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MEANS AND METHOD OF SAMPLING WELL FLUID

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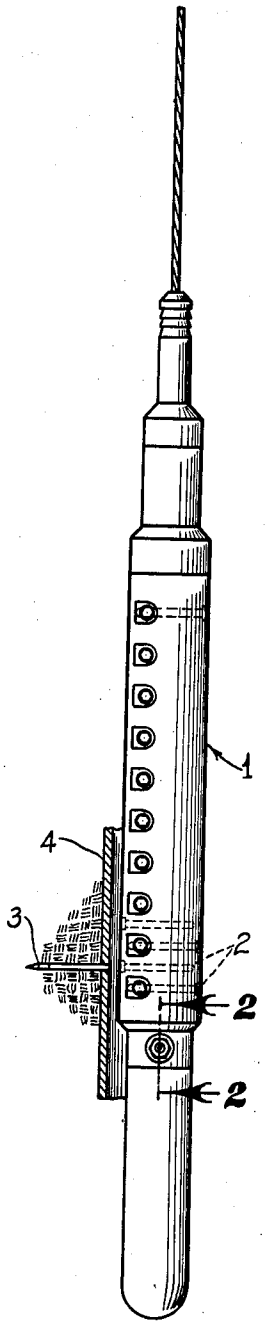


FIG. 1

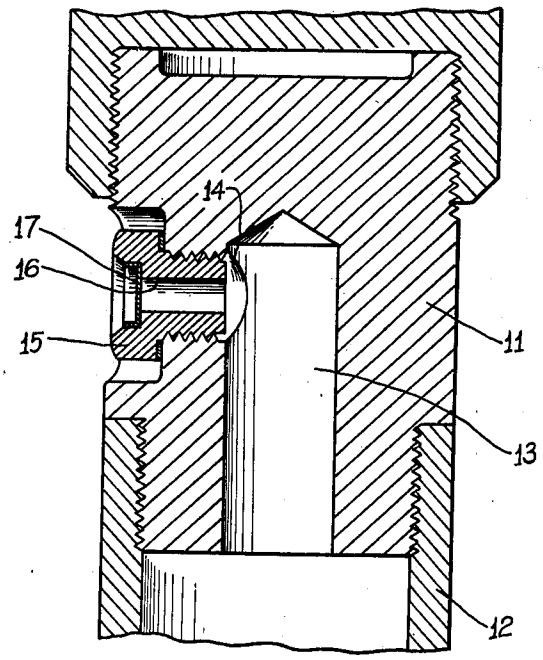


FIG. 2

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MEANS AND METHOD OF SAMPLING WELL FLUID

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8 Claims. (Cl. 166—1)

My invention relates to means and method of sampling well fluid, and among the objects of my invention are:

First, to provide a means and method of this character which is adapted to function in conjunction with a gun perforator in order to trap samples of well fluid that may enter through perforations made by the gun perforator through a surrounding casing into the formation;

Second, to provide a means and method of sampling well fluid which does not materially interfere with the operation of a gun perforator with which it is associated and which may be adapted for use with any type of gun perforator;

Third, to provide a means and method of this character which is particularly useful in the perforating of old wells in which the fluid level is low, particularly when exploring upper sections of the well for possible producing zones which were sealed off during the initial construction of the well; and

Fourth, to provide a sampling means for use with gun perforators which is particularly simple and economical of manufacture, and of operation, and which is particularly sturdy and rugged of construction to meet the extreme conditions of its use.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is an elevational view of a gun perforator with my sampling means shown in association therewith; and

Figure 2 is an enlarged fragmentary sectional view thereof, through 2—2 of Figure 1.

A gun perforator with which my sampling means is particularly adapted for cooperation comprises an elongated gun body 1 having a plurality of laterally directed gun bores 2 adapted to fire projectiles 3 through a surrounding casing 4. The gun body 1 may include a suitable controller housing in which is provided a controller whereby these several gun units may be connected in sequence with a source of electrical energy. Such electrical energy is applied by a cable 6 which is attached to the gun perforator through a cable head 7.

The lower end of the gun body 1 is threaded to receive a block member 11 which is likewise threaded at its lower end to receive a shell 12 which is closed at its lower end to form a sample-receiving chamber. The block 11 is provided with a central bore 13 extending part way upwardly from its lower end, which is intersected by a lateral opening 14. The opening 14 is threaded to receive a plug member 15 having a passage 16 therethrough. At the outer end of the passage 16 there is provided a shoulder adapted to receive a sealing disc 17 which initially seals the passage 16. The sealing disc 17 may have a peripheral skirt 18 adapted to be forced outwardly by hydrostatic pressure to effectively seal the passage 16.

