therein first and second releasable valve means which are adapted to equalize pressure on the pistons. Biasing means, such as compression or tension springs, are attached to each of the pistons for retracting the shoe and the sample tube. The biasing means causes retraction of the shoe and the sample tube when pressure is equalized on each side of the piston.

The device of the present invention is adapted to take either a solid sample such as a core from the wall of a well bore or is adapted to take a fluid sample, such as oil from a producing formation which the well bore traverses.

When the apparatus is employed to obtain a core it may be provided with a core cutter head arranged on a sample tube. On the other hand when the apparatus is employed for obtaining a fluid sample, the sample tube may be modified by providing it with a sealing lip which may be constructed of a deformable material to provide a seal with the face of the formation to prevent drilling fluid from contaminating the fluid sample. When fluid sample is obtained, the housing will define a sample chamber which communicates with the sample tube by means of a passageway in which is arranged a valve mem-

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ber which opens automatically on release of the sample tube and which closes automatically on retraction of same into the housing.

The apparatus will be further described by referring to the drawing in which

Fig. 1 is a view of the apparatus suspended in a borehole showing the housing positioned against the wall of the well bore and a coring tube projected into the wall;

Fig. 2 is a sectional view of the apparatus of Fig. 1 with the shoe and the sample tube in a retracted position;

Fig. 3 is a view taken along the lines III-III of Fig. 2;

Fig. 4 is a view of the apparatus in accordance with the present invention for taking a liquid sample showing the apparatus positioned with the shoe in extended position and a sample tube against the wall of the well bore adjacent a producing formation;

Fig. 5 is a sectional view of the apparatus of Fig. 4; and

Fig. 6 is a view of Fig. 4 taken along the lines V-V.

Referring now to the drawing and particularly to Fig. 1, numeral 11 designates a well bore which has been drilled in the earth's surface to traverse a producing formation indicated generally as 12. The device of the present invention is indicated generally as 13 and includes a housing 14 which defines an open cage 15 provided with windows 16. The housing 14 has a shoe 17 attached thereto by attaching means 17a and is provided with a sample tube 18 which is shown projecting into producing formation 12. The tool 13 is suspended from the top of the borehole 11 by a suspension means 11a such as a wire line.

Referring to Fig. 2, arranged in the cage 15 is a pressure responsive means 19 which is a deformable bag member in which is arranged a hydraulic fluid 20. The hydraulic fluid may suitably be any non-compressible fluid, such as water, a liquid hydrocarbon, and the like. Spaced vertically in the housing 14 from cage 15 are first and second pistons 21 and 22 which are arranged respectively in horizontal piston cylinders 23 and 24 in housing 14. A third piston 25 is arranged in a third piston cylinder 26. The pressure responsive means 19 communicates fluidly with the pistons by means of a first passageway indicated generally as 27 and a second passageway indicated generally as 28. It will be noted that passageway 27 is arranged to communicate fluidly with the right-hand side of pistons 21 and 22 and with the left-hand side of piston 25 and

that passageway 28 is arranged to communicate fluidly with the left-hand side of pistons 21 and 22 and the right-hand side of piston 25. Communicating with passageways 27 and 28 is a vertical passageway 29 which, in turn, communicates with a horizontal passageway 30. Passageways 27, 29 and 30 may be considered as another passageway. Arranged in the passageway 30 are first and second valves 31 and 32. These valves are operated mechanically by tripping means 33 and 34. The tripping means 33 and 34 are attached through cables 33a and 34a to attaching means 13a which, in turn, is connected to the lower end of suspension means 11a. Tripping means 33 and 34 are held against upward movement by shear pins 35 and 36 which are so arranged to be sheared at desired intervals.

The shoe 17 is connected to the attaching means 17a by means of threaded bolts 37 as shown. These bolts may be eliminated and the shoe attached to the attaching means 17a by welding or other attaching means.

