March 9, 1943. L. SPENCER 2,313,369

FORMATION TESTER

Filed Feb. 28, 1940 3 Sheets-Sheet 1

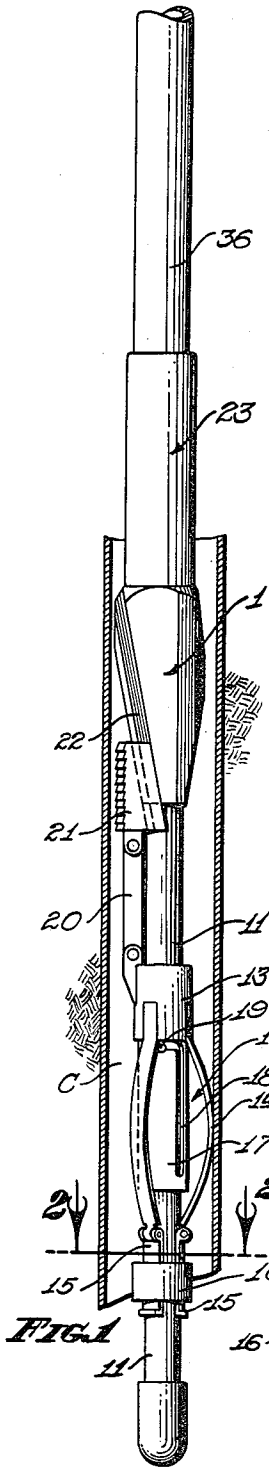

FIG. 1

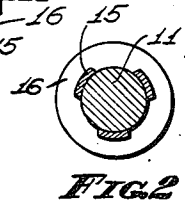

FIG. 2

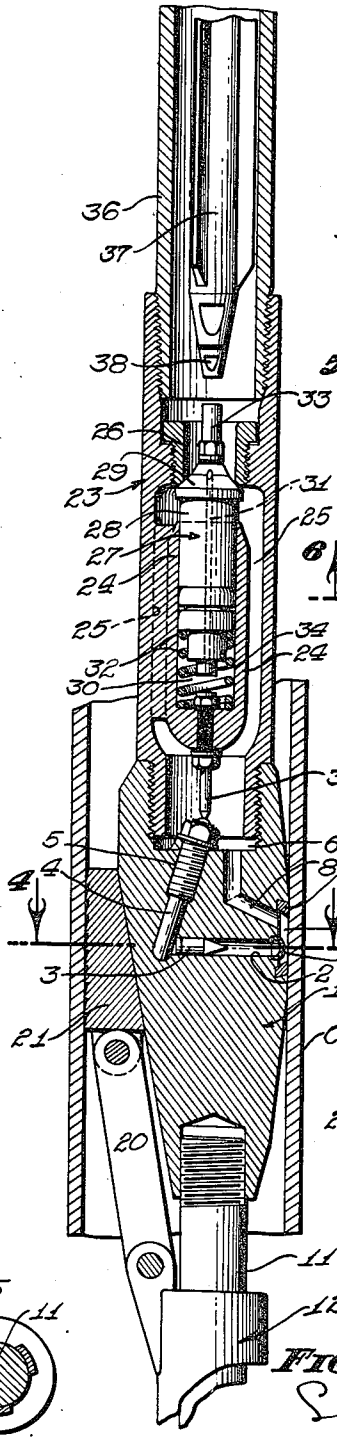

FIG. 3

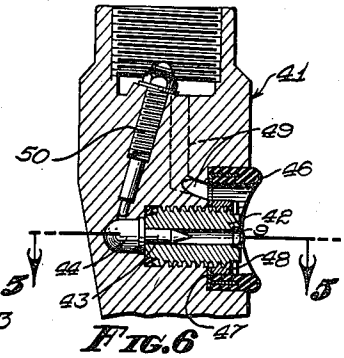

FIG. 6

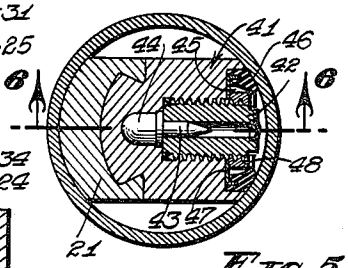

FIG. 5

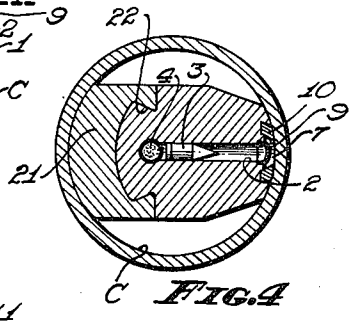

FIG. 4

INVENTOR

Lloyd Spencer.

