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PERFORATING AND STRATA FRACTURING DEVICE

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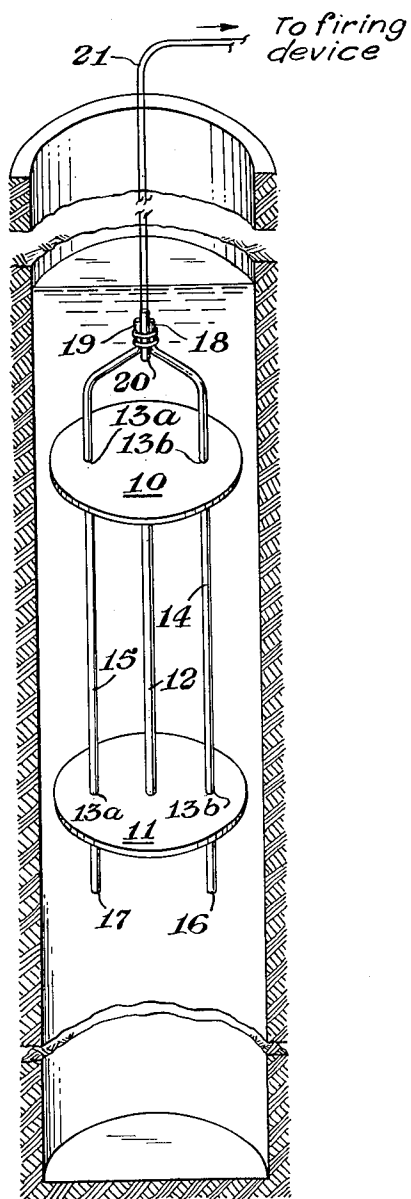


Fig. 1

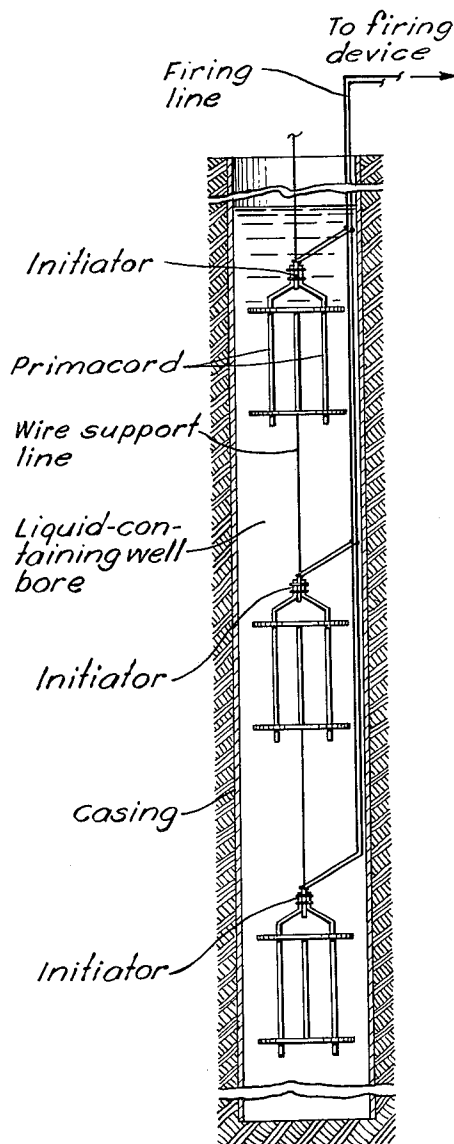


Fig. 2

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1

3,118,374 PERFORATING AND STRATA FRACTURING DEVICE

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This invention relates to a perforating device and more particularly is concerned with an explodable assembly for perforating well casings and fracturing rock strata.

In general, the present invention comprises a non-enclosed holder and two or more strands of spaced apart high order-high velocity detonating fuse, e.g., Primacord, mounted in substantially parallel relationship therein, which assembly is submerged in a fluid containing cased or uncased bore hole.

This invention distinguishes over conventional perforators and is an improvement over these in that no shaped charges, bullet guns or other projectile hurling perforating guns are employed in the instant new and novel apparatus.

The present invention will be further illustrated by the drawing and described fully hereinafter.

In the drawing:

FIGURE 1 represents one embodiment of the perforating device of the instant invention.

FIGURE 2 illustrates a plurality of the instant perforators arranged in spaced apart relationship in a bore hole.

The embodiment as shown in FIGURE 1 comprises a circular-flat disc top holder member 10 and an identical bottom holder member 11 separated and connected by a rigid supporting member 12. Each of said members 10 and 11 contains at least two spaced apart openings 13a-13b. When the top and bottom holder members 10 and 11 are positioned in spaced apart vertical alignment having their flat sides in parallel horizontal relationship, the openings 13a and 13b in each plate are in direct axial alignment.

Matching strands of high velocity-high explosive detonating fuse, e.g. Primacord, 14 and 15 are passed through the aligned openings in the two plates and are thereby maintained in parallel relationship. Ordinarily, the bottom ends 16 and 17 respectively extend below plate 11. The openings 13a-13b in the plates 10-11 are formed to a predetermined size so as to snugly accommodate a given size of fuse.

