

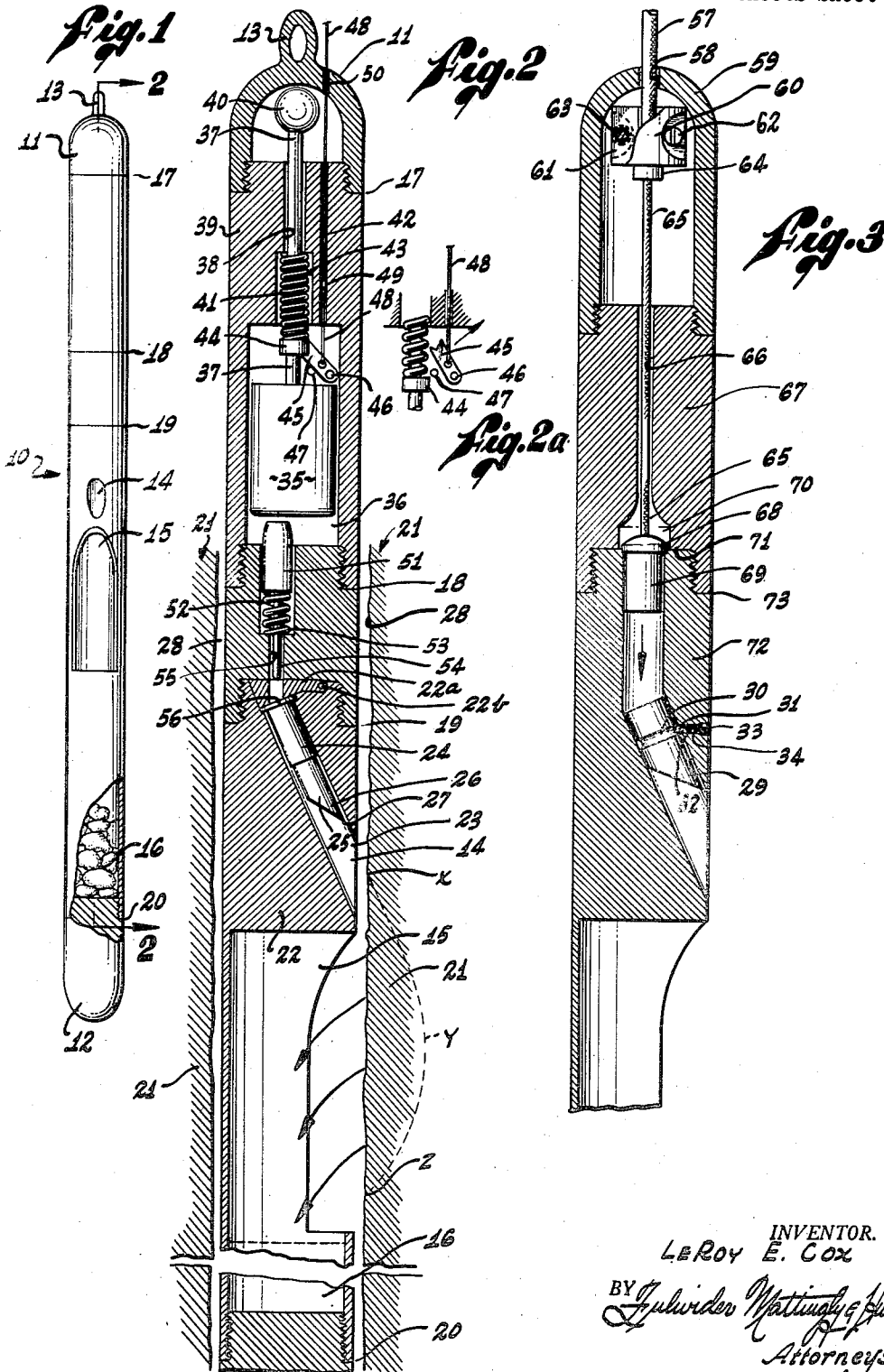
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LE ROY E. COX
BORE HOLE SAMPLER

