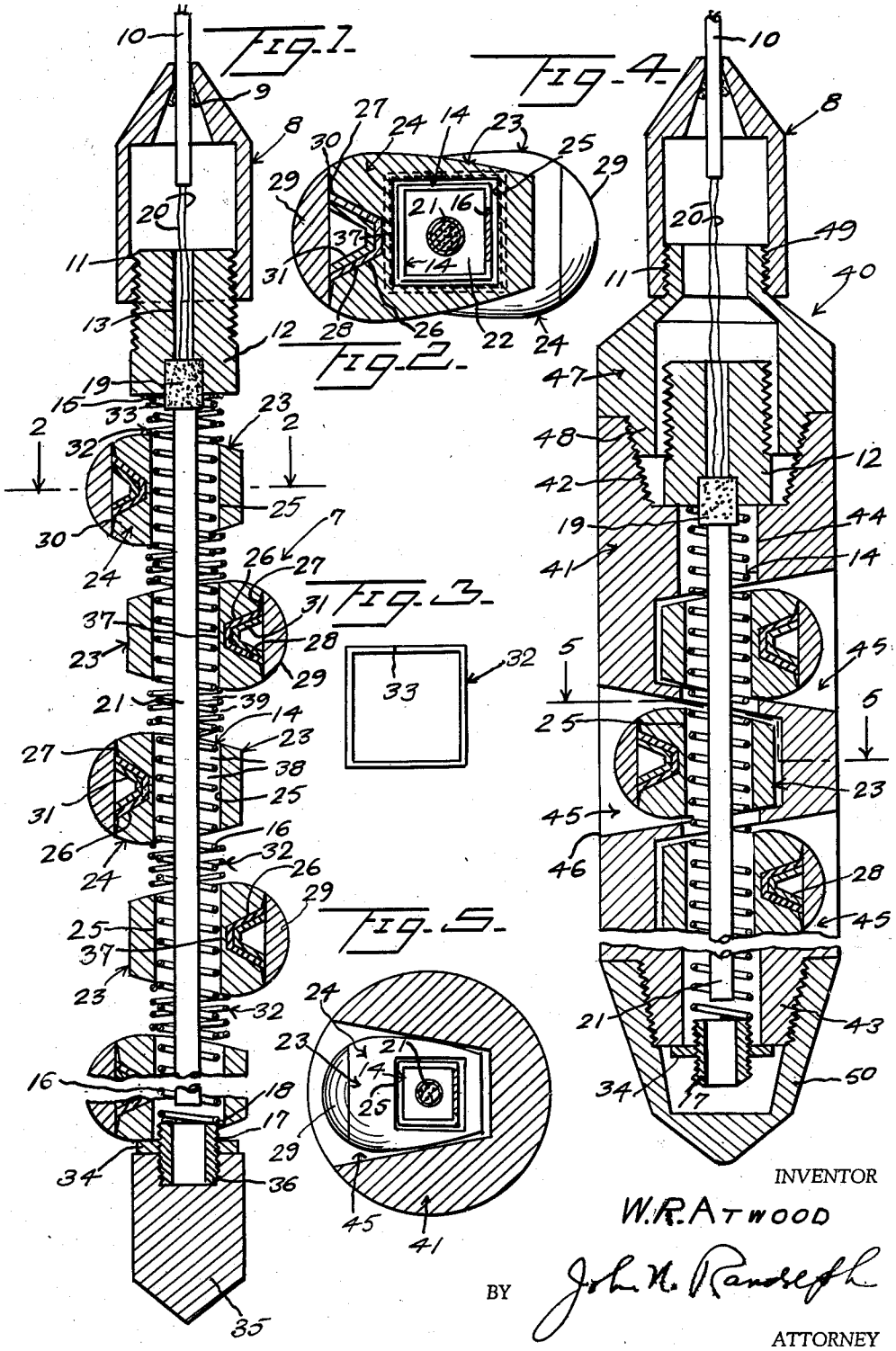
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WELL CONDUCTOR PERFORATOR AND CONTAINER ASSEMBLY

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WELL CONDUCTOR PERFORATOR AND CONTAINER ASSEMBLY

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This invention relates to a novel assembly for perforating well casings, well bores and formations, and has for its primary object to provide such an assembly which can be very economically manufactured and which may be effectively utilized in various lengths and for simultaneously perforating in a plurality of directions.

Another object of the invention is to provide a well perforator which may be assembled at the well by persons not possessed of special skills in the utilization of explosives.

A further object of the invention is to provide a well perforator which may be assembled in various lengths so that under certain circumstances a complete strata or formation may be perforated simultaneously.

Still a further object of the invention is to provide a well perforator including an elongated supporting member for supporting a plurality of explosive charge containing bodies and which itself constitutes a housing for an explosive utilized to detonate the explosive charges contained in said bodies.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawing, illustrating presently preferred embodiments thereof, and wherein:

FIGURE 1 is a fragmentary longitