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2,563,284

FLUID SAMPLER FOR WELLS

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2 Sheets-Sheet 1

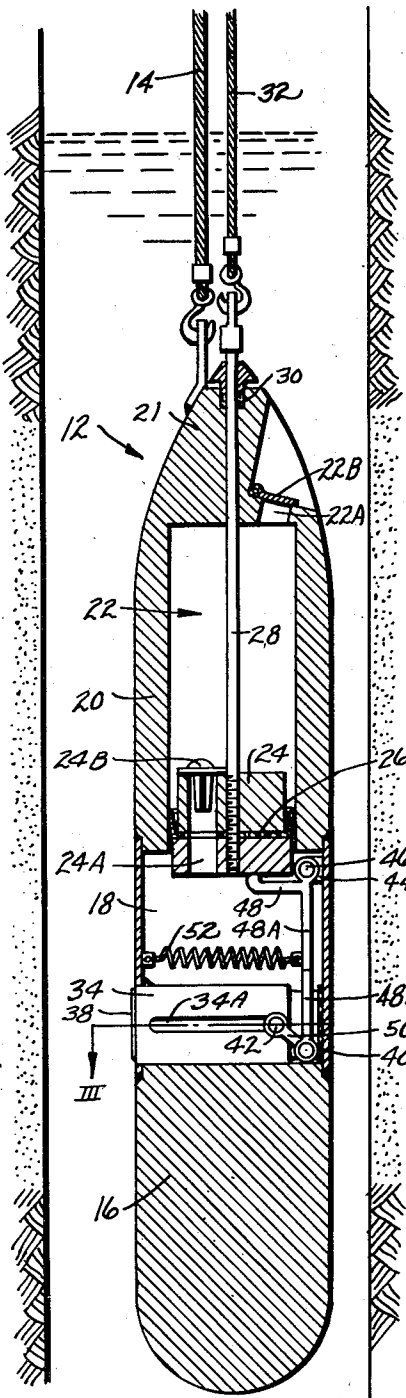


Fig. 1.

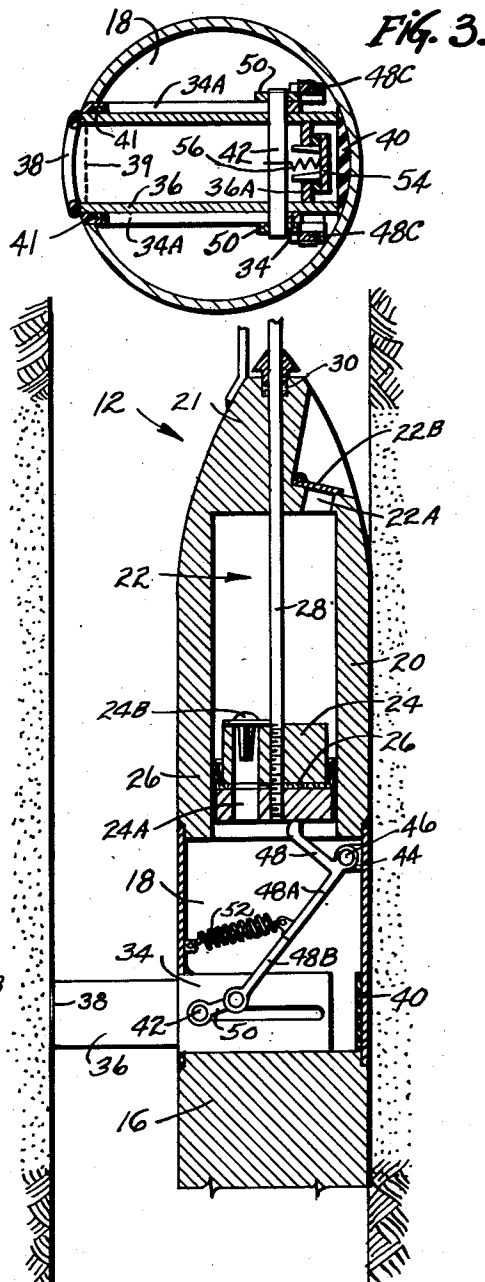


Fig. 3.