Arranged in the piston cylinders 23 and 24 are biasing means such as compression springs 38 and 39 which serve to retract the shoe 16 when pressure is equalized on each side of the pistons 21 and 22. Similarly arranged in piston cylinder 26 is a biasing means such as a compression spring 40 which serves to retract the sample tube 18 on equalization of pressure on both sides of the piston 25. The sample tube 18 is provided with an enlarged expandable cutter head 41 which serves to cut the core from the side of the well bore 11 as will be described in further detail hereinafter.

It will be noted that the pistons 21 and 22 are provided with sealing means 42 and 43, and that the attaching means 17 attached to pistons 21 and 22 are also suitably sealed by sealing means 44 and 45. Similarly piston member 25 is also provided with a sealing means 46 and the sample tube 18 is also provided with sealing means 47 which causes a seal as the sample tube is projected.

The tripping means 33 and 34 are provided with pins 48 and 49 which are also provided with sealing members 50 and 51.

Referring now to Fig. 4, the apparatus in accordance with my invention when employed to take a liquid sample from the wall of a well bore may be indicated generally as 60 and defines with an upper end thereof a cage 61 provided with windows 62. The assembly 60 is shown as lowered into a well bore 11 and arranged opposite a producing formation 12. In this embodiment of the invention the apparatus defines a housing 63 which may be lowered in the well bore 11 by means of a wire line 64 attached to an upper end of the housing 63 and extending to the earth's surface to a suitable reeling device. The housing 63 is provided with a shoe 65 which is suitably attached to the housing 63 by attaching means 66 as will be described further. In the apparatus of Fig. 4 the sample tube 67 is extended out to the wall of the well bore 11 to obtain a fluid sample, the sample tube 67 being provided with a lip 68 constructed of a deformable material. This lip may be a sealing means and can be constructed in a manner similar to the construction of a plumber's friend in the nature of a plunger and having a suction cup on the end thereof. The lower end of the housing 63 defines a section 69 in which is arranged a chamber for the fluid sample and which will be described in more detail hereinafter.

Referring now to Fig. 5, it will be seen that a pressure responsive means 70 is arranged in the cage 61 and that the pressure responsive means 70 is filled with a hydraulic fluid 71 which is similar to the hydraulic fluid 20 and may be water, a liquid hydrocarbon, and the like.

Spaced vertically from the cage 61 is a first piston cylinder 72 defined by the housing 63 and a second piston cylinder 73. The housing 63 defines a third piston cylinder 74. Arranged in piston cylinders 72 and 73 are first and second pistons 75 and 76 and arranged in piston cylinder 74 is a third piston 77. The first and second pistons 75 and 76 are connected by attaching means 66 and by threaded bolts 78 to shoe 65. The third piston 77 is attached to sampling tube 67, the end of which is provided with sealing lip 68 of a deformable material, such as natural or synthetic rubber and the like. Arranged in the sampling tube 67 is a sample pipe 81 which communicates fluidly with a passageway 82 in the housing 63. Arranged in the passageway 82 is a valve member 84 which is operated by a piston 86. Piston 86 is normally urged downwardly by a biasing means, such as a spring 87, arranged in a cavity 88 in the housing 63.

The pistons 75 and 76 have attached thereto biasing means 89 and 90 which serve to retract the shoe 65 when pressure is equalized on the pistons 75 and 76. Similarly, piston 77 is also provided with a biasing means 91 which serves to retract the sample tube 67 into the piston cylinder 74.

The pressure responsive means or hydraulic bag member 70 fluidly communicates with the right-hand side of pistons 75 and 76 through a passageway 92 which also serves to communicate with the left-hand side of piston 77. Passageway 93 on the other hand, communicates the hydraulic member 70 with the cavity 88 and thence through conduit 94 with the left-hand side of pistons 76 and 75 and with the right-hand side of piston 77. The passageways 92 and 93 communicate with the bag member 70 by means of a horizontal passageway 95 and a vertical passageway 96. It may be considered that the passageway defined by the passageways 92, 95 and 96 make up one continuous passageway, while the passageway defined by passageways 93, 94, 95 and 96 make up another passageway.