2,825,533

Filed Aug. 30, 1955

2 Sheets-Sheet 1



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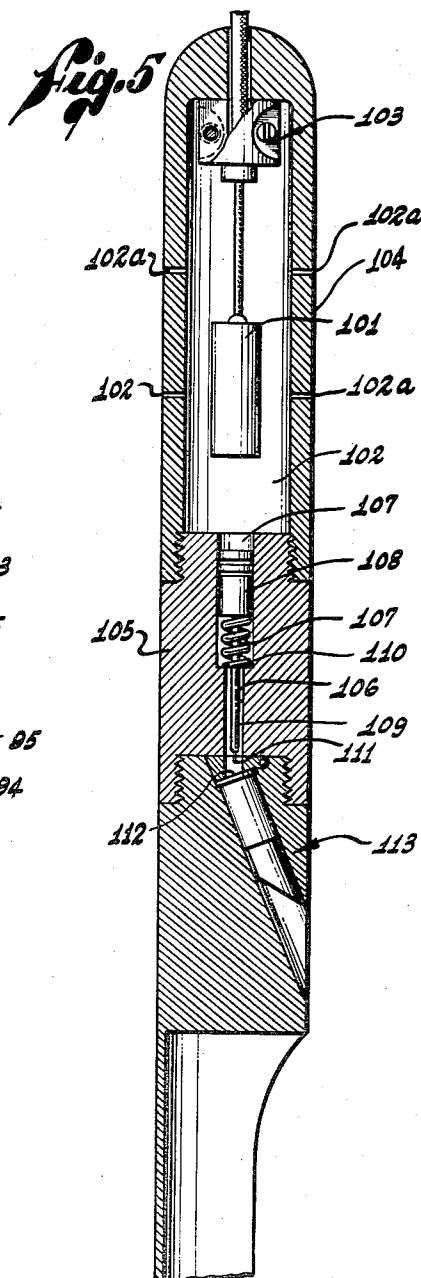
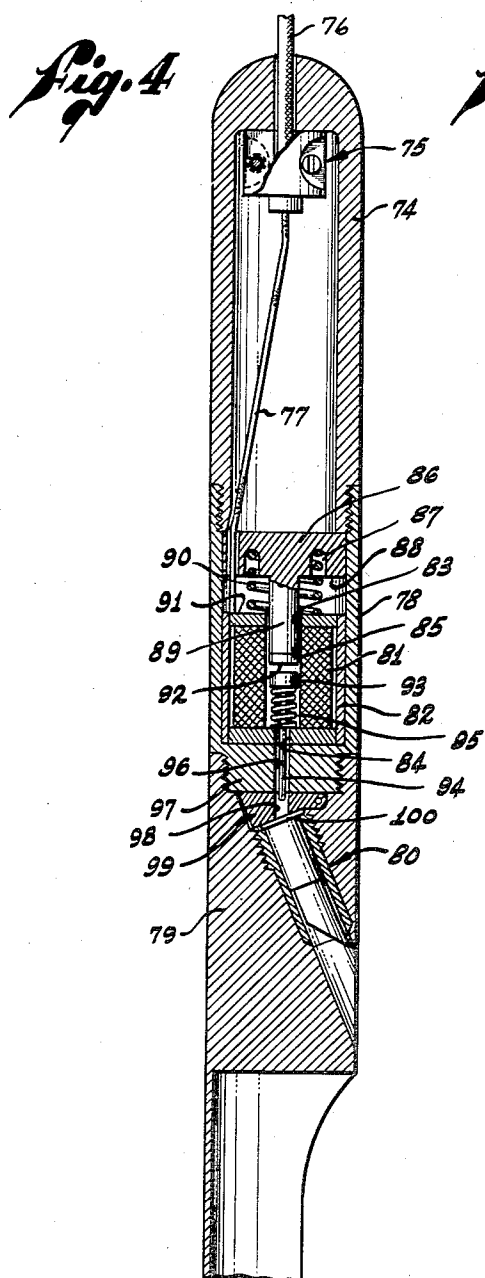
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2 Sheets-Sheet 2



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BORE HOLE SAMPLER

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10 Claims. (Cl. 255—1.4)

This invention relates to geological and mining exploratory and test equipment, and more particularly to a device for taking an earth sample from a hole of minimal bore made by a plug bit or a bore of any larger diameter at any time during or subsequent to the sinking of the bore in the ground. By way of example, but not by way of limitation, the invention is useful in prospecting for uranium.