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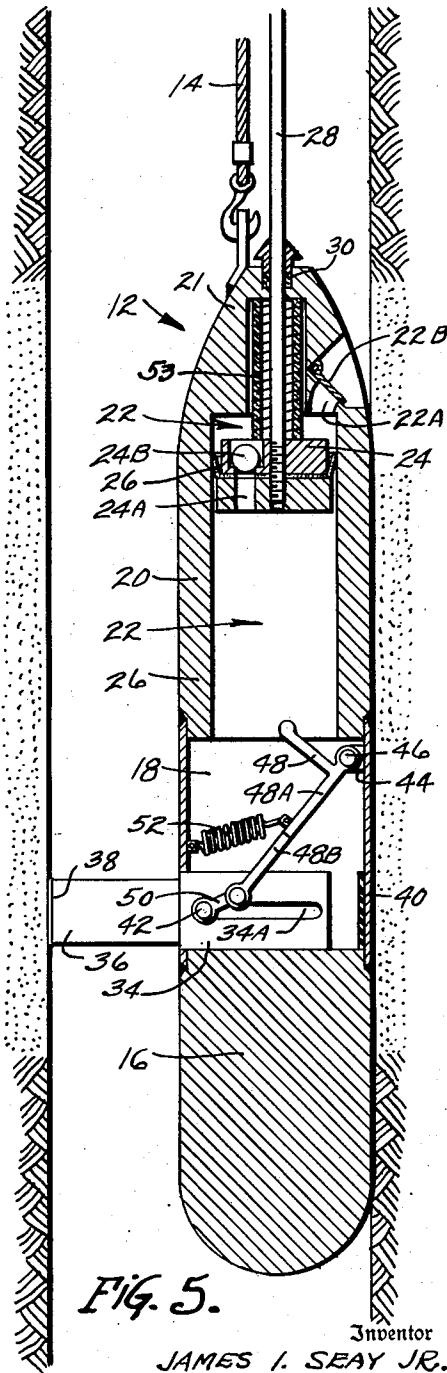
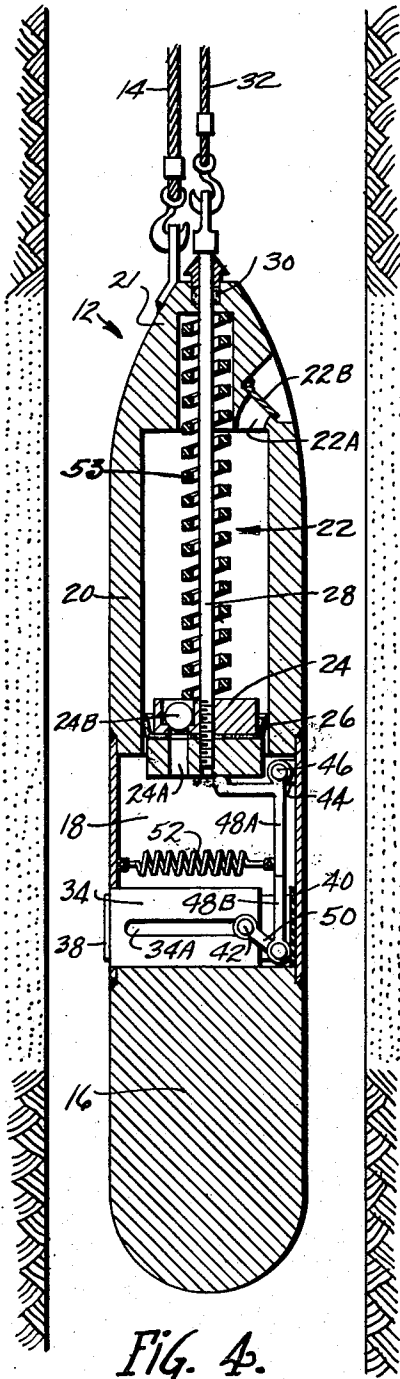
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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FLUID SAMPLER FOR WELLS

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14 Claims. (Cl. 166—1)

1 This invention relates to means for securing samples of fluids from well strata at depth. It particularly relates to mechanisms for securing fluid samples as distinguished from those devices by which samples of the strata themselves are obtained.