My method of sampling well fluid is as follows: The gun perforator is lowered without the sampling device and a series of perforations made in the casing. The gun perforator is then withdrawn, the sampling device attached, the gun reloaded and returned to the well until the sampling device is approximately opposite the perforations previously made. The gun is then again discharged.

The sealing disc 17 is made strong enough to resist the hydrostatic pressure of the well fluid, but gives way to the concussive pressures generated upon discharge of the gun; such pressures may exceed the normal hydrostatic pressure as much as four times, so that there is ample differential pressure to insure sealing of the sample chamber formed within the shell 12 until discharge of the gun.

The interior of the sample chamber is, of course, initially at atmospheric pressure. Consequently, when the disc 17 ruptures, fluid surrounding the gun is drawn into the sample chamber. Inasmuch as the sample chamber is opposite the perforations previously made, most of the fluid so entrapped in the chamber will be fluid which entered the well through the perforations.

It is not in all cases necessary to make an independent run of the gun perforator. The percussive pressures generated by discharge of each gun unit are greatest in the vicinity of the gun unit and diminish rapidly as the distance from the gun unit is increased. Consequently, by firing the uppermost gun unit first and at the same time raising the gun perforator, several shots may be fired before the disc 17 ruptures, that is, the gun unit closest to the sample chamber will exert the necessary pressure to rupture the disc, whereas the more remote gun unit will fail to accomplish this.

It is, of course, contemplated that the seal disc may be made of a variety of materials. For example, it may be a relatively thin sheet metal stamping and reliance made on the shear strength of the material. Glass or other frangible material having a low resistance to shock may be employed.

The disc may be set directly into the block 11 and the plug 15 omitted; however, it should be borne in mind that the velocity of the incoming fluid is relatively high and that the walls of the passage 16 will tend to erode away so that a replaceable member is preferred. Because of the relatively small size of the passage 16 and its location at the top of the sample chamber, no provision need be made to seal the sample chamber during removal of the gun, for the reason that little or no contamination will occur.

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. The combination with a gun perforator, of a fluid sampler including an initially sealed fluid sample chamber, and means responsive to concussive pressures generated upon discharge of said gun perforator for opening said sample chamber to well fluids in which the gun perforator and sampling device may be immersed.

2. In a means for sampling fluids: a gun perforator adapted to direct bullets through a surrounding well casing into formation whereby fluids from the formation may enter the casing; a sampling device associated with said gun perforator and having a sample chamber and means responsive to discharge of the gun perforator for opening said sample chamber to fluids that may enter said perforations.

3. In a fluid sampling means for wells: a sampling device having a sample receiving chamber therein and a port for receiving a sample of fluid in which the sampling device may be immersed; a rupturable sealing means for said port adapted to withstand the normal hydrostatic pressure of the fluid in which the sampling device is immersed; and a gun perforator in close association with said rupturable means adapted, upon discharge, to create surge pressure sufficient to break said rupturable means.

4. In a fluid sampling means for wells: a sampling device having a sample-receiving chamber therein and a port for receiving a sample of fluid in which the sampling device may be immersed; a rupturable sealing means for said port adapted to withstand the normal hydrostatic pressure of the fluid in which the sampling device is immersed; and means for creating a surge pressure capable of rupturing said rupturable means.

5. A fluid sampling device for wells, including: means defining a sampling chamber; a port communicating with said chamber and rupturable sealing means initially closing said port whereby, when lowered in well fluid, substantially atmospheric pressure is maintained in said chamber, said rupturable means adapted to withstand the hydrostatic head of fluid contained within said well; and explosive means for generating a surge pressure in the fluid of said well capable of rupturing said rupturable means for establishing a communication between said sampling chamber and said well.

6. In a sampling device: a gun perforator including a plurality of gun units and means for firing said gun units in sequence; a sampling device having a sample-receiving chamber and an intake port communicating between said chamber and the surrounding well bore, and rupturable sealing means initially closing said port, said sealing means capable of withstanding the hydrostatic pressure of the fluid in said well and the percussive pressures generated by discharge of the gun unit in more remote relation with the sampling device, but adapted to give way to the percussive pressures generated upon discharge of a gun unit in proximity to said sampling device, whereby at least several of the gun units may be discharged before rupturing said sealing means and opening of said sampling device to the well fluids.

7. A method of sampling well fluids for determining the character of fluid entering a well through gun perforations, characterized by: perforating a zone of the well to be investigated; lowering a sampling device into said zone while initially sealed from communication with the well fluid; and creating a surge pressure to establish communication between said sampling device and the well fluid, whereby fluid entering said perforated zone may enter said sampling device.

8. A method of determining the character of connate fluid sealed off by a well casing, characterized by: perforating said casing opposite a zone to be investigated; and utilizing the surge pressures incidental to gun perforating said casing, to establish communication with a sampling device in association with said gun perforator.

KEITH H. MINER.