

May 4, 1943.

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2,318,062

SOIL SAMPLER

Filed Nov. 29, 1940

2 Sheets-Sheet 1

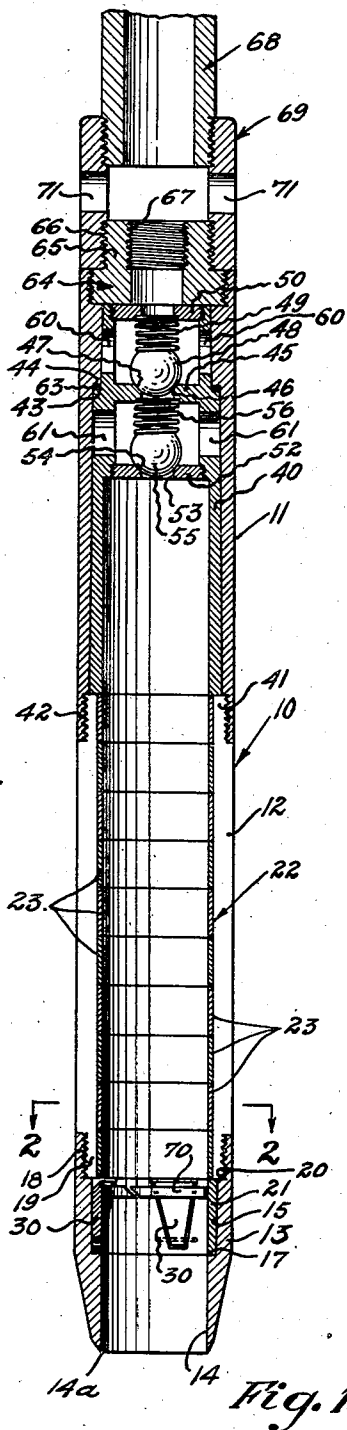


Fig. 1.

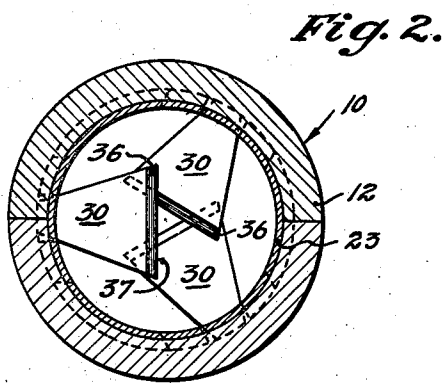


Fig. 2.

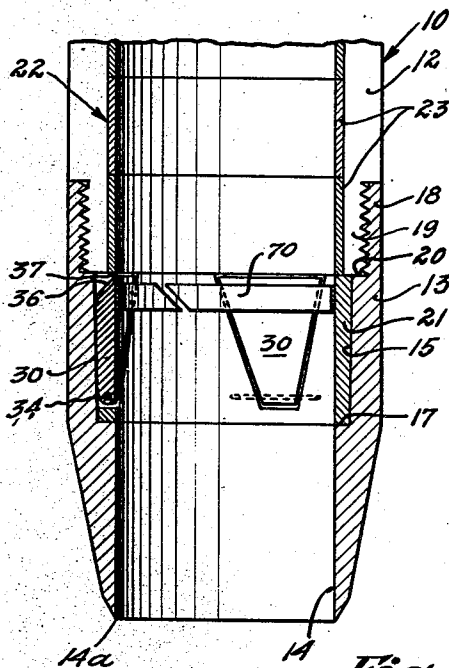


Fig. 1a.

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Fig. 5.

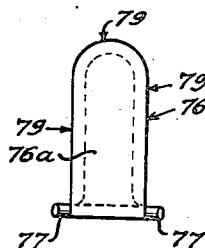
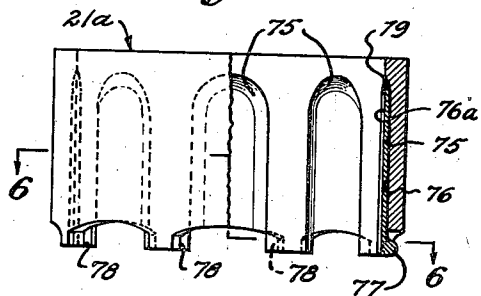


Fig. 7.