As is generally known to those familiar with the art, most test drilling for uranium is done by the plug bit method which provides a hole large enough for the insertion of a radiation-sensitive probe but too small to permit the practical taking of an actual core sample. The holes are drilled, then probed and radiometric readings taken to reveal the possible presence of uranium. When a reading of sufficient value is obtained, it is then necessary either to enlarge the bore with a core drill and take an actual sample at the proper level for chemical assay or to core-drill a new hole. Obviously, this second drilling operation increases the prospecting cost considerably.

A somewhat similar problem exists in connection with bores drilled during the past by engineers in search of some other mineral. Here too, the bore must be probed and core drills of proper size used to obtain samples when promising readings are obtained. This involves the use of core drills of various sizes and a rather considerable amount of rigging and equipment in the case of larger bores and small shafts.

As a result, there are thousands of test bores, so-called dry holes and open shafts on which no geophysical or geochemical stratigraphic data are available and which are too small for obtaining samples by conventional methods but which appear deserving of further investigation in view of the radiometric readings obtained by probing.

The present invention has been made with the foregoing in mind and has a plurality of separate and important objects.

One main object of this invention is the provision of a device for obtaining samples from a plug bit hole without the necessity of enlarging the hole with a core drill.

A still further object of this invention is the provision of a device adapted to take a sample from a bore from within a limited vertical range so that the sample will be representative of the deposits at a certain definite level and will not be diluted by non-typical material from above or below.

Yet another object is the provision of a sampler adapted for forming a cavity from which the sample is dislodged that is long enough and of suitable conformation to keep the side wall of the bore from caving into the bore when the sampler is removed.

Another equally important object of this invention is the provision of a bore hole sampling device as previously described adapted to carry adequate integrated pressure generating means not requiring the use of elec-

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tricity, compressed air or other external power source for forcibly removing the sample from the bore wall at any desired depth.

In brief, the bore hole sampling device of my invention includes an elongate assembly which can be lowered into a plug bit hole. The upper portion of the device consists of a plurality of interfitting longitudinal segments in which is disposed a triggering means, operable from the surface of the ground by a trigger line, to fire a cartridge and drive a chisel-edged projectile into the wall of the bore hole breaking fragments therefrom which fall through an opening in the side wall into a hollow section at the bottom of the device.

Other important objects and distinguishing features of this invention will be apparent upon reading the following description of one preferred embodiment and modifications thereof with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic elevational view of the sampling device according to my invention, with a portion of the outer wall cut away to show the hollow sample chamber in the bottom thereof.

Figure 2 is a view on a larger scale than Figure 1, showing an axial section of the device taken on the line 2—2 in Figure 1;

Figure 2a is an enlarged schematic view of the trigger member and plunger after release thereof by pulling the trigger line from above;

Figure 3 is a sectional view similar to Figure 2 showing an alternate embodiment in which an electrically fired cartridge is used to expel a separate and spaced projectile from the muzzle of the firing chamber;

Figure 4 is also a schematic sectional view showing the firing chamber components provided with a solenoid for imparting force to the firing pin; and

Figure 5 is a sectional view similar to Figure 4 showing a further variation of my invention in which a blasting cap is used to move the firing pin into contact with the detonator of the cartridge.