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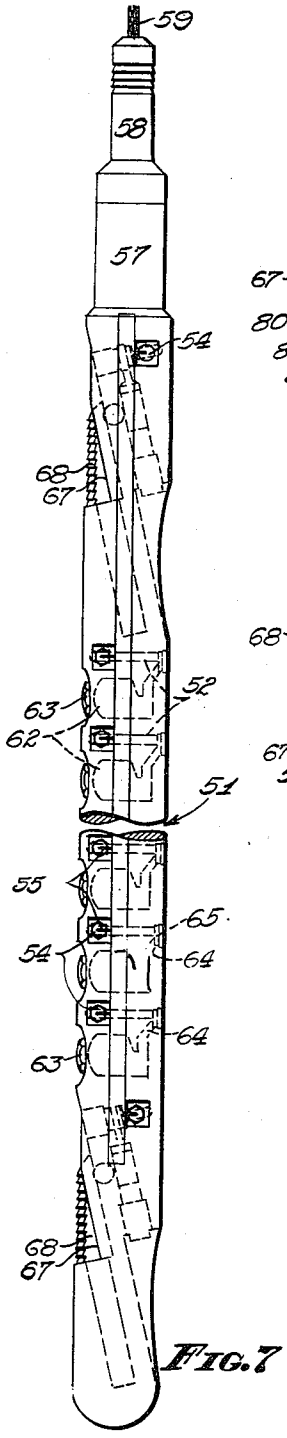

FIG. 7

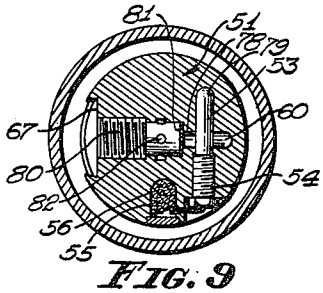

FIG. 9

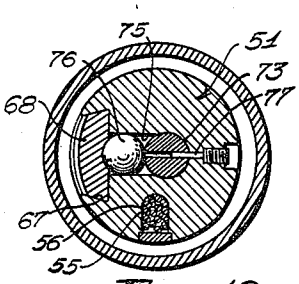

FIG. 10

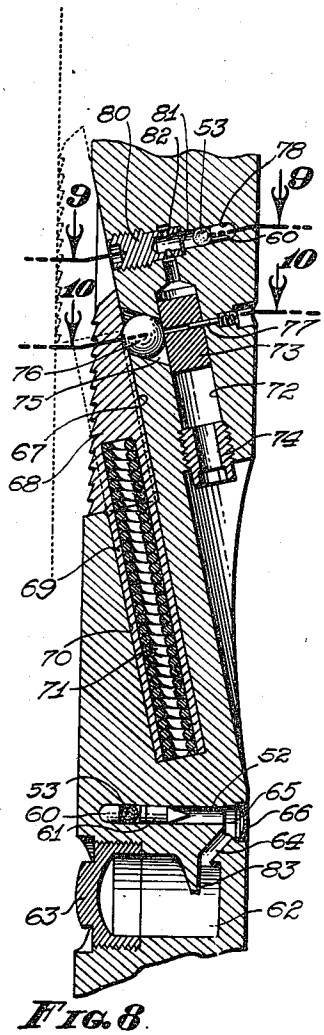

FIG. 8

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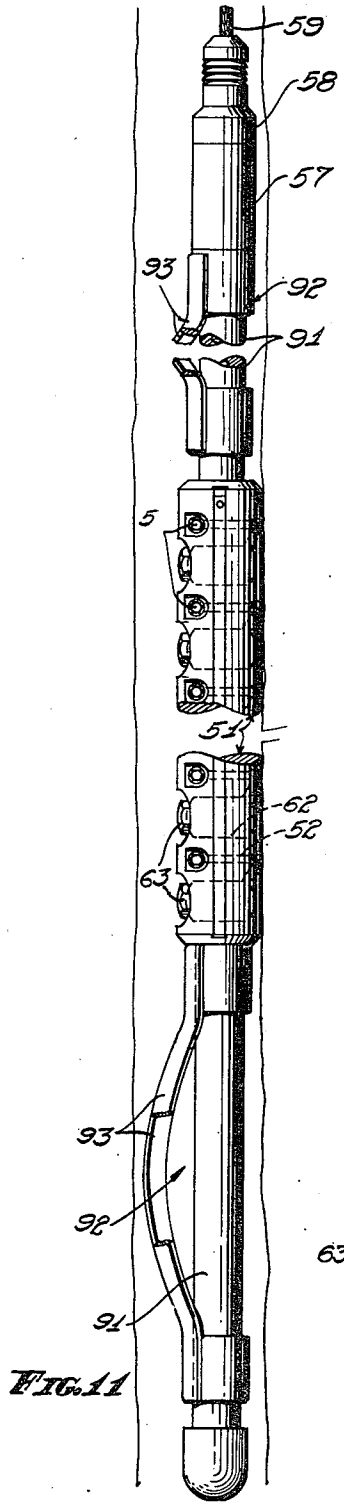