During the construction of wells it is often desirable to know whether a stratum which has been reached is of suitable structure and extent, which is accomplished by securing samples of the structure. It also is desirable to determine the nature and characteristics of the fluid in the stratum, be it water, oil, or otherwise; or perhaps where more than one fluid bearing stratum has been penetrated, which of the strata is the more desirable, or whether any may be of value. The present invention is concerned with mechanism for accomplishing the fluid sampling only. In testing it is important that all contaminating wall mud and well fluid used in digging be excluded from the sample, in order that the sample may truly show the nature and characteristics of the fluid content of the stratum and that only.

During drilling of a well the various strata encountered are logged and their depth noted until an apparently favorable stratum is encountered and drilled through. The drilling tools are then withdrawn, and according to heretofore existing practice a complete test pump outfit including discharge piping is installed at heavy expense, the well is tested and the test outfit withdrawn. If favorable, the permanent pumping equipment is installed, otherwise drilling is resumed and the tests subsequently repeated.

In drilling the well bore is kept filled, or filled at least above the level of any soft strata encountered, with a heavy slush which "muds off" and holds back such strata. All of this slush and much of the mud wall are removed by the test pumping, but even so it is practically impossible to free the water of the strata from contamination during testing, and where drilling is again resumed the slush must be replaced before the drilling can be again resumed.

The primary object of the present invention is to provide means for obtaining a true sample of the fluid content of a well stratum at depth, and in furtherance thereof:

To provide means for lowering the testing mechanism into the well, positioning it at desired level and subsequently removing it; and

To provide independently operable means for establishing intimate contact of said mechanism with a side wall of the well and for sealing off the slush and other content of the well bore; said

2 operating means being also adapted to operate said mechanism to repeatedly withdraw and discharge to waste, fluid from the stratum until well fluids and other diluting or contaminating well materials trapped within the mechanism have been eliminated, and so long as it may be desired, said mechanism being adapted to subsequently retain and remove the last sample withdrawn.

The means by which the foregoing and other objects are accomplished, and the manner of their accomplishment will readily be understood from the following specification on reference to the accompanying drawings, in which:

15 Fig. 1 is a vertical sectional elevation taken substantially on the longitudinal axis of the device, with the device lowered to a desired position in a well; and showing the working parts of the device in the positions which they occupy during lowering into, and removal from, the well.

20 Fig. 2 is a complementary sectional elevation showing the sampling tube extended, and the relation of the other working parts through which this has been accomplished; and the pump piston at the bottom of the working stroke.

25 Fig. 3 is an enlarged sectional elevation taken on the line III—III of Fig. 1.

Fig. 4 is a sectional elevation corresponding to Fig. 1 showing a modification of the pumping portion of the device, and

30 Fig. 5 is a sectional elevation embodying the modification and corresponding to Fig. 2 with the pump piston at the top of its stroke.

Referring now to the drawings in which the various parts are indicated by numerals: 12 is a heavily weighted plug having a diameter of some two-thirds of the diameter of the well bore in which it is to be used, the plug being of metal and relatively much elongated to provide working space and weight. The plug is lowered into and supported within the well at desired level, preferably by a cable 14 which extends to the surface of the earth and is there manipulated by suitable raising and lowering mechanisms, not shown.

45 The plug preferably comprises a solid lower end portion 16 providing weight only, an intermediate annular relatively thin wall chamber section 18, and an upper pump section 20, the plug preferably having an upwardly facing nose portion 21, the section 20 being bored, and if desired lined, though such lining is not shown, to provide a pump cylinder, for which the nose portion 21 of the plug forms an upper head. Co-operating with the cylinder 22 is a pump piston

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or plunger 24 preferably incorporating a cup-leather 26 upwardly faced and providing the necessary cylinder wall contact. Secured to and extending upwardly from the piston is a piston rod 28 which extends through a suitable stuffing box 30 in the nose 21 of the plug, the gland portion of the stuffing box preferably being shaped to form an upward continuation of the nose. The piston 24 and piston rod are of weight to accomplish the down stroke of the piston, and are preferably of much less weight than the plug, and the plug of such weight that the upstroke of the piston will not raise the plug which is supported only, and must rely on its own weight to resist such upstroke.