Reference is again made to Figure 1 in which the numeral 10 designates the complete bore sampler assembly which is seen to be longitudinally extended normally vertically in space and of rod-like conformation, rounded at both ends 11 and 12, and having an eye member 13 disposed axially from its upper end 11 to which a line is attached for lowering and raising the device in a bore hole. Intermediate of the ends 11 and 12 are two apertures in the side wall, the smaller being the opening of a firing muzzle 14; and the larger, lower opening 15 providing ingress to a generally tubular sample receiving chamber or pocket 16 in the lower half of the assembly. More specifically, the rod-like body portion 10 is neither a solid rod nor a hollow tube, but is actually a plurality of longitudinal segments assembled by means of threaded joints at the points indicated in Figures 1 and 2 by the numerals 17, 18, 19 and 20.

The operating principle of the device may be seen in Figure 2 in which the sampler 10 is shown entered in a bore in the surrounding formation 21. In the central portion of the sampler adjacent the joint 19 is a relatively solid longitudinal section 22 having a diagonal breech plate 22a pivotally mounted at 22b to permit the loading of a cartridge into, and removal of a shell from a diagonally disposed gun bore 23 in the solid section 22. The cartridge 24 is fitted with a generally cylindrical projectile 25 which is truncated at its end spaced from the cartridge to provide a chisel-like leading edge 26, the point 27 of which is positioned adjacent the muzzle opening 14 which, in turn, is in close juxtaposition with the side of the bore hole 28.

Firing the cartridge 24 forces the projectile 25 outwardly of the chamber 23 causing the point 27 to pene-

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trate the formation at X dislodging the material bounded by the dotted line X—Y—Z from the bore wall 28. This dislodged material falls in the direction of the arrows in Figure 2 through the opening 15 into the sample receiving chamber, best seen at 16 in Figure 1.

After being lifted to the surface of the ground, the body assembly is separated at the screw joint 20, and the sample material removed for inspection and assay.

Various embodiments of my invention are shown in other figures in the drawings, but all use the same general type of projectile. In the embodiment shown in Figure 3 the projectile 29 is provided with a circumferential groove 30 which is engaged by a ball detent 31 urged inwardly by a spring 32 anchored with a set screw 33 in a radially disposed bore 34.

The other differences in the various embodiments reside mainly in the means employed to fire the cartridge or otherwise actuate the expulsion of the projectile.

Returning again to Figure 2, the firing means employed in this embodiment are entirely mechanical and include a massive hammer member 35 movable longitudinally in a cylinder 36 and with a rod 37 extending upwardly and axially of the hammer 35 through a bore 38. The rod is terminated upwardly in a ball knob 40 disposed within the hollow dome-shaped cap member 11.

Around the rod 37 is a coil compression spring 41 through which the rod 37 is longitudinally movable. The spring 41 is positioned in a counterbore 43 of the bore 38 extending upwardly from the hammer 36, and is confined longitudinally between the bottom of the counterbore 43 and a collar 44 fixedly attached to the rod 37 adjacent the hammer 35. Thus the hammer 35 is constantly urged downwardly within the cylinder 36 by the spring 41 but is restrained from movement by the engagement of a sear 45, pivoted at 46 and rotatable upwardly from the stop pin 47 by means of a trigger line 48 which, in turn, is movable through the bore 49 in the body portion 39 and bore 50 in the cap portion 11.

To cock the firing mechanism, the device is held in a vertical position with the cap member 11 removed, then the ball-knob 40 is pulled upwardly of the body segment 39 until the sear 45 drops by gravity (or conventional spring means not shown) against the stop pin 47 and under the collar 44. As shown in Figure 2a, pulling the trigger line 48 rotates the sear 45 upwardly about the pivot 46a in the direction of the arrow a—a, out of engagement with the collar 44, thereby permitting the hammer to move downwardly to the relative position shown in Figure 2a.