FIG. 11

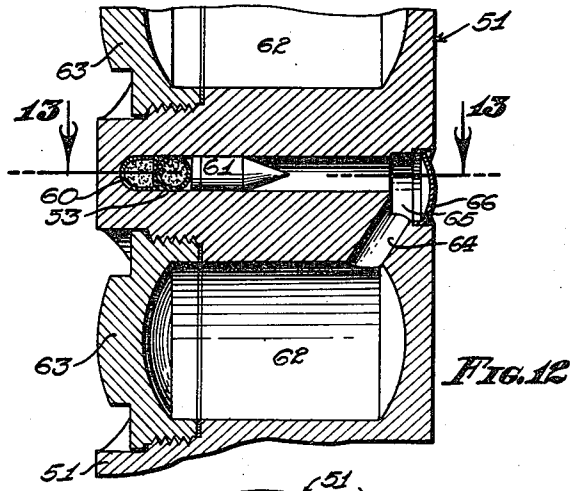

FIG. 12

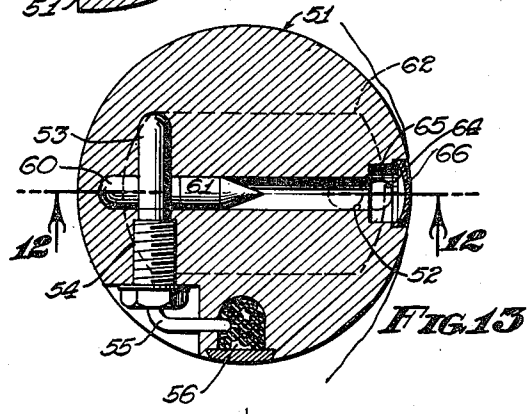

FIG. 13

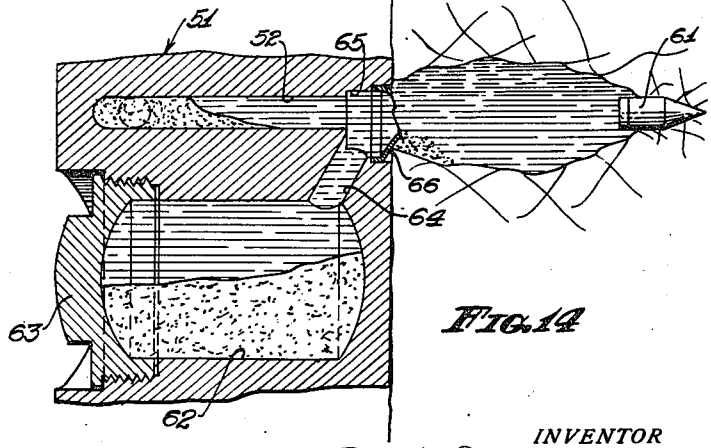

FIG. 14

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Lloyd Spencer.

Patented Mar. 9, 1943

2,313,369

UNITED STATES PATENT OFFICE

2,313,369

FORMATION TESTER

Lloyd Spencer, Los Angeles, Calif., assignor to Lane-Wells Company, Los Angeles, Calif., a corporation of Delaware

Application February 28, 1940, Serial No. 321,298

20 Claims. (Cl. 166—1)

My invention relates to formation testers, and among the objects of my invention are:

First, to provide a formation tester which incorporates a gun unit designed to fire a bullet through a well casing surrounding formation or directly into the formation itself, and a sample-collecting means having an intake port in close proximity to the muzzle of the gun unit whereby part of the formation itself loosened by the discharge of the gun, as well as fluid connate to the formation, may be collected;

Second, to provide a formation tester of this type in which the gun muzzle and sample-taking port are held against the casing or formation so that fluid contained within the well bore is substantially isolated from sample-taking means;

Third, to provide a formation tester employing a gun unit which may be designed to run on tubing or on a cable, depending upon the quantity of sample desired;

Fourth, to provide a formation tester of this type which, when run on tubing string, may utilize the tubing itself as a sample-receiving chamber, whereby flow tests, pressure tests, etc., may be made while the formation tester remains in position, it being possible to measure the flow of fluid from the tubing string or to determine the static head if the formation pressure is insufficient to flow; also a swab may be used within the tubing to assist in flowing the well or bring a sample to the surface without disturbing the formation tester, or other sampling means such as a bailer may be operated in the tubing;

Fifth, to provide a gun type formation tester wherein any sand or loosened particles of the formation are conducted directly into the tester, rather than into the well bore or casing around the formation tester, so that danger of the formation tester becoming sanded within the casing or open hole is minimized.

Sixth, to provide a gun type formation sampler designed primarily to collect samples of the formation itself loosened by discharge of a gun unit, and arranged to incorporate a plurality of gun units with associated sample chambers whereby several samples may be collected from different points along the well bore; and

Seventh, to provide a formation sampler which incorporates a novel sample chamber associated with the muzzle end of a gun perforator, wherein the chamber is designed to entrap a sample of a fluid lighter than the liquid in which the formation sampler is immersed.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings.