Above the stuffing box the piston rod is coupled to operating linkage, preferably a cable 32 which like the supporting cable 14 extends to the surface of the earth and is manipulated therefrom. The piston 24 is raised through the operating linkage 32, and is of heavy construction to insure as above stated its return by gravity when raising pull thereon is relaxed. The piston is provided with a through opening or passageway 24A and with an upwardly opening, non-return-flow closure valve 24B. The upper end or head of the cylinder is similarly provided with a passageway 22A, adapted to permit discharge from the cylinder, and with an upwardly opening non-return-flow closure valve 22B.

Secured in the section 18 adjacent its lower end, is a horizontally disposed guide sleeve 34 which opens through one of the side walls of the section 18 and is rigidly secured and sealed thereto as by welding, the sleeve terminating short of the opposite wall of the section to provide a fluid escape opening into the chamber. The sleeve is provided on its opposite sides with longitudinal guide slots 34A. Slidably mounted within the sleeve 34 is a sampling tube 36 which is made as long as housing within the section 18 will permit and may even project slightly therefrom, though this projection is undesirable. Preferably a sealing ring 38 as of soft rubber, which will aid in effecting a seal between the tube and the wall of the well bore when the tube is extended for use, is secured on the outer end of the tube. The tube is also preferably provided with a screen 39 preventing the entrance of sand with the fluid from the strata into the tube. A seat 40, as of soft rubber, which seals off the tube when in retracted position, is also preferably provided. 41 is a sleeve carried seal ring through which the tube 36 is slidably shiftable, this ring preventing entrance of fluid into the section 18 along the exterior of the tube. The tube 36 carries projecting pins which preferably are the extending ends of a transversely disposed pin 42 extending across the tube and projecting therebeyond through the slots 34A of the guide sleeve.

The tube 36 is preferably projected and retracted by a structure which includes brackets 44 rigidly secured adjacent the top of the section 18 and the lower end of the cylinder 22. The brackets 44 carry a pin 46, which pivots a bell crank lever comprising a laterally extending arm 48 and a downwardly extending arm 48A preferably longer than the laterally extending arm. The arm 48A is split and spread apart at its lower end to form fork arms 48B, on opposite sides of the guide sleeve 34, which are coupled through links 50 to the opposite ends of the pin 42. A tension spring 52 is coupled to the arm 48A and to the opposite side wall of the section 18 and is tensioned to urge the arm 48A, and

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through the links 50 and pin 42, the tube 36, outward at all times into wall contact. The outer end of the lateral arm 48, of the bell crank lever, is upwardly curved to engage the underside of the piston 24, and in what will hereinafter be designated the "over-travel" position of the piston, to hold the arm 48A retracted against the action of the spring 52. This action of the arm 48A, through the links 50 and the pin 42, retracts the tube 36 into the plug section 18, and its inner end against the sealing seat 40, cutting off the section 18 against inflow from or discharge into the well.

In Fig. 3 a valve 54 is shown lying within the tube 36, which valve is normally held seated against an annular flange 36A in the tube, by a tension spring 56, which is oppositely anchored to the valve and to the pin 42.

The tube 36 when fully retracted, as shown in Fig. 3, is closed by the seat 40, as well as by the valve 54, but otherwise only by the valve 54. During shift of the tube, the flange 36A, and pin 42, the valve 54 and the spring 56 move together, and the valve is held seated against the flange by the spring except when action of the piston 24 draws fluid from the chamber section 18 and the valve opens to allow flow of the fluid into the chamber.

In the modified form shown in Figs. 4 and 5 the structure is substantially identical except that a spring 53 is interposed between the top of the piston 24 and the underside of the cylinder head 21 and assists the weight of the piston in accomplishing the down stroke.

In using the sampler the drilling tools are removed and the plug 12 lowered by the hoisting cable 14 to the level at which test is to be made and is there supported by the cable. During lowering the operating cable 32 is slack and allowed to run slack, with the piston 24 resting on the bell crank lever arm 28 in the "over-travel" position shown in Fig. 1, and by its weight holding the sampling tube 36, against the action of the spring 52, in retracted position within the plug.