When so released, the hammer 35 is thrust downwardly against a firing pin shank 51 which is slidably positioned in the counterbore 52 disposed downwardly from the cylinder 36. The downwardly moving shank 51 compresses the coil spring 53, forcing the firing pin 54, which is fixedly attached to and extended downwardly from the shank 51, through the pin bore 55 and into contact with the detonator 56 of the cartridge 24. The cartridge 24 is fired; the projectile 25 is driven outwardly of the muzzle 14; fragments from the arcuate area of the bore wall bounded by the line X—Y—Z are dislodged and fall through the opening 15 into the sample chamber 16. After the sampler is raised, unthreading the bottom end segment 12 permits pouring or shaking the sample particles out of the bottom of the sampler and also makes it possible to flush out the chamber with water or cleaning solvent to avoid contaminating subsequent samples.

In the embodiment shown in Figure 3, the surface line 57 enters through a bore 58 in the upper cap segment 59 and is secured therein by clamp members 60 and 61 which are drawn together by set screws 62 and 63 above the collar 64, the latter being the lower termination of the load-bearing sheath of the line 57.

An electrically conductive insulated wire 65 is disposed at the center of the line 57 and is carried through a bore 66 in a generally solid upper segment 67 and connected

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to a conventional electric fuse in the cap 68 of the cartridge 69. A small, generally cylindrical space 70 is provided in the lower face 71 of the segment 67 to facilitate connecting the wire 65 to the cap 68 and to provide space for slack in the wire when the longitudinal segments 67 and 72 are threaded together at the joint 73. The opposite, normally-above-ground end of the wire 65 is connected through a suitable firing switch to a suitable current supply above the ground, neither of which is shown in the drawings.

The embodiment of my device shown in Figure 4 includes an elongated upper cap segment 74 in which is disposed an assembly 75, for attaching the surface line 76, substantially the same as that previously described with reference to Figure 3. The arrangement of the central segment 79 and the details of the cartridge chamber and breech cap assembly 80 in Figure 3 are generally the same as those of the embodiment shown in Figure 2. In the embodiment of Figure 4, however, an electrically operated solenoid is employed to depress the firing pin instead of the hammer shown in Figure 2.

To fire the device shown in Figure 4, electric current is supplied, through a wire 77 extending from the line 76, to a magnetic coil 81 enclosed within a cylindrical casing 82 having an axial bore 83 in the top thereof and a smaller bore 84 in the bottom. The casing 82 is fixedly attached to the rigid structure of the entire assembly and the bores 83 and 84 therein are axially aligned with the centerbore 85 of the coil 81.

Slidably disposed within the cylindrical wall of the device above the casing 82 is a hammer 86 having a circular groove 87 in the underface 88 thereof, and a core 89 extended axially downwardly therefrom through the bore 83 in the casing 82 and into the magnetic coil 81. A helical compression spring 90 is anchored in the groove 87 in the hammer and against the surface 91 of the casing 82 to urge the hammer to its "cocked" position shown in Figure 4.

Directly below the end face 92 of the core 89 is a generally cylindrical shank 93 having a firing pin 94 extended therefrom. The shank 93 is slidable axially within the coil bore 85, and the firing pin 94 is similarly slidable in the bore 84 and in continuations 96 and 98 thereof, through the lower portion 97 of the longitudinal segment 78, and through the breech cap 99, to the percussion detonator 100 on the face of the cartridge shell. A helical compression spring 95 is disposed around the firing pin 94 and the inner face of the bottom of the casing 82 adjacent the bore 84 therein to hold the same retracted.

Although in Figure 4, and in other figures, only a single strand of wire, such as 77 in Figure 4, has been shown it is to be understood that the diagrams were not intended to show any details of the circuitry, to which no claims of invention are made, and the electrical circuit may be completed by the use of metal shielding on the outside of the line 76 as the ground connection, or the strand 77 may, if preferred, contain a pair of insulated conductors.

In either case, when the electrical circuit is completed by the operation of switching means above the surface of the ground, the magnetic coil 81 is energized, drawing the rod 89 downwardly through the bore 85 of the coil 81, and bringing the circular end face 92 of the rod 89 into sharp impact against the opposed face of the shank 93, thereby driving the firing pin 94 against the detonator cap 100 of the cartridge in assembly 80.

