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GUN TYPE WELL CASING PERFORATOR

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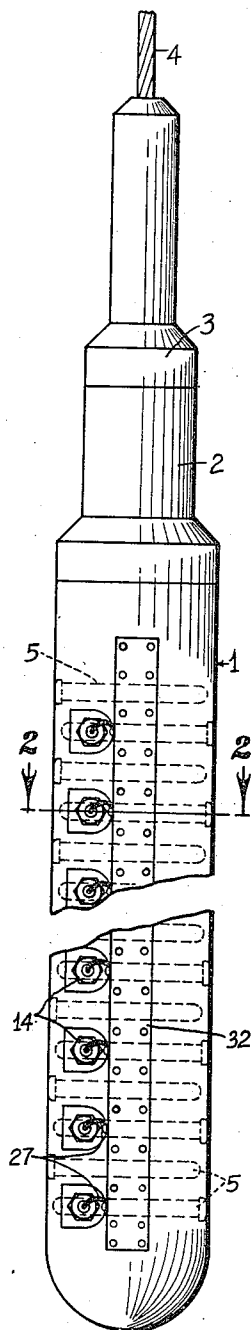


FIG. 1

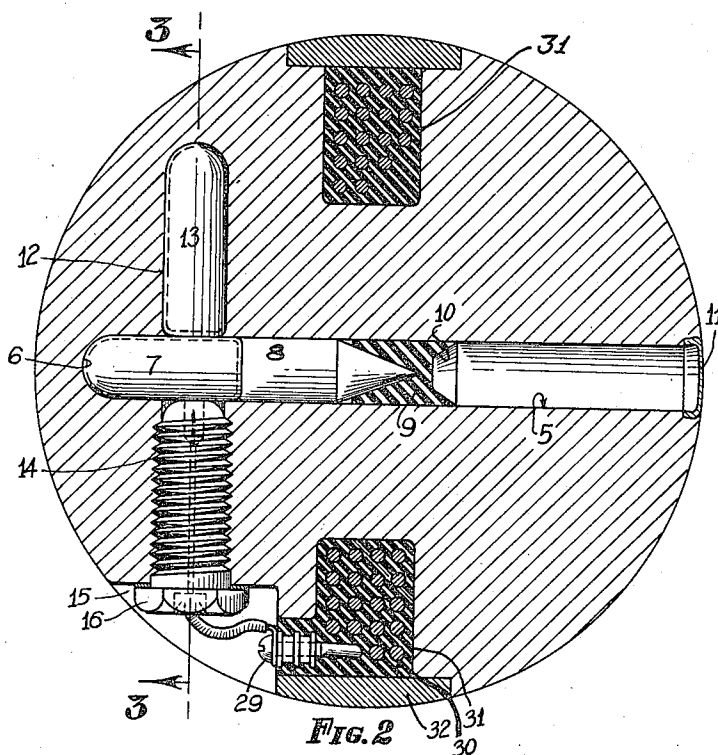


FIG. 2

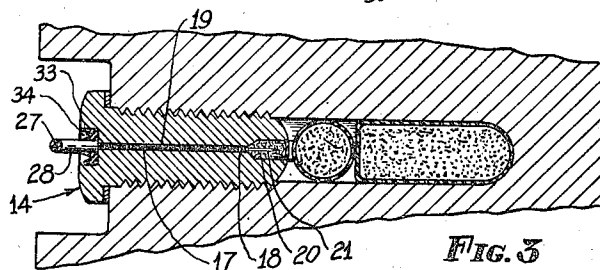


FIG. 3

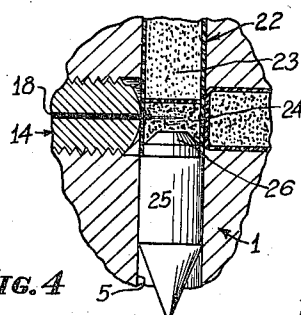


FIG. 4

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GUN TYPE WELL CASING PERFORATOR

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poration of Delaware

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10 Claims. (Cl. 164—0.5)

My invention relates to gun type well casing perforators, that is, to devices which are adapted to be lowered into well casing and fire bullets through the casing into the surrounding formation for the purpose of establishing passages in order that connate fluid may flow into the casing. Among the objects of my invention are:

First, to provide a gun type perforator which incorporates a relatively large number of gun units within a body of nominal axial dimension;

Second, to provide a well casing perforator wherein the gun bore and powder chamber are formed integrally within the body of the gun itself, eliminating the need of removable gun barrels;

Third, to provide a gun type well casing perforator in which each gun unit is provided with a supplementary cartridge chamber extending laterally from the main cartridge chamber in such a manner that the axial spacing of one gun unit from the other by reason of the supplementary cartridge chamber is in no manner affected, thus permitting the application of a larger amount of explosive than would otherwise be possible with a given spacing between the gun units;

Fourth, to provide a well casing perforator wherein the gun bore and main cartridge chamber are coaxial and of equal diameter, and the auxiliary or supplementary cartridge chamber is likewise of the same diameter so that cartridges may be used interchangeably in the main cartridge chamber or supplementary cartridge chamber;

Fifth, to provide a gun perforator which incorporates a novel electrically responsive ignition means which eliminates both percussion caps and fuse wires, the ignition means being capable of use either as an independent cartridge or incorporated in one of the firing cartridges of the gun; and

Sixth, to provide, on the whole, a novelly constructed gun type well casing perforator which is particularly simple and economical of manufacture, easily and quickly serviced, and particularly rugged and sturdy of construction, to withstand the extreme use to which devices of this character are necessarily subjected.