Arranged in the passageway 95 are first and second valve members 97 and 98. These valve members serve to open communication into passageways 92 and 93 as will be described. The valve member 97 is arranged in a closed position by the dropping of a pin 99 into a slot 100 in the valve 97. The pin 99 is provided with a shoulder 101.

The upper end of the tool 60 defines a section 102 which forms part of the housing 63. This section 102 encloses the pin 99 and also the pin 103 which fits into a slot 104 in the valve 98. A trigger mechanism 105 cooperates with the shoulder 101 and is biased downwardly thereagainst by means of a biasing means or spring member 106 which, in turn, urges the trigger member 105 against the valve actuating member 107. The pin 103 is provided with a shoulder 108 which is similar to the shoulder 101 of pin 99. This shoulder fits into a slot 109 of an annular collar 110 of the valve actuating means 107. This collar 110 is held in place by a shear pin 111.

It will be noted that the passageway 92 also communicates fluidly with a horizontal passageway 112 which directs hydraulic fluid to the

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underside of the piston 86 to cause operation thereof and opening of the valve 84.

It will be further noted that the passageway 94 is provided with a disc 113' of a frangible or easily rupturable material, the purpose of which will be described in more detail hereinafter.

The apparatus of the present invention operates in the following manner with respect to the device of Figs. 1 to 3, inclusive. With this embodiment of my invention, it is desired to cut a core from the producing formation 12 in the well bore 11. To this end the device generally indicated as 13 may be lowered in the well bore by means of the wire line 11a to a position immediately opposite the point where the core sample is to be taken. The shear pin 35 and cable 33a are used to support the body member 13 while it is lowered in the well bore 11. It will be assumed that the well bore 11 is filled with drilling fluid so that a hydraulic head is imposed on the pressure responsive means 19 through the window 16. The shear pin 35 is then sheared by exerting a pull on wire line 11a at the well head to cause the tripping means 33 to retract the pin 48 from valve 31 allowing the hydraulic pressure in the well bore to work against the deformable bag member 19 which allows hydraulic fluid 20 to flow through conduits 29 and 30 and thence to conduit 27 to work against pistons 21 and 22 and piston 25. This causes the shoe 17 to assume the position shown in Fig. 1 and sample tube 18 with the core cutting head 41 likewise to assume the position shown in Fig. 1. After a suitable interval of time sufficient to insure obtaining a core, the tripping means 34 is released by shearing pin 36 which causes the pin 49 to be withdrawn from the valve 32. Pin 35 is designed to shear under a tension less than that required for pin 36 so that in all cases pin 35 will be sheared first. This allows hydraulic fluid 20 to flow through passageways 29, 30 and 28 to equalize pressure in the piston cylinders 23, 24 and 26. On equalization of pressure in these piston cylinders the biasing means or springs 38, 39 and 40 cause retraction of shoe 16 and sample tube 18 allowing the sample core to be withdrawn into the housing and allowing the tool to be raised to the earth's surface. After shear pin 36 has been sheared, the attaching means 13a supports the body member in the well bore. Prior to the shearing of shear pin 36 the body member 13 is supported by cable 33a.

The apparatus of Figs. 4 to 6 operate in a similar manner as will be described further. In this embodiment of my invention the device indicated generally as 60 is lowered on the wire line 64 to a point opposite producing formation 12 from which it is desired to take a liquid sample. When the tool 60 has reached a desired point by paying out a sufficient amount of wire line 64, a go-devil or other weight 200 is dropped on the wire line 64 and contacts the valve actuating mechanism 107 which presses the trigger mechanism 105 against the spring 106 which lifts the pin 99 out of the slot 100. This allows the pressure exerted against deformable bag member 70 to cause hydraulic fluid 71 to flow through vertical conduit 96 into horizontal conduit 95 and through conduit 92 against pistons 75, 76 and 77 which serves to extend shoe 75 into the position shown in Fig. 4 and the sample tube 67 into the position also shown in Fig. 4. Continuation of pressure exertion causes fluid to rupture disc 113 in the lowermost part of passageway 92 and allows passage of fluid to passageway 112 and hence to the