Another variation of my invention is set forth in the embodiment shown in Figure 5 in which a blasting cap 101 is disposed in a hollow chamber 102 in the upper portion 104 of the sampler assembly, being connected and suspended therein by means of a cable and clamp assembly 103 similar to that shown at 75 in Figure 4. In the next lower segment 105, is an axially disposed bore 106 and counterbore 107 opening into the bottom of the chamber 102. A piston 108, generally cylindrical in con-

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formation and having a rod-like firing pin 109 extended downwardly therefrom, is positioned slidably in the counterbore 107 with the pin member 109 slidable within the throughbore 106. A coil spring 110 bottomed in the counterbore 107 serves to hold the piston 108 upwardly of the bottom of the counterbore and the tip 111 of the firing pin 109 out of contact with the detonator 112 on the upwardly disposed end-face of the cartridge in the firing assembly 113 which is substantially a counterpart of that shown at 39 in Figure 4 and described in detail above in reference to Figure 2.

Electrical firing of the blasting cap 101 generates pressure in the chamber 102 sufficient to drive the hammer member 108 downwardly in the counterbore 107 and simultaneously drive the end 111 of the firing pin 109 into the detonator end 112 of the cartridge in the firing assembly at 113. Since the detonation of a blasting cap is usually too sharp to be employed directly to propel the projectile, the chamber 102 is provided and made large enough in volume to absorb a part of the detonating shock and prevent damage to the casing. The gas pressure in the chamber 102 escapes relatively slowly after detonation, through bleed holes 102a. Test experience indicates the advisability of using a cartridge similar to standard small arms ammunition of suitable calibre, replacing the conventional lead or steel jacketed bullet portion with the projectile of truncated cylindrical conformation previously described herein.

While the forms shown and described herein are fully capable of achieving the advantages hereinbefore stated, they are capable of some modification without departure from the spirit of the invention. For that reason I do not mean to be limited to the forms shown and described above, but rather to the scope of the appended claims.

I claim:

1. A bore hole sampler comprising: an elongate body having a chamber formed therein with an enlarged opening to receive material dislodged from the wall of an earth bore in which said body is suspended; gun means in said body having a projectile supporting bore directed obliquely from the axis of said body and against said wall, the muzzle of said projectile bore being directly above said enlarged opening when said body is suspended as aforesaid said enlarged opening being substantially larger than said projectile bore; means to suspend said body adjacent the wall of an earth bore; and means to fire a projectile through said gun bore against said wall, said projectile following a downward path in said wall immediately adjacent said enlarged opening, to dislodge material from the wall into said opening.

2. A bore hole sampler comprising: an elongate body having a chamber formed therein with an enlarged opening to receive material dislodged from the wall of an earth bore in which said body is suspended; gun means in said body having a projectile supporting bore directed obliquely from the axis of said body and against said wall, the muzzle of said projectile bore being directly above said enlarged opening when said body is suspended as aforesaid said enlarged opening being substantially larger than said projectile bore, said elongate body being separable intermediate its ends to permit breech loading of said bore; means to suspend said body adjacent the wall of an earth bore; and means to fire a projectile through said gun bore against said wall, said projectile following a downward path in said wall immediately adjacent said enlarged opening, to dislodge material from the wall into said opening.

3. A bore hole sampler comprising: an elongate body having a chamber formed therein with a lateral enlarged opening to receive material dislodged from the wall of an earth bore in which said body is suspended; means to suspend said body at a predetermined depth in an earth bore; means forming an oblique gun bore in said body having a muzzle above said chamber opening said opening being substantially larger than the muzzle of said gun bore; an

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explosive charge positioned in the breech end of said gun bore; a projectile in said gun bore between said charge and muzzle; and means actuatable from the earth surface to explode said charge and drive said projectile into said wall, said projectile following a downward path in said wall immediately adjacent said enlarged opening, to dislodge material from the wall into said opening.