Figures 1 through 6 illustrate a form of my invention constructed for use with a tubing string, in which:

Figure 1 is an elevational view of my formation tester with the parts in the positions assumed when the tester is being moved through a well casing, the well casing being shown in section and fragmentarily;

Figure 2 is an enlarged transverse sectional view through 2—2 of Figure 1, illustrating a detail of the friction cage construction;

Figure 3 is an enlarged fragmentary, longitudinal sectional view taken in the same plane as Figure 1, with the parts shown in the positions assumed when the formation tester is secured in the well casing and about to be operated;

Figure 4 is a transverse sectional view through 4—4 of Figure 3, illustrating particularly the gun unit and locking slip;

Figure 5 is a transverse sectional view similar to Figure 4, showing a modified construction of the gun unit, this section being taken through 5—5 of Figure 6; and

Figure 6 is a fragmentary, longitudinal sectional view taken through 6—6 of Figure 5, with the parts in the positions assumed when the formation tester is being moved into the well bore.

Figures 7 through 10 illustrate a modified form of my invention designed for suspension from a conductor core wire rope and adapted to collect a plurality of samples, in which:

Figure 7 is an elevational view of my formation tester;

Figure 8 is a fragmentary, longitudinal sectional view thereof, taken in the same plane as Figure 7; and

Figures 9 and 10 are transverse sectional views taken through 9—9 and 10—10, respectively, of Figure 8.

Figures 11 through 14 illustrate a further modified form of my formation tester, which is particularly designed for operation in uncased or open holes, in which:

Figure 11 is an elevational view of my formation tester;

Figure 12 is a fragmentary, longitudinal sectional view thereof on an enlarged scale taken in a plane parallel to Figure 11 and through 11—11 of Figure 13;

Figure 13 is a transverse sectional view taken through 13—13 of Figure 12; and

Figure 14 is a fragmentary, longitudinal sec-

tional view similar to Figure 12, showing the parts in the positions assumed after discharge of a gun unit.

Reference is first directed to Figures 1 through 6.

This invention is an improvement upon and utilizes some of the features of my previous patents, Nos. 2,092,337 and 2,092,338. Also it is contemplated to utilize the invention disclosed in the Anderson Patent No. 2,058,287, namely, a battery-contained go-devil or weight bar.

A gun body 1 is provided in which is formed a laterally directed gun bore 2 adapted to receive a bullet 3. The inner end of the gun bore 2 is intersected by an angularly disposed, upwardly extending cartridge chamber which receives a cartridge 4, the outer end of which is closed by a plug 5. The upper end of the gun body is provided with an internally threaded socket 6, into which the plug 5 extends. The upper end of the plug 5 is provided with a head adapted to be engaged by a wrench and is located at approximately the center of the socket 6.

At the muzzle end of the gun bore 2 the gun body 1 is provided with a rudimentary recess 7 which extends sufficiently above the gun bore to embrace the outer end of a passage 8 which extends inwardly and upwardly into the socket 6. The outer end of the gun bore 2 is initially closed by a sealing disc 9 for the purpose of excluding the water from the gun bore until the gun is fired.

Around the recess 7, which may be circular, there may be press-fitted a sealing ring 10 formed of relatively soft material such as lead, aluminum, copper or the like. To retain the sealing ring the margins of the recess may be undercut slightly, the ring being secured by placing it in the recess and expanding it into the undercut margins. The sealing ring may likewise be undercut around its inner periphery and its outer edge normally projecting slightly beyond the body 1. The body 1 surrounding the recess is given a curvature corresponding to the curvature of the inside of the casing in which the formation tester fits, and the outer surface of the sealing ring 10 is likewise given such a curvature. Thus when the gun body is forced against the casing, as will be described hereinafter, the sealing ring is pressed inwardly and its undercut inner periphery forms a sealing lip tending to prevent leakage of fluid between the recess 7 and the interior of the casing beyond the sealing ring.

A stem 11 is secured to the lower end of the gun body 1. Mounted upon the stem 11 is a friction cage 12 which includes a top collar 13, to which is attached a plurality of bow springs 14. The lower end of the bow springs are hinged to guide arms 15 which slide in slots provided in a lower collar 16. A sleeve 17 is secured to the upper collar and is provided with a bayonet slot 18 therein which is adapted to coact with a pin 19 secured in the stem 11. A link 20 extends upwardly from the upper collar and is joined to a slip 21 which is adapted to slide on an angularly disposed dovetail guide 22 formed along the side of the body 1 opposite from the muzzle end of the gun bore 2.

The socket 6 formed in the upper end of the gun body is adapted to receive the screw-threaded lower end of a valve case 23. Supported within the valve case 23, in concentric relation therewith, is a valve housing 24, passages 25 being formed between the valve housing and the valve case. Above the valve housing 24 the valve case 23 is reduced in its internal diameter and receives a removable valve seat ring 26. The valve housing 24 is provided with a bore which receives a valve member 27. The valve member comprises a valve stem 28 which fits the bore of the valve housing and a valve head 29 which is adapted to engage the lower end of the valve seat ring 26. The effective diameter of the valve opening provided by the valve seat and valve head and the diameter of the valve stem is approximately equal so that the valve 27 is substantially balanced. The lower end of the valve housing is closed so as to form, with the valve stem, an equalizing chamber 30 which is in communication with the upper end of the valve head above the valve seat through an equalizing port or ports 31. Valve cups, or other sealing means, are provided on the valve stem so as to isolate the chamber 30 from the passages below the valve seat. A comparatively weak spring 32 serves to hold the valve closed.