When the plug is positioned at the desired level, the piston 24 is raised by a limited movement of the operating cable 32 to the release position shown in Fig. 2, allowing the spring to force the tube and its seal ring 38 against one side wall of the well bore, and the plug body oppositely against and diametrically opposite side wall, this action embedding the tube end and seal in the mud and side wall structure, and sealing the tube against inflow from the well.

Above the level of the piston shown in Fig. 2, the piston is free for pumping action and may be alternately raised by pull of the operating cable and allowed to descend by gravity, or in the modified form of Figs. 4 and 5 by gravity supplemented by action of the spring 53, care being taken to stop the downward movement before it reaches the release position.

During the upward strokes of the piston, fluid in the cylinder 22 is discharged through the valved passageway 22A, into the well, and other liquid is drawn in from the stratum through the tube 36 into the section 18 and the cylinder. On the downward stroke the valve 22B acts as a foot valve and the valve 24B to allow flow from the section 18 into the cylinder. During the initial strokes the muddy water trapped within the tube 22, the section 18, and perhaps the cylinder, is removed and the mud washed from the well wall, within the confines of the

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tube, and such strokes must be continued until all the contaminating fluid is discharged and the parts washed out. When it is believed that this has been done, restraining action of the operating cable is released and the piston is allowed to rest on the bell crank arm 23 and to descend and be entirely supported by the arm, this piston action retracting the tube 36 within the plug and against the seal 40, this retraction of the tube discharging a limited amount of fluid through the piston valve 24B and the cylinder valve 22B into the well. Since the tube and chamber section 18 are separated by the valve 54, well fluid entering the open end of the tube during withdrawing movement of the tube toward the seal cannot contaminate the sample within the cylinder, or the chamber section 18 exterior to the tube. The plug with the sample therein is then raised by the cable 14 to the surface of the ground, and such sample examination made as is desired.

It will be understood that the details of construction shown and described are illustrative only and that I do not desire or intend to be limited thereto except where in a claim such details are set out.

I claim:

1. A device for securing samples of fluid from well strata at depth, comprising an elongated heavily weighted plug, and means secured to said plug and extending above ground level for raising and lowering said plug and supporting it at desired level; said plug embracing a chambered section and a pump cylinder opening into said section, and having upper and lower portions, respectively forming a head for said cylinder and a bottom for said chamber; a piston reciprocally mounted in said cylinder, operating means secured to said piston and extending through said head to and above said ground level for raising said piston, said piston and said head having passageways therethrough, and non-return-flow valves respectively allowing flow through said passageways into said cylinder and discharge flow from said cylinder; a horizontally disposed sampling tube slidably mounted within said chamber and extending through a side wall thereof, means urging shift of said tube outward beyond said wall, and means engaging said piston, and displaced by the weight thereof, for retracting and holding said tube against the action of said urging means; said piston being of weight to effect return movement of said piston and retraction of said tube, said cylinder being of length to allow movement of said piston to actuate said tube retracting and holding means and to additionally provide for pumping stroke of said piston.

2. A sampling device in accordance with claim 1, which includes annular sealing means carried by said plug and slidably embracing said tube.

3. A sampling device in accordance with claim 1, which includes a compression spring interposed between said head and said piston.

4. A device for securing samples of fluid from well strata at depth, comprising an elongated heavily weighted plug, and means secured to said plug and extending above ground level for raising and lowering said plug and supporting it at desired level; said plug embracing a chambered section and a pump cylinder opening into said section, and having upper and lower portions, respectively forming a head for said cylinder and a bottom for said chamber; a piston

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reciprocally mounted in said cylinder, operating means secured to said piston and extending through said head to and above said ground level for raising said piston, said piston and said head having passageways therethrough, and non-return-flow valves respectively allowing flow through said passageways into said cylinder and discharge flow from said cylinder; a horizontally disposed sampling tube slidably mounted within said chamber and extending through a side wall thereof, sealing means carried by said plug and slidably embracing said tube adjacent said wall, means resiliently urging shift of said tube outward beyond said wall, and means engaging said piston and displaced thereby, for retracting and holding said tube against the action of said urging means, said piston being of weight to effect downward stroke thereof and said displacement, said cylinder being of length to allow movement of said piston to actuate said tube retracting and holding means and additionally to provide pumping stroke.