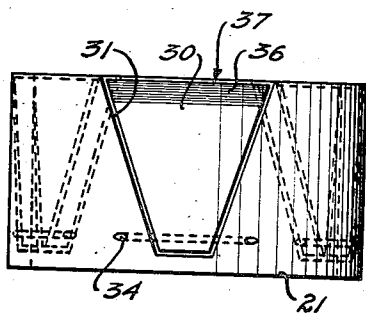


Fig. 4.

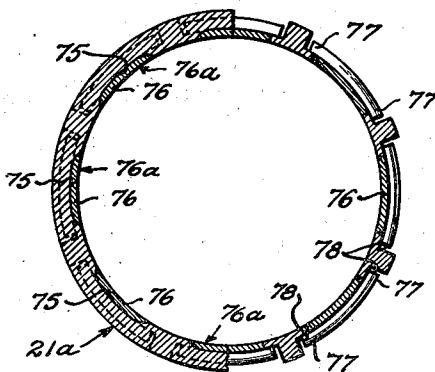


Fig. 6.

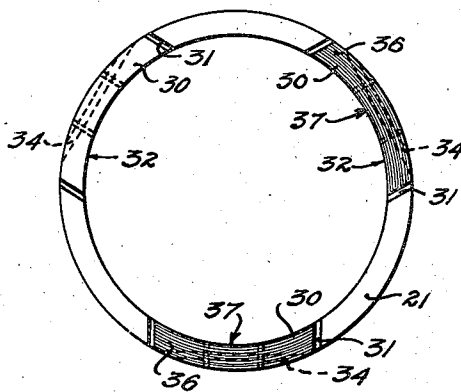


Fig. 3.

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UNITED STATES PATENT OFFICE

2,318,062

SOIL SAMPLER

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3 Claims. (Cl. 255—1.4)

This invention relates generally to soil samplers for taking undisturbed samples of soil from bores in the earth, and particularly to soil sampler devices of the type which are driven or forced into the soil without rotation.

The problem in soil sampling is to secure an undisturbed sample—that is, a sample which is not remolded, fractured, crumpled, or compressed; and which can therefore be subsequently analyzed in substantially its natural or pristine state. A common type of sampler comprises a barrel having a bit at its lower end adapted to cut a core, which is received inside the barrel, and provided with sample catching devices, sometimes in the form of spring fingers, which engage the core and prevent it from sliding back out of the barrel when the barrel is elevated. As previously designed, however, these sample catching devices have marred or disturbed the core as the latter is forced upwardly into the barrel, spoiling the core for the purpose of the tests to which it is later to be subjected. A further difficulty in such sampling devices as invariably heretofore made is the provision of a non-uniform bore for reception of the core, i. e., a bore which has either enlarging offsets, clearances, or projections, any one of which hinders or prohibits the taking of an undisturbed core. Enlarging offsets or clearances allow extrusion of the core, particularly with wet or plastic soils, while any projecting elements cut into, mar or cause remolding of the soil.

The primary object of the present invention is therefore to provide a soil sampler capable of taking sample cores with much less disturbance to the core than has heretofore been possible.

The sampler of the present invention is characterized by the provision of a tubular body having a bit at its lower end, and having a continuous uniform diameter bore from the mouth of the bit upwardly into a tubular or ring like core retaining means contained within the body. The sample catcher elements are located in flush positions in comparatively closely fitting recesses formed or sunk in the walls defining the uniform bore, where they are incapable of disturbing the core while the core is being forced upwardly past them. When the sampler is then subsequently elevated, the soil works in back of these sample catcher elements, forcing them outwardly into engagement with the core and so preventing its escape. The provision of the continuous uniform bore, together with the flush mounted sample catcher elements, enables the cutting and preservation of cores with negligible disturbance.

The present invention has various additional

accomplishments and features of advantage, all of which will be understood from the following detailed description of a present illustrative embodiment thereof, wherein reference is directed to the accompanying drawings, in which:

Fig. 1 is a longitudinal section through the sampler;

Fig. 1a is an enlarged view of the lower portion of Fig. 1;

Fig. 2 is a transverse section on the line 2—2 of Fig. 1, with the sample catcher element swung to sample retaining position;

Fig. 3 is a plan view of the sample catcher ring shown in Figs. 1 and 1a;

Fig. 4 is a side elevation of the ring of Fig. 3;

Fig. 5 is an elevation, partly in section, of a modified sample catcher ring, showing one of the valve plates in position;

Fig. 6 is a section taken on broken line 6—6 of Fig. 5, all of the valve plates being shown in position; and

Fig. 7 is a detail of a valve plate as used with the ring of Figs. 5 and 6.