The valve 27 is provided with an insulated electrical conductor therethrough having an upper terminal 33 extending above the valve head 29 and a lower terminal 34 extending into the equalizing chamber 30. A contact pin 35 is secured in the lower end of the equalizing chamber for engagement by the lower terminal 34 and protrudes below the valve housing 24; its lower end is pointed for engagement with the upper end of the cartridge plug 5. The cartridge plug is provided with a suitable conductor (not shown) which extends therethrough and into the cartridge 4 for the purpose of ignition.

The upper end of the valve case 23 is screw-threaded for connection to the lower end of a tubing string 36, by means of which the formation tester is lowered into the well bore.

The valve 27 is adapted to be engaged by a weight bar 37 which may be in the form of a go-devil adapted to be dropped through the tubing 36, or may be suspended on a wire line (in either case the weight bar contains several batteries—more fully disclosed in the above-mentioned Patent No. 2,058,287) on the weight bar may be suspended from an electrical conductor cable, in which case the source of electrical energy is at the surface, as shown in Patent No. 2,092,337. In all cases the weight bar is provided with a contact head 38 at its lower end adapted to engage the upper terminal 33. The weight of the weight bar is utilized to open the valve 27 against the action of the spring 32, as set forth in Patent No. 2,092,337.

Operation of my formation tester is as follows: The gun unit, slip assembly and valve arrangement are lowered on tubing until the gun body is opposite the point at which a test is desired. The tubing is then rotated in a manner to free the bayonet slot with respect to the pin 19, so that the slip 21 may move upwardly on the gun body from the position shown in Figure 1 to the position shown in Figure 3, so as to force the muzzle side of the gun body against the casing. The weight bar 37 is then lowered or dropped, the contact head 38 engages the upper terminal 33 of the valve and the weight of the weight bar urges the valve against the comparatively weak spring 32 until the lower terminal 34 engages the contact pin 35 so that a circuit is completed to the cartridge 4, it being noted that a suitable electrical ground connection is provided between the weight bar and tubing. Ignition of the cartridge discharges the bullet 3 through the casing C to form an opening for the entrance of fluid

which may be present on the outside of the casing. The incoming fluid passes through passage 8 and passages 25 into the tubing string 36. If the weight bar has been lowered on a wire line or conductor cable the position of the valve may be readily controlled by the operator at the surface, and should the incoming fluid flow out of the tubing at the well mouth the weight bar may be lifted to close the valve.

Various procedures may be adopted in conducting a test, for example, pressure gauges may be incorporated with the weight bar and connected with apparatus at the surface, particularly if a conductor cable is used, so that the height to which the liquid rises may be ascertained. Also, in removing the weight bar it is a comparatively simple matter to determine by weight indicators when the surface of the liquid is reached.

Further, it is possible by conventional means such as used in conjunction with removable core barrels, to disconnect the cable or wire line from the weight bar and then use a swab or other device lowered in the tubing for the purpose of withdrawing the fluid. Thus, any one of a number of tests may be made, according to the desire of the operator, all while the gun body remains in position.

It is not mandatory that a sealing ring be provided around the recess as the surface of the gun body itself may conform sufficiently to the casing to provide a fairly satisfactory seal, inasmuch as slight contamination of the incoming fluid would do no harm. In this connection, it should be borne in mind that under normal operation the casing C is entirely filled with liquid and that its static head is in most cases greater than the fluid which is tested. However, it is not necessary that the casing be filled with liquid, in which case incoming fluid pressure is greater than any nominal hydrostatic head within the casing and any slight leakage would merely subtract from the quantity of the sample instead of contaminating it.

It is unnecessary that the stem 11 line up axially with the tubing string or valve case. Also it is preferable to provide independent movement of the bow springs so that when the gun body is moved laterally in the casing by reason of the slips 21 the bow springs are free to give independently and allow eccentric location of the stem 11.

In Figures 5 and 6 there is illustrated a modified form of my formation tester, particularly in respect to the construction of the gun unit. The modified gun body 41 is in most respects similar to the gun body 1, except that in place of the gun bore 2 the gun body 41 is provided with a screw-threaded socket which receives a gun barrel 42. At the inner end of the gun barrel 42 there is formed in the gun body a chamber adapted to receive a cartridge 43. The gun barrel receives a bullet 44. Around the outer end of the gun barrel the gun body 41 is provided with a recess 45 which is sufficiently larger than the gun barrel to receive a sealing ring 46. The sealing ring may be formed of rubber or may be formed of relatively soft metal, and include a radially inwardly directed flange 47 adapted to be engaged by a clamping nut which may screw-thread upon the outer end of the gun barrel 42. The sealing ring 46 may normally extend slightly beyond the surface of the gun body. A passage 49 communicates with the recess 45 and the socket formed at the upper end of the gun body for connection to the valve case. A suitable electrically operated firing means 50 extends from the socket provided in the upper end of the gun body 41 to the cartridge 44. In operation the modified construction is similar to that previously described, with the added feature that the gun barrel may be replaced when it becomes worn.