5. A device in accordance with claim 4, in which said tube is provided at its outer end with an annular seal ring of coextensive diameter.

6. A device in accordance with claim 4, in which said tube is provided with a screen of mesh to restrain inflow of strata material with said fluid.

7. A device in accordance with claim 4, which includes sealing means carried by the chambered section of said plug and engaged by an end of said tube in retracted position.

8. A sampling device in accordance with claim 4, which includes a compression spring interposed between said head and said piston.

9. A device for securing samples of fluid from well strata at depth, comprising an elongated heavily weighted plug, and means secured to the upper end of said plug and extending above ground level for raising and lowering said plug and supporting it at desired level; said plug embracing a chamber and a pump cylinder opening downward into said chamber, and having upper and lower portions respectively forming a head for said cylinder, and a bottom for said chamber; a piston reciprocally mounted in said cylinder, a piston rod secured to and extending upward from said piston through said head, and operating means secured to said piston rod and extending above said ground level for raising said piston, said head being apertured for said rod and provided with a suitable stuffing box; said piston and said head having passageways therethrough, and upwardly opening non-return-flow valves respectively allowing flow through said passageways from said chamber into said cylinder, and discharge flow from said cylinder, a guide sleeve secured in the lower end of said chamber and opening through one side wall thereof, a sampling tube slidably disposed in said sleeve, and shiftable to project outward beyond the outer end of said sleeve, a bell crank lever pivotally secured at its upper end adjacent the lower end of said cylinder, said lever having an arm extending laterally into underlying relation to said piston, and an arm extending downwardly and operatively linked to said tube; and a spring coupled to the latter said arm and said plug, urging outward extension of said tube, said piston and rod being of weight to effect downward stroke of said piston and to hold said tube retracted against the action of said spring, said cylinder being of length to allow movement of said piston to release said bell crank arm, and in addition to provide pumping stroke.

10. A device of the character described in claim 9, in which a spring interposed between said head and said piston supplements weight action in effecting said downward piston movement.

11. A device for securing samples of fluid from well strata at depth, comprising an elongated, heavily weighted, chambered plug, and means secured to said plug and extending above ground level for raising and lowering said plug and supporting it at desired level; said plug including a head portion, a pump cylinder opening downward from said portion into the chambered portion of said plug, a piston reciprocally mounted in said cylinder, a piston rod secured to and extending upward from said piston through said head portion, and operating means secured to said piston rod and extending above said ground level for raising said piston, said head portion being apertured for said rod and provided with a suitable stuffing box, said piston and said head portion having passageways therethrough, and non-return-flow valves respectively allowing flow through said passageways from said chamber into said cylinder, and discharge flow from said cylinder, a guide sleeve secured in the lower end of said chambered portion and opening through one side wall thereof, a sampling tube slidably disposed in said sleeve, and shiftable to project outward beyond the outer end of said sleeve, a seal ring carried by said guide adjacent said side walls, slidably embracing said tube, a bell crank lever pivotally secured at its upper end adjacent the lower end of said cylinder, said lever having an arm extending laterally into underlying relation to said piston, and an arm extending downwardly and operatively linked to said tube; and means coupled to said lever urging extension of said tube, said piston and rod being of weight to effect downward return stroke of said piston and to hold said tube retracted against the action of said

urging means, said cylinder being of length to allow piston movement to release said lever and to additionally provide pumping stroke.

12. A sampling device in accordance with claim 11, which includes a compression spring interposed between said head portion and said piston.

13. A device for securing samples of fluid from well strata at depth, comprising an elongated heavily weighted plug, and means secured to said plug and extending above ground level for raising and lowering said plug and supporting it at desired level; said plug housing pumping means, a sampling tube, and a chamber intercommunicating said pumping means and said sampling tube, said tube being slidably mounted for projection through a side wall of said plug, and said pumping means including a cylinder formed in said plug and a weighted piston in said cylinder; linkage extending from said piston above ground level for raising said piston, means urging extension of said tube, and means carried by said plug, coupled to said tube, and operable by downward over-travel of said piston for retracting and holding said tube against the action of said urging means.

14. A device in accordance with claim 13, in which said weighted part action is supplemented by action of a spring interposed between said piston and said plug.

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