In the drawings, numeral 10 designates generally a tubular body embodying a tubular head 11, a longitudinally split barrel 12 screwed into the lower end of head 11, and a steel bit 13, the lower end of the split barrel 12 being screwed into the upper end of the bit, and the bit having a bore 14 defined by a sharp, annular cutting edge 14a. The bit 13 is of a "driven" type, that is, it is adapted to be driven or forced into the soil rather than rotated. Above bore 14 bit 13 is formed with an enlarged counterbore 15, providing an annular upwardly facing seat 17. Counterbore 15 meets with the internally threaded box into which is screwed the pin 19 on the lower end of barrel 12.

A sample catcher ring 21 is removably received within counterbore 15 of bit 13, seating on shoulder 17, and being of a height equal to the length of counterbore 15. The exterior of the ring 21 and the counterbore 15 are preferably formed with slight complementary tapers, which facilitate removal of the ring 21 from the device for cleaning out purposes following use. The internal diameter of ring 21 is equal to the diameter of bore 14 at the point of juncture of bore 14 with the bore of the ring. The internal diameter of longitudinally split barrel 12 is sufficiently greater than that of ring 21 to permit reception of tubular or generally cylindrical core retaining means 22, the latter defining a cylindrical bore having a diameter equal to the internal diameter of ring 21. Preferably, and as here shown, the

cylindrical core retaining means is segmented into a plurality or stack of individual core retainer rings 23, each of which has an internal diameter equal to that of ring 21. Such a plurality of rings permits the core to be severed at a later time between any pair of adjacent rings, thus producing a plurality of undisturbed samples which may be subjected to different tests. The lower pin end 19 of barrel 12 seats against annular shoulder 20 of bit 13, and comes adjacent the upper end of ring 21, confining the latter against longitudinal displacement. The stack of sample retainer rings 23 in turn engage and are supported by the upper end of ring 21 inside pin 19. Thus there is provided an uninterrupted uniform diameter bore from the mouth of the bit up through ring 21 and into retainer rings 23, bore 14 and the internal diameters of ring 21 and of rings 23 all being of the same size. In practice, it is found that no detriment results from a slight constriction of the bore 14 by a few thousandths of an inch at its mouth; in such case, the walls of the bore above still fit the core with comparative closeness, and prevent extrusion or deformation of the core. And when I refer to the core receiving bore of the sampler as being of substantially uniform diameter throughout, a slight constriction at the mouth of the bit, or a slight divergence of the bore 14 from the mouth of the bit to the point of juncture with the bore of ring 21, of the order indicated, is therefore not excluded. A greater constriction or divergence, however, such as will permit any substantial extrusion or deformation of a wet, plastic, or crumbly core, cannot be permitted, it being requisite in all cases that the sides of the bore afford complete lateral support for the core as cut by the bit.

Sample catcher ring 21 is recessed to receive a set of sample catcher elements which are normally in positions flush with the described uniform bore extending upwardly from the bit into the sample retainer rings, these elements thus being in such positions that they will not damage the core during its upward passage into the sampler. In the form of Figs. 1, 3 and 4, these sample catcher elements are in the form of arcuate flap valve plates or leaves 30, mounted with comparatively close marginal fit in complementary recesses or notches 31 formed in ring 21, the valve plates or leaves having inner surfaces 32 forming continuations of, or being flush with, the cylindrical inner surface of ring 21, and being supported in such positions by the abutting surface afforded by the counterbore 15. As shown, the valve plates may be described as having a key-stone shape, with the narrower ends at the bottom. The narrower, lower ends of these key-stone-shaped plates 30 are pivotally mounted on horizontal pivot pins 34 set into ring 21, as clearly illustrated. Thus the plates 30 are adapted to swing from the upper flush positions shown in Fig. 1 (occupied during cutting of the core) to the downwardly folded, sample-catching position indicated in Fig. 2. Preferably, the upper ends of plates 30 are beveled, as at 36, so as to provide sharp arcuate edges 37 adapted to penetrate and catch the core when the device is elevated and the core tends to slide out of the sampler.