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

Figure 1 is a fragmentary elevational view of a gun type well casing perforator embodying my invention;

Figure 2 is a typical transverse sectional view

through one of the gun units, taken through 2—2 of Figure 1;

Figure 3 is a fragmentary sectional view taken through 3—3 of Figure 2, illustrating particularly the ignition means; and

Figure 4 is a fragmentary sectional view similar to Figure 2, showing a modified construction of ignition means.

My gun perforator consists essentially of a gun body 1 which is connected at its upper end to a controller case 2 in which is mounted a suitable controller or sequencing switch, not shown inasmuch as this type of device is well known in the art. The controller case is, in turn, connected to a cable head 3 secured to the lower end of a cable 4 having a conductor core for supplying electrical energy to the controller contained within the case 2.

The gun body 1 is provided with a plurality of laterally directed bores 5 arranged in two sets pointing in opposite directions. The members of the two sets are arranged in alternation. The inner or closed end of each bore 5 is rounded, as indicated by 6, and need terminate only a short distance from the surface of the body, so that each gun bore extends almost the diameter of the body.

Each gun bore 5 receives at its inner end an explosive cartridge 7 and outwardly therefrom a bullet 8 which may be held in place by a plug 9 of rubber or other soft material. The outer end of the plug 9 is preferably provided with a lip 10 so that the plug tends to seal against the walls of the gun bore 5, should fluid enter from the outer end thereof. The outer end of each bore 5 is, however, closed by a sealing cap 11, which may have an inwardly directed skirt which fits into a rudimentary counterbore formed in the outer end of the bore 5. The sealing disc 11 is slightly dome-shaped so that external pressure tends to increase its sealing contact.

Opposite the cartridge 7 the body member 1 is provided with a transverse bore 12 which intersects the gun bore 5 and continues beyond the gun bore to form a chamber which receives an explosive cartridge 13. The outer portion of the transverse bore 12, that is, the portion on the opposite side from the cartridge 13 is screw-threaded to receive an ignition plug 14. The outer end of the transverse bore 12 intersects a recess 15 which accommodates the head 16 of the plug 14.

The plug 14 is provided with a bore 17 of extremely small diameter, which receives a needle conductor 18 covered with insulation 19. The

inner end of the plug 14 is provided with a small counterbore 20, into which the uninsulated inner end of the needle conductor 18 extends. The counterbore 20 receives an ignition cartridge 21.

5 The ignition cartridge 21 comprises a mixture of inflammable substance and metallic particles; for example photographic flash powder and brass grindings. This mixture, when supplied with electric current through the needle conductor 10 18, forms a conductive path between the needle conductor and the ground formed by the walls of the counterbore. If sufficient current or voltage is employed, the mixture is either heated by reason of its resistance or sparking occurs by reason of the superficial spacing of the metallic particles, to ignite the ignition cartridge. When ignited, sufficient heat is generated to burn through the thin shell which encompasses the explosive of the cartridge 7. This shell need only be wax 15 paper or, if desired, thin Celluloid or analogous inflammable substance may be used.

It is not necessary, however, that the ignition cartridge be within the counterbore 20, but instead a special cartridge 22 may be employed in 25 place of the explosive cartridge 21. Such special cartridge is shown in Figure 4 and comprises an explosive charge 23 filling the major portion of the cartridge, and an ignition charge 24 filling the outer end of said cartridge, so that the needle conductor 18 may be thrust into the ignition 30 charge 24. In order to form a ground return, a special bullet 25 may be employed, the inner end of which is shaped to fit within and constitute the cover of the cartridge 22, as indicated by 26. Thus the ground connection is through the bullet to the gun body 1.

Electrical energy may be supplied in any suitable manner to the needle conductor 18; for example, the outer end of the needle conductor 18 10 may join to a lead wire 27, preferably covered with insulation 28. The lead wire 27 connects to a terminal 29 provided on a special multiple conductor cable 30. The multiple conductor cable 30 may fit within a channel 31 provided along the 15 side of the body 1, which channel may be protected by a cover plate 32. Lateral recesses between the channel 31 and the recess 15 accommodate the terminals 29 for the several gun units. By reason of the fact that the gun units are arranged in oppositely directed sets, two such channels 31 may be provided at diametrically opposite 20 sides of the gun body. In order to prevent fluid leakage into the bore 17 of the ignition plug 14, the outer end of the ignition plug may have a counterbore 33 adapted to receive a sealing washer 34.