In both constructions the gun body is provided with sufficient clearance at its sides to permit circulation around the gun, even when the gun body is secured in the casing.

Reference is now directed to Figures 7 through 10.

This construction includes a body member 51 in the form of an elongated round bar of the requisite diameter and having a plurality of laterally directed gun bores 52. The gun bores are preferably arranged in vertical alignment and have their muzzle ends at one side only of the gun body. The gun bores may be of uniform diameter and each is intersected near its inner end by a cross bore which receives a cartridge 53. The outer end of the cross bore is closed by a sealing plug 54 which is adapted to carry an electrical conductor 55. The conductors from the several sealing plugs fit within a longitudinally extending conductor channel 56 formed in the side of the gun body and pass upwardly through the channel to a sequencing controller (not shown) contained within a controller casing 57. The casing is attached to a cable head 58 which in turn is attached to a conductor core wire rope or cable 59. The inner end of each gun bore 52 may contain an additional cartridge element 60 and forwardly thereof a bullet 61.

The gun bores are spaced sufficiently far apart to provide spaces for sampler chambers 62. Each sampler chamber is in the form of a relatively large bore extending laterally into the gun body at the opposite side from the muzzle end of the gun bore. Each sampler chamber 62 is closed by a screw-threaded cap member 63. The inner or forward end of each sampler chamber connects by a port 64 with the muzzle end of the corresponding gun bore. At the muzzle end of each gun bore the body is provided with a rudimentary recess 65 which is common to the gun bore and corresponding port. Each recess 65 is initially closed by a sealing disc 66 which is preferably dome-shaped and designed to withstand the external pressure of liquids in which the gun may be immersed. Inasmuch as the gun units and sampler chambers of the modification shown in Figures 10 through 14 are similar, reference may be had to Figures 12 and 13.

Above and below the series of gun units and sampler chambers formed in the body member are provided slip means for holding the body member against one side of a surrounding casing. Such means include a slip guide 67 formed in the body member and arranged at a slight angle with respect to the axis of the body member. The slip guides may be in the form of dovetail channels and receive wedge-shaped slips 68 having teeth or serrations on their outer edges for engagement with a surrounding casing, as shown by dotted lines in Figure 8. Each slip is provided with a stem 69 which is adapted to extend downwardly into a socket formed in the body member in alignment with the corresponding slip guide 67. A spring 71 is fitted within the slip stem 69, which stem is hollow. The spring tends to force the corresponding slip upwardly and outwardly along the slip guide.

Paralleling the slip stem socket 70, on the opposite side of the gun body, is a keeper bore 72 which receives a keeper piston 73 and is provided at its lower or outer end with a tubular keeper plug 74. The slip guide and keeper bore are connected by a key ball passage 75 in which is fitted a key ball 76. The key ball is slightly larger in diameter than the length of the passage so that the key ball may fit into a recess provided on the back side of the corresponding slip, and is initially held therein by the keeper piston 73. The keeper piston is in turn held in position by a shear pin 77.

The inner or upper end of each keeper bore 72 is reduced in diameter and intersects a laterally directed cartridge bore 78 which is intersected by a right angularly disposed cartridge bore 79. These bores 78 and 79 receive cartridge elements 60 and 53 respectively. The outer end of the cartridge bore 78 receives a retainer plug 80 which holds a sealing plate 81 over the end of the cartridge element so as to exclude water therefrom and to permit pressure to be built up before rupturing. The retainer plug 80 is provided with ports 82 which connect the bore 78 with the keeper bore 72, so that when the cartridges are discharged the sealing plate 81 ruptures and the keeper piston is driven downwardly, shearing pin 77 and allowing the key ball to release the corresponding slip. The transverse cartridge bore 79 is provided with a conductor-carrying sealing plug 54 which is connected through a conductor 55 to the controller in the manner of the other conductors associated with the gun unit.

Operation of the construction shown in Figures 7 through 10 is as follows: The formation tester is lowered on a cable to a point below the place at which the samples are to be taken. The controller is operated to fire cartridges in bores 78 and 79 so as to release the slips. When the slips are released the muzzle side of the gun body is forced against the casing and the weight is taken off the cable, the slips preventing the gun from moving downwardly. When the gun or formation tester is set in position the controller is operated to fire one or more of the gun units. Inasmuch as the gun unit is held against the surrounding casing the muzzles remain in alignment with the holes made by the corresponding bullets and a passage is formed between the hole made by the bullet and the sampler chamber. The pressure in the sampler chamber is materially lower than the ordinary hydrostatic head of the fluids around the gun, being initially at atmospheric pressure, and although upon discharge of the gun this pressure may rise to several atmospheres the gas generated by the explosive rapidly cools, again lowering the pressure. Such lowered pressure region causes the particles of formation loosened upon passage of the bullet therein to be drawn into the chamber, along with a small quantity of fluid. Inasmuch as the entrance port to each sampler chamber is disposed at the upper end thereof, the solid material collected by the sampler chambers remains therein although the gun is moved through the well fluid. However, should the fluids which entered through the gun perforation be lighter than the liquid within the casing, the fluids would normally be displaced by the liquid within the casing. This may be prevented by providing a baffle 83 in the form of a lip extending downwardly from the upper side of the sampler chamber. Any lighter fluid entering the chamber is trapped behind the baffle. After the tester has been fired in one position it may be raised and again fired, or removed from the casing; it being noted that the slips tend to release when the tester is moved upwardly.