The sampler as here illustrated is embodied in a form suitable for taking samples under water as well as in dry or semi-dry conditions, and is therefore provided with valve means at the top to pass any water which may enter the bore of

the device ahead of the sample. A tubular valve cage 40 is positioned within head 11, its lower end being supported by the upper end of the upper connecting pin 41 of barrel 12, this pin being shown as screwed into box 42 at the lower end of head 11. It may here be mentioned that the sample retainer rings 23 are so dimensioned that the upper ring also engages the lower end of valve cage 40, the latter thus serving to confine rings 23 against longitudinal displacement as the core is moved within them. Tubular valve cage 40 is shown as having an offset near its upper end, providing an upwardly facing annular shoulder 43 adapted to seat against downwardly facing annular shoulder 44 formed inside head 11. Preferably, the exterior of the tubular valve cage 40 and the interior of the tubular head 11 within which the valve cage is received are formed with slight complementary tapers, which facilitate separation of the members in disassembly, especially when mud or sand has worked in between them during use.

A feature of the invention is the preferred use of two ball valves in series in valve cage 40, it being found in practice that a single valve frequently becomes clogged with mud and does not permit proper functioning of the apparatus. As here embodied, tubular cage 40 has a partition 45 near its upper end, provided with a central aperture 46 and with a seat 47 for a valve ball 48. Preferably, a spring 49 is provided to assure proper seating of valve ball 48, being here shown as confined between the valve ball and a centrally perforated disk 50 screwed into the top end of cage 40. A valve seat disk 52 is screwed into cage 40 below partition 45, and has a central aperture 53 and a seat 54 for valve ball 55, a spring 56 for ball 55 preferably being positioned between said ball and partition 45, as illustrated.

Tubular valve cage 40 is provided, between partition 45 and disk 50, with cleaning out ports 60, and between partition 45 and disk 52, with cleaning out ports 61. These are used simply in cleaning the mud out of the valve cage after disassembly of the device following use under water. The engaging shoulders 43 and 44 are located between the sets of ports 60 and 61, and a gasket 63 clamped between said shoulders prevents water escaping through upper ports 60 for reentering via lower ports 61 and so rendering ineffective the upper valve.

A centrally apertured adapter plug 64 is screwed into the upper end of head 11, above valve cage 40. This plug is provided with a tubular extension 65, having external screwthreads 66 and internal screwthreads 67, adapted for connection with the lower end of a pipe string. This pipe string, here indicated at 68, may be adapted for connection with either the external or the internal threads of extension 65, though I have here typically indicated a pipe string 68 connected by means of a coupling 69 screwed onto external screwthreads 66.

The operation of taking a sample core with the device as described is as follows: A suitable bore having been made in the earth, the sampler 11 is lowered therein by means of pipe string 68, and is driven or forced downwardly into the soil at the bottom of the bore through the medium of the pipe string. The bit 13 cuts a cylindrical core which is forced upwardly through bore 14, ring 21 and into the sample retainer rings 23. Preferably, before lowering the sampler in the bore hole, and at the time the sample catcher

ring 21 is assembled within the sampler, a split expansive retainer ring 70 is placed inside the ring 21, in a position to hold the valve plates 30 in their upper positions as illustrated in Figs. 1 and 1a. This ring 70 is carried upwardly by the upper end of the core, freeing the valve plates 30 for inward movement. However, the plates 30 remain in the positions illustrated in Fig. 1 during the cutting of the core, and do not project into the path of the core so as to deface or disturb the core while it is being forced upwardly past them.

If the core is being taken under water, any water which has entered the bore ahead of the core rises past valve balls 55 and 48 into pipe string 68, and when the device is subsequently elevated, this water is thus prevented from washing the core back out of the sampler. The water thus entering pipe string 68 may be discharged through apertures provided in the string, for instance, the drill holes 71 in coupling 69.

The core having been cut and forced upwardly into the rings 23, the sampler is then elevated by means of pipe string 68. Any tendency of the core to slide downwardly out of the sampler now results in soil working in back of valve plates 30, causing the sharp upper edges 37 of said plates to move radially inwardly and to penetrate the core. Once said edges have penetrated substantially into the core, further downward pressure of the core may cause them to swing downwardly to a substantially horizontal position, as to the position indicated in Fig. 2. This depends largely upon the nature of the soil, its water content, etc. In any event, the valve plates 30 move outwardly and penetrate the core to a sufficient extent to prevent it from escaping from the sampler; and depending upon soil and water conditions, this outward movement of the plates 30 may amount to only a few degrees of angular swing, or may amount to a swing of approximately 90° such as indicated in Fig. 2.