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underside of piston 86 causing valve 84 to open and allowing sample fluid to flow from passage 82 into sample container 83. After a suitable interval of time has passed to allow the taking of a liquid sample to fill the sample chamber 83, the tool is released by taking a strain on the wire line 64 which causes the shear pin 111 to shear which thus lifts pin 103 out of the slot 104 which causes the valve 98 to move to the left by virtue of the pressure exerted by the bag member 70. This allows hydraulic fluid to flow through vertical conduit 96 to horizontal conduit 95 and thence by conduit 93 to cavity 88 which equalizes the pressure on piston 86 allowing the spring 87 to close same and drop the closure member 201 into the valve 84 sealing the sample in chamber 83. The hydraulic fluid flows through conduit 94 against frangible disc 113' which may be of tin causing rupture of same, acting as a time delay mechanism to insure that the apparatus is properly positioned and allowing hydraulic fluid to flow through conduit 94 to piston cylinder 73, 74 and 72 to equalize pressure on the piston cylinders 75, 76 and 77. When pressure is equalized the shoe 65 and the sample tube 67 are retracted. The tool 60 may then be raised to the earth's surface for obtaining the sample in chamber 83.

While tin discs 113 and 113' have been illustrated as suitable time delay mechanisms, I may also use bleeder orifices, and the like, to insure the desired time interval between projection and withdrawal of the sample tube to and from the wall of the well bore.

Likewise it is not necessary that the cage enclosing the deformable bag member be arranged at an upper end of the device. It suitably may be arranged at a lower end thereof or at a midpoint. Also it is possible to provide a device in which both a liquid and a solid sample may be taken by providing a plurality of sample tubes.

In a similar manner while a deformable bag member is preferred as the pressure responsive means, other pressure responsive means may be employed, such as a Bourdon spring arrangement, and the like, which is responsive to fluid pressure. In short, it will be clear that my apparatus is adapted to many modifications falling within the spirit and scope of the appended claims.

The nature and objects of the present invention having been completely described and illustrated, what I wish to claim as new and useful and to secure by Letters Patent is:

1. A tool for obtaining samples in a well bore which comprises, in combination, a housing defining a cage, a pressure responsive member arranged in said cage adapted to be subjected to fluid pressure of the well bore when said tool is lowered therein, at least a first piston arranged in a horizontal piston cylinder in said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, first releasable valve means arranged in a first passageway in said housing fluidly communicating said pressure responsive means with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing

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means attached to said pistons for retracting said shoe and sample tube, second releasable valve means arranged in a second passageway in said housing fluidly communicating said pressure responsive means with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and sample tube, and means for actuating said valves.

2. A tool for obtaining samples in a well bore which comprises, in combination, a housing defining a cage, a deformable hydraulic bag member arranged in said cage adapted to be subjected to fluid pressure of the well bore when said tool is lowered therein, at least a first piston arranged in a horizontal piston cylinder in said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, first releasable valve means arranged in a first passageway defined by said housing fluidly communicating said bag member with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing means attached to said pistons for retracting said shoe and sample tube, second releasable valve means arranged in a second passageway in said housing fluidly communicating said bag member with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and said sample tube, and means for actuating said valves.

3. A tool for obtaining samples in a well bore which comprises, in combination, a housing defining a cage, a deformable hydraulic bag member arranged in said cage adapted to be subjected to fluid pressure of the well bore when said tool is lowered therein, at least a first piston arranged in a horizontal piston cylinder in said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube provided with a cutter head adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, first releasable valve means arranged in a first passageway in said housing fluidly communicating said bag member with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing means attached to said pistons for retracting said shoe and sample tube, second releasable valve means arranged in a second passageway defined by said housing fluidly communicating said bag member with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and said sample tube, and means for actuating said valves.