Reference is now directed to Figures 11 through 14: The structure herein illustrated is particularly designed for operation in open or uncased holes. The gun body, gun bores and sample-receiving chambers may be identical to the construction shown in Figures 7 through 10 and these parts are given like reference characters. In place of the slip arrangement provided at the extremities of the gun body illustrated in Figure 7, the gun body is provided at its upper and lower end with a stem 91 upon which is mounted cages 92. Each cage is secured on the gun against rotation and includes a pair of bow springs 93 positioned on the opposite side of the gun body from the muzzle ends of its gun bores, so that the springs in riding against one side of the well bore urge the muzzle side of the gun body into contact with the opposite side of the gun bore, as shown in Figure 11.

The chambers may or may not have the baffle members, depending upon whether the primary interest is in investigation of the formation itself or in the collection of a fluid sample therefrom. Because of the necessarily limited space of the sample chambers, samples of the formation itself, of course, afford better means of identification. In this connection, it should be pointed out that particles of the formation obtained by the formation tester are examined through a microscope for identification by their physical properties. Chemical tests also may be made and the results checked with samples from other wells to identify a given formation. It also should be noted that a bullet in penetrating the formation tends to pulverize or break up the formation to a diameter several times that of the bullet itself, and that the loosened material being immediately opposite the gun barrel is readily drawn into the chamber and tends to enter ahead of any other fluid which may be surrounding the gun. It is not necessary to obtain a complete seal between the gun and the remainder of the well bore, but mere contact of the gun with the casing or formation is sufficient, particularly if formation samples, as distinguished from fluid samples, are desired.

The first described structure is particularly directed to the sampling of fluid connate to the formation. However, particles of the formation loosened by the bullet, as well as additional formation which may be washed into the tubing by the action of the flowing fluid, may be examined when the formation tester and tubing are removed. Also, if there is any quantity of sand or the like entering through the formation, a conventional suction bailer may be utilized to collect any sand that may enter the tubing before raising the tester.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. A gun perforator for well casing comprising: a gun body having a laterally directed gun bore, its muzzle end intersecting one side of the gun body; wedge means coacting with the opposite side of said gun body for wedging the muzzle end of said gun bore tightly against a

surrounding casing; a tubing string for supporting said gun body; and means operable by manipulation of said tubing string for controlling said wedge means.

2. In a fluid sampling apparatus: a gun body having a laterally directed gun bore, its muzzle end intersecting one side of the gun body; wedge means coacting with the opposite side of said gun body for wedging the muzzle end of said gun bore tightly against a surrounding casing; cartridge and bullet means for said gun body, said bullet adapted to perforate said casing; and a sample-receiving means communicating with the muzzle end of said gun bore.

3. In a fluid sampling apparatus: a gun body having a laterally directed gun bore, its muzzle end intersecting one side of the gun body; wedge means coacting with the opposite side of said gun body for wedging the muzzle end of said gun bore tightly against a surrounding casing; a tubing string for supporting said gun body; means operable by manipulation of said tubing string for controlling said wedge means; cartridge and bullet means for said gun body, said bullet adapted to perforate said casing; and means communicating between the muzzle end of said gun bore and tubing string whereby said tubing string may collect fluid entering said perforation.

4. In a fluid sampling apparatus: a gun body having a laterally directed gun bore and a sampling passage terminating respectively in a muzzle and a port at one side of the gun body and in close proximity to each other; a sealing means embracing said muzzle and port; means coacting with said gun body for urging said sealing means against a surrounding casing to isolate said muzzle and port from the remainder of the casing interior; a cartridge and bullet means for said gun body, said bullet adapted to perforate said casing; and a sample-collecting means communicating with said perforation.

5. In a fluid sampling apparatus: a gun body having a laterally directed gun bore and a sampling passage terminating respectively in a muzzle and a port at one side of the gun body and in close proximity to each other; a sealing means embracing said muzzle and port; means coacting with said gun body for urging said sealing means against a surrounding casing to isolate said muzzle and port from the remainder of the casing interior; a tubing string for supporting said gun body and communicating with said sampling passage; and a valve controlling communication between said passage and said tubing string.