The upper ends of the multiple conductor cables 30 are suitably connected to the controller or sequencing switch contained within the housing 2. This switch, which, for the purposes of 0 this invention, is conventional, and which is fully disclosed in the prior art, is designed to connect the several gun units in sequence, either automatically or by reason of making and breaking the circuit through the conductor of the cable 4.

It will be noted that by reason of the auxiliary or supplementary cartridge 13, more than twice the amount of powder may be provided behind the bullet 8 than is otherwise possible without decreasing the effective barrel length of the gun 5 bore 5.

Furthermore, provision of the auxiliary powder charge in no manner affects the spacing between the gun units; in fact, a gun spacing as short as one inch from center to center is possi-

ble, so that a large number of gun units may be provided. This fact assumes primary importance when it is realized that it is customary to fire several hundred bullets through well casing in order to open the well casing to the formation, and 5 more perforations would be used if the cost, particularly in rig-time, that is, the time required for the service company to perform the perforating job, could be reduced.

Such rig-time is largely due to the fact that 10 with the present gun design only a comparatively few shots may be fired with each round trip; for instance, ten to fifteen shots per gun has heretofore been the optimum limit by reason of the fact that the weight which may be suspended 15 from the conductor cable is limited, and the length of the gun must be maintained within a prescribed length in order that it will pass around bends that may exist in the well casing. By reason of the very close spacing made possible with 20 my gun perforator herein disclosed, from three to four times as many gun units may be provided per foot of gun perforator than is possible with conventional gun perforators. It, therefore, follows that from three to four times as many gun 25 units may be provided in a gun of given length and weight, so that the number of round trips required is reduced to one-third or one-fourth.

By reason of the provision of the auxiliary cartridge 13, no appreciable sacrifice in the quantity 30 of powder placed behind the bullet is necessary in order to accomplish the close spacing of the gun units. For example, as much as 140 grains of powder may be packed in a gun approximating the size illustrated in Figure 2. This is approximately equal to the present-day standard load of a conventional gun unit of like diameter. Furthermore, this is accomplished without sacrifice 35 in effective barrel length; in fact, the barrel length is actually increased in comparison with the barrel length of conventional gun perforators. 40

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 45 the prior art permits.

I claim:

1. In a gun type well casing perforator: a gun body having a gun bore and a cartridge bore traversing said gun bore; a bullet for said gun 50 bore; an explosive cartridge for said cartridge bore; and means for igniting said cartridge said bores defining a plane passing laterally through said gun body.

2. In a gun type well casing perforator: a gun 55 body having a coaxial gun bore and cartridge chamber, and a supplementary cartridge chamber intersecting the first cartridge chamber; an explosive cartridge for each of said chambers; a bullet for said gun bore; and means for igniting 60 said cartridges said bore and its cartridge chambers defining a plane passing laterally through said gun body.

3. In a gun type well casing perforator: a gun 65 body having a pair of blind-ended bores crossing each other; explosive cartridges in the inner ends of said bores; a bullet in one of said bores; a sealing plug closing the other of said bores; and means for igniting said cartridges. 70

4. In a gun type well casing perforator: a gun body having a coaxial gun barrel and cartridge chamber of substantially equal diameter; a supplementary chamber extending laterally from 75 said first chamber; an explosive filling said cham-

bers; a bullet fitting said gun barrel; and means for igniting said explosive.

10 5. In a gun type well casing perforator: a gun body having a plurality of laterally directed gun bores arranged in sets pointing in diametrically opposite directions; a cartridge bore crossing each gun bore near its inner end; an explosive in each of the inner ends of said gun bores and cartridge bores; bullets for said gun bores; explosive re-

sisting plugs for said cartridge bores; and means for igniting said explosive said bores defining parallel planes crossing the axis of said gun body.

6. A gun type well casing perforator, as set forth in claim 1, wherein said ignition means comprises: a mixture of an explosive and metallic particles, and means for conducting electrical energy to said mixture.

7. A gun type well casing perforator, as set forth in claim 3, wherein said ignition means comprises: a mixture of an explosive and metallic particles in close association with said car-

tridges; an insulated conductor extending through said sealing plug and electrically contacting said mixture; and means for supplying electrical energy to said conductor.

8. In a gun type well casing perforator: a gun 5 body having a plurality of laterally directed gun units, each unit including a gun bore and a cross bore intersecting and continuing laterally beyond the inner portion of said gun bore; a cartridge 10 for the inner end of said crossbore; an explosive- resisting plug for the outer end of said crossbore; and a bullet for said gun bore.

9. A gun type well casing perforator, as set forth in claim 8, which incorporates an electrical 15 ignition means extending through said explosive- resisting plug.

10. A gun type well casing perforator, as set forth in claim 8, wherein the bores of said gun units define parallel planes which pass through 20 the axis of said gun body.

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