The top ends 18 and 19 of the strands 14 and 15 are joined to a common initiator 20, e.g. an electric blasting cap, which in turn is connected to a firing line 21 and conventional cap initiator (not shown).

The assembly is positioned in a well bore at the region to be perforated or fractured and below the surface of a liquid column contained in this bore. The assembly is lowered into the well by conventional means, such as a calibrated wire line or the firing line itself in such a manner that the fuse strands are parallel to the major axis of the cylindrical bore hole and are spaced apart a distance equal to at least about 1/2 of the diameter of the well bore.

The top and bottom holding members for positioning the fuse ordinarily will be circular in shape although they can be of any plate-like configuration of other means which will hold the strands apart in the required parallel relationship. The sole limitation is that the maximum diameter of the holder be such that the assembly will readily slide into a given well bore. For example, square sheets of wood or liquid impervious cardboard, rectangular flat metal discs, a wire positioning device, metal clips etc. are only a few of the many devices that can be used

2

for holding the fuse strands in the predetermined spatial relationship as will be apparent to one skilled in the art.

The size of the high velocity-high power detonating fuse strands employed will be equivalent in strength, i.e. explosive power, to at least 100 grains per foot Primacord and preferably for larger well bores will be equivalent to from about 200 to about 400 grains per foot Primacord or more.

Ordinarily two strands will be used although for certain applications up to four strands or more will be employed. Preferably the strands of explosive are to be spaced apart so as to be at a distance equal to from about 1/2 to about 3/4 of the cylindrical well bore diameter and will be substantially parallel to the center axis of the well bore. For example, with two strands these can be placed in a straight line relationship on opposite sides of the center of the circular well bore. The length of detonating fuse used for perforating or fracturing a predetermined vertical amount of casing or strata will be determined by the length of hole to be treated with a given unit. Preferably, a multiplicity of short units, i.e. each ranging from about 6 inches to about 24 inches in length will be used to achieve a number of perforations over an expanse of well bore rather than one long assembly to give a continuous perforation.

The assembly must be operated in a section of a well bore that is filled with a liquid. This liquid can be oil, water, brine or other fluids normally present in the well or fluids which have been added to the well to bring the liquid up to the level to be treated. For treatment of dry wells, i.e. those having no liquid standing in the bore, or those wherein the section to be treated is above the liquid level, liquid can be added or the section of the well bore to be perforated can be sealed off, by use of a packer for example, and liquid then introduced into the sealed off section for the treatment.

The effectiveness of the perforator of the present invention is shown by the following example.

Two 100 grains per foot strands of Primacord were mounted in parallel relationship and spaced about 1 inch apart utilizing thin circular wooden top and bottom holder members to give an assembly shown in FIGURE 1. The circular member had a diameter of about 1 1/4 inch. The tops of the strands were connected, by taping, to a single No. 8 electric blasting cap. The assembly was positioned inside a 2 inch diameter steel seamless pipe about 18 inches long having a wall thickness of about 3/16 inch. The length of the Primacord assembly extended along the entire length of the pipe.

The pipe with Primacord assembly contained therein was placed on end and entirely submerged in a tank of water. The lead wires from the blasting cap were fastened to a firing line from a capacitor type blasting cap initiator and the Primacord detonated. The pipe was split into two equal pieces, the split running the length of the pipe and occurring at substantially the center of the wall as established by a plane perpendicular to the plane defined by the parallel strands of Primacord.

In a second run, the length of the Primacord assembly was shortened so as to cover only about the middle half of the pipe and positioned about equidistant from the top and bottom of the pipe. In this test, two perforations were formed through the pipe wall at about 90° to the plane defined by the Primacord strand. This split extended approximately along the middle section of the pipe for a distance equal to about the length of the original Primacord assembly.

Various modifications can be made in the present invention without departing from the spirit or scope thereof for it is understood that I limit myself only as defined in the appended claims.

I claim:

1. A perforating apparatus for use in a liquid containing well bore which comprises; a holder for high explosive-high velocity detonating fuse, said holder consisting of a flat disc top member and a flat disc bottom member in horizontal, parallel relationship, a vertical rigid supporting member separating and connecting said top and bottom members, two substantially identical strands of high explosive-high velocity fuse positioned in spaced apart parallel relationship and passed through aligned openings in said bottom and top holder members, said strands snugly held by said openings of said members, each of said fuses having an explosive power equivalent at least to that of 100 grains per foot Primacord, the top of said strands connected to a common initiator, said strands being substantially parallel to said rigid vertical supporting member of said holder and said strands being spaced

apart at a distance of from about $\frac{1}{2}$ to about $\frac{7}{8}$ of the diameter of said well bore, the overall length of said apparatus being from about 6 to about 24 inches, and, a line attached to said apparatus whereby said apparatus is lowered into said well bore.

2. The perforator as defined in claim 1 wherein the explosive fuse is Primacord, said Primacord ranging from about 100 to about 400 grains per foot.

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