4. A bore hole sampler comprising: an elongate body having a sampler chamber formed therein with a lateral enlarged opening to receive material dislodged from the wall of an earth bore in which said body is suspended; means to suspend said body at a predetermined depth in an earth bore; means forming an oblique gun bore in said body having a muzzle above said chamber opening said opening being substantially larger than the muzzle of said gun bore; an explosive charge positioned in the breech end of said gun bore; a truncated cylindrical projectile positioned in said bore between said charge and muzzle, said projectile having a chisel-shaped point disposed to penetrate said wall when said projectile is fired from said bore and dislodge material by a cutting action from said wall downwardly and inwardly through the enlarged opening into said sample chamber; and means actuatable from the earth surface to explode said charge and drive said projectile into said wall, said projectile following a downward path in said wall immediately adjacent said enlarged opening, to dislodge material from the wall into said opening.

5. A bore hole sampler comprising: an elongate body having a pocket formed therein with a lateral enlarged opening to receive material dislodged from the wall of an earth bore in which said body is suspended; means to suspend said body in an earth bore at a predetermined depth therein; gun means in said body including a bore having an explosive charge-receiving chamber substantially parallel to the axis of said body, and an oblique projectile bore communicated with such chamber portion and with the muzzle thereof directly above said opening said opening being substantially larger than the muzzle of said gun bore, said body being separable adjacent said chamber to permit the loading thereof; an explosive charge in said chamber; a separate projectile in said bore; and means actuatable from the surface to explode said charge and drive said projectile into said wall, said projectile following a downward path in said wall immediately adjacent said enlarged opening, to dislodge material from the wall into said opening.

6. A bore hole sampler comprising: an elongate body having a pocket formed therein with a lateral opening to receive material dislodged from the wall of an earth bore in which said body is suspended; means to suspend said body in an earth bore at a predetermined depth therein; gun means in said body including a bore having an explosive charge-receiving chamber portion substantially parallel to the axis of said body, and a downwardly oblique projectile bore communicated with such chamber portion and having the muzzle thereof positioned directly above said opening, said body being separable adjacent said charge-receiving portion to permit the loading thereof; detent means in said body adjacent said projectile bore to retain a projectile therein when loaded through said muzzle; an explosive charge in said gun chamber; a separate projectile in said gun bore; and means actuatable from the surface to explode said charge and drive said projectile into said wall, said projectile following a downward path in said wall immediately adjacent said enlarged opening to dislodge material from the wall into said opening.

7. A bore hole sampler comprising: an elongate body having a pocket formed therein with an enlarged lateral opening to receive material dislodged from the wall of an earth bore in which said body is suspended; means forming an oblique gun bore in said body having a muzzle above said pocket opening, said opening being substantially larger than said gun bore, said bore being adapted

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to receive a percussion-fired cartridge-projectile; a firing pin movably supported in said body to fire a cartridge in said bore; means to suspend said body at a predetermined depth in a bore hole; and power means in said body actuatable from the ground surface to move said pin and fire said cartridge as aforesaid whereby to drive a projectile obliquely through said bore against said wall, said projectile following a downward path in said wall immediately adjacent said enlarged opening, to dislodge material from the wall into said opening.

8. The construction of claim 7 wherein said power means includes a solenoid in said body, a hammer driven by said solenoid and adapted to strike said firing pin, and electrical conductor means extending from said body to the ground surface whereby to energize said solenoid.

9. The construction of claim 7 wherein said power means includes a movable hammer supported in said body adjacent said firing pin, a spring positioned and adapted to urge said hammer towards said firing pin, sear means to hold said hammer in a cocked position away

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from said firing pin and against the urging of said spring, and trigger means extending from said sear means to the ground surface and adapted when actuated to release said hammer and permit said spring to drive said hammer against said firing pin to fire said cartridge as aforesaid.

10. The construction of claim 7 wherein said power means includes an expansible fluid chamber in said body having a movable wall portion connected to said firing pin, and a fluid pressure source actuatable from the ground surface to pressurize said chamber and drive said firing pin against a cartridge in said bore to fire the same as aforesaid.

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