4. A tool for obtaining samples in a well bore, which comprises, in combination, a housing defining a cage, a deformable hydraulic bag member arranged in said cage adapted to be subjected to fluid pressure of the well bore when

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said tool is lowered therein, at least a first piston arranged in a horizontal piston cylinder defined by said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube provided with a deformable sealing lip adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, a sample chamber defined by said housing spaced vertically from said pistons and said cage, a first passageway in said housing communicating fluidly said sample chamber with said sample tube, valve means in said first passageway adapted to seal a fluid sample in said chamber, first releasable valve means arranged in a second passageway defined by said housing fluidly communicating said bag member with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing means attached to said pistons for retracting said shoe and sample tube, second releasable valve means arranged in a third passageway in said housing fluidly communicating said bag member with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and said sample tube, and means for suspending said tool in the well bore and for actuating said valves.

5. A tool for obtaining samples in a well bore, which comprises, in combination, a housing defining a cage, a deformable hydraulic bag member arranged in said cage adapted to be subjected to fluid pressure of the well bore when said tool is lowered therein, at least a first piston arranged in a horizontal piston cylinder in said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, a sample chamber in said housing spaced vertically from said pistons and said cage, a first passageway in said housing communicating fluidly said sample chamber with said sample tube, valve means in said first passageway adapted to seal a fluid sample in said chamber, first releasable valve means arranged in a second passageway defined by said housing fluidly communicating said bag member with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing means attached to said pistons for retracting said shoe and sample tube, second releasable valve means arranged in a third passageway defined by said housing fluidly communicating said bag member with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and said sample tube, and means for suspending said tool in the well bore and for actuating the valves.

6. A tool for obtaining samples in a well bore which comprises, in combination, a housing defining a cage, a pressure responsive member arranged in said cage adapted to be subjected to fluid pressure of the well bore when said tool is

lowered therein, at least a first piston arranged in a horizontal piston cylinder in said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, first releasable valve means arranged in a first passageway in said housing fluidly communicating said pressure responsive means with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing means attached to said pistons for retracting said shoe and sample tube, second releasable valve means arranged in a second passageway in said housing fluidly communicating said pressure responsive means with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and sample tube, and an actuating and suspending means attached to an upper end of said housing for lowering said tool in the well bore from the earth's surface and for actuating and then retrieving same.

7. A tool for obtaining samples in a well bore which comprises, in combination, a housing defining a cage, a pressure responsive member arranged in said cage adapted to be subjected to fluid pressure of the well bore when said tool is lowered therein, at least a first piston arranged in a horizontal piston cylinder in said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, first releasable valve means arranged in a first passageway in said housing fluidly communicating said pressure responsive means with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing means attached to said pistons for retracting said shoe and sample tube, second releasable valve means arranged in a second passageway in said housing fluidly communicating said pressure responsive means with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and sample tube, tripping means for actuating each of said valves, and a wire line attached to an upper end of said housing operatively connected to said tripping means to open said valves and adapted to lower said tool in the well bore from the earth's surface and for retrieving same.

tons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and sample tube, a wire line attached to an upper end of said housing for lowering said tool in the well bore from the earth's surface and for retrieving same, and an actuating means for said tool on said wire line.

8. A tool for obtaining samples in a well bore which comprises, in combination, a housing defining a cage, a pressure responsive member arranged in said cage adapted to be subjected to fluid pressure of the well bore when said tool is lowered therein, at least a first piston arranged in a horizontal piston cylinder in said housing vertically spaced from said cage, an external shoe attached to said first piston through an opening to an exterior surface of said housing adapted to position said housing against a wall of the well bore, a second piston arranged in a second horizontal piston cylinder in said housing spaced vertically from said cage, said second piston being provided with a sample tube adapted to be projected through an opening in said housing to obtain a sample from the wall of the well bore, first valve means arranged in a first passageway in said housing fluidly communicating said pressure responsive means with said pistons and adapted to extend said shoe and said sample tube from said housing, biasing means attached to said pistons for retracting said shoe and sample tube, a second valve means arranged in a second passageway in said housing fluidly communicating said pressure responsive means with said pistons adapted to equalize pressure on same whereby said biasing means will cause retraction of said shoe and sample tube, tripping means for actuating each of said valves, and a wire line attached to an upper end of said housing operatively connected to said tripping means to open said valves and adapted to lower said tool in the well bore from the earth's surface and for retrieving same.

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