6. In a fluid sampling apparatus: a gun body having a laterally directed gun bore and a sampling passage terminating respectively in a muzzle and a port at one side of the gun body and in close proximity to each other; a sealing means embracing said muzzle and port; wedge means coacting with said gun body to urge the same laterally and said sealing means into engagement with a surrounding casing; a tubing string for supporting said gun body; a device responsive to manipulation of the tubing string for operating said wedge; and a valve for controlling communication between said sampling passage and said tubing.

7. A formation testing apparatus comprising: a gun body having a laterally directed gun bore, a cartridge chamber and a sampling passage; a bullet and cartridge means therefor; a fuse plug communicating with said cartridge chamber and exposed to the upper end of said gun body; a valve housing secured to said gun body; a valve in said valve housing; conductor and terminal means providing an electrical connection from said fuse plug through said valve; a device adapted to make electrical and mechanical contact with said valve for opening said valve and completing an electrical circuit to said fuse plug; said gun bore and said sampling passage having, respectively, a muzzle and intake port in close proximity, the sampling passage communicating with said valve; and means for urging said gun body laterally against a surrounding casing to isolate said muzzle and port from the remaining interior of said casing.

8. In a fluid sampler for cased wells: a sample-receiving means having an intake port; a gun unit having a muzzle in close proximity to said intake port; a sealing means embracing said muzzle and port; and means for urging said sealing means into engagement with a surrounding casing to isolate said muzzle and port from the remainder of the well casing interior.

9. A sampler for wells comprising: a gun unit having a laterally directed gun bore and a sample-receiving means having an inlet port in proximity to the muzzle end of said gun bore said gun unit having a recess embracing said muzzle end and said inlet port and a sealing cap fitting said recess and closing both said muzzle end and said inlet port.

10. A sampler for wells comprising: a gun unit having a laterally directed gun bore; a sample-receiving means having an inlet port in proximity to the muzzle end of said gun bore; and means for urging the muzzle end of said gun bore and said intake port against one side of the well bore.

11. A construction, as set forth in claim 9, wherein said sample-receiving means is in the form of a chamber, including a pocket adapted to entrap fluid having a lighter density than the liquid in which the gun unit may be immersed.

12. A sampling apparatus for wells comprising: a body member having a plurality of gun bores, their muzzle ends directed laterally from one side of said body member; sampling chambers interposed between said gun bores, each chamber having an inlet port, and the muzzle end of each gun bore being enlarged to embrace its corresponding inlet port; cartridge and bullet means for each of said gun bores and a seal means fitting the muzzle end of each gun bore to close initially both said gun bore and the corresponding inlet port.

13. An apparatus, as set forth in claim 12, which includes means for urging the muzzle ends of said gun bores against a side of a well bore.

14. A sample apparatus for wells, comprising: a body member having a plurality of gun bores, their muzzle ends directed laterally from one side of said body member; sampling chambers in said body member interposed between said gun bores, each chamber communicating with the muzzle end of an adjacent gun bore; cartridge and bullet means for said gun bores; and means for urging the muzzle ends of said gun bores against the side of a well bore.

15. In a well tool: a wedging slip; a supporting and guiding means therefor; said means defining an intersecting keyway and cylinder; means for urging said slip into operative position; a key element in said keyway initially restraining said slip in an inoperative position; a piston in said cylinder and holding said key element; and an explosively actuated means for

moving said piston to release said key element, thereby to release said slip.

16. A sampler for wells, comprising: a unitary cylindrical body member having a lateral gun bore and a lateral sampler chamber, the sampler chamber having an inlet port intersecting the muzzle end of said gun bore whereby said gun bore and inlet port have a common point of communication with the exterior of said body member.

17. A sampler for wells, comprising: a unitary body member having a plurality of laterally directed gun bores, their muzzle ends intersecting one side of the body member, and a plurality of sampler sockets in said body member interposed between said gun bores and having openings intersecting the opposite side of said body member, there being an inlet port for each sampler socket communicating with the muzzle end of a corresponding gun bore; covers for said openings in said sampler sockets; and seal means common to the muzzle end of each gun bore and the corresponding inlet port.

18. A sampler for wells, comprising: a unitary cylindrical body member having a lateral gun bore and a lateral sampler chamber, the sampler chamber having an inlet port intersecting the muzzle end of said gun bore whereby said gun bore and inlet port have a common point of communication with the exterior of said body member; and means for urging the muzzle end of the gun bore against a side of the well bore.

19. A sampler for wells, comprising: a unitary body member having a plurality of laterally directed gun bores, their muzzle ends intersecting one side of the body member, and a plurality of sampler sockets in said body member interposed between said gun bores and having openings intersecting the opposite side of said body member, there being an inlet port for each sampler socket communicating with the muzzle end of a corresponding gun bore; covers for said openings in said sampler sockets; seal means common to the muzzle end of each gun bore and the corresponding inlet port; and means for urging said body member laterally whereby the muzzle ends of said gun bores and said inlet ports are pressed against the side wall of the well bore.

20. In a well tool: a wedging slip; a unitary body member incorporating a supporting and guiding means for said slip; means for urging said slip into an operative position; restraining means for said slip initially holding said slip in an inoperative position; and an explosively actuated means for releasing said restraining means.

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