The provision of the uniform and continuous bore from the mouth of the bit upwardly through the sample catcher ring 21 and into the retainer rings 23 enables the cutting and preservation of a substantially undisturbed core. The valve plates 30 being positioned in closely fitting recesses during the up travel of the core, the core is uninterfered with by said plates. The complete avoidance of any discontinuity or clearance in the bore, at the location of the sample catcher elements or elsewhere, prevents the core from spreading out or losing its initial cylindrical form. The sampler having been hauled to the ground surface and disassembled, the undisturbed core contained within the retainer ring 23 may be subjected to various tests, such as shear tests, friction tests, etc., while still retained within or supported by the rings 23.

Figs. 5 to 7 show a modified form of sample catcher ring. In this instance, the ring, here designated by numeral 21a, has a plurality of relatively shallow arch shaped recesses 75 sunk in its inner surface, the recesses extending from the lower end of the ring to a point just short of its upper end, as illustrated in Fig. 5. Valve plates 76, complementary in shape to recesses 75, are adapted to be received in said recesses, with their outer concave surfaces 76a flush with the inner surfaces of ring 21a, and with the surfaces of recesses 75 serving as the abutment means holding the plates 76 up to such position.

The lower ends of these valve plates 76 are furnished with trunnions 77 adapted to be received in notches 78 formed in the lower edge of ring 21a, as will be understood from an inspection of the drawings. The plates 76 are tapered to a sharp edge at 79, both at the top and along the longitudinal edges, so as to permit the soil to readily work in back of said plates as the sample tends to slide out of the bore, thus causing the plates 76 to swing outwardly on their trunnions to penetrate and support the sample. The operation of the sampler when equipped with the sample catcher device as shown in Figs. 5 to 7 will of course be understood to be the same as previously described, the only difference being that the two forms of sample catcher elements permit selection to suit soils of different natures.

I have now illustrated and described the invention by reference to certain present preferred illustrative embodiments thereof; it will be understood, however, that various changes in design, structure and arrangement may be made without departing from the spirit and scope of the invention or of the appended claims.

I claim:

1. In a soil sampler comprising a hollow tubular body having a bit on its lower end, a bore extending upwardly into said body through said bit, and core retainer means inside said body projectible into said bore; the combination of a valve cage in said tubular body above said core retainer means, upper and lower downwardly seating ball valves arranged in series in said valve cage, upper and lower cleaning ports in the side of said cage opposite said ball valves, and packing means between said cage and tubular head at a point between the upper and lower cleaning ports, said packing means preventing circulation of water outside the valve cage between the upper and lower cleaning ports.

2. A tubular driven soil sampler, embodying a head, a longitudinally split barrel detachably coupled at its upper end to said head, a tubular bit detachably coupled to the lower end of said longitudinally split barrel, said bit tapering to an annular cutting edge at its lower end, a plurality of removable core retainer rings positioned end to end within said longitudinally split barrel, said sampler including walls defining a continuous uninterrupted core receiving bore of substantially uniform diameter throughout extending upwardly from said annular cutting edge of said bit to said plurality of removable core retainer rings, and said rings having bores of the same diameter as and forming an uninterrupted continuation of said core receiving bore, whereby a soil sample cut by said annular cutting edge of said bit may be forced upwardly with close sliding fit in said core receiving bore and in said bores in said rings, recesses sunk in said walls from said bore, and sample catcher elements receivable with relatively close marginal fit within said recesses and freely pivoted at their lower end portions on said walls, said elements having concave cylindrical faces of the same radius of curvature as said bore adapted to be positioned flush with said bore when said elements are received in said recesses, said elements being pivotally movable from said flush positions into positions of projection inside said bore, and said sampler including abutment means backing up said sample catcher elements when received in said recesses and positioning said elements with their said concave cylindrical faces in said flush position, whereby said elements afford lateral

support for the sides of the core at the cylindric surface defined by said bore during passage of the core relatively upwardly in said bore.

3. In a device of the character described, including a tubular wall defining a core receiving bore, a recess sunk in said wall from said bore, and a sample catcher element receivable with relatively close marginal fit within said recess and pivotally mounted at its lower portion on said wall, said recess and sample catcher element be-

ing arch-shaped in general outline, and the arched upper end of said element being beveled to a relatively thin edge, said element having a concave cylindric face of the same radius of curvature as said bore adapted to be positioned flush with said bore when said element is received in said recess, said element being pivotally movable from said flush position into a position of projection inside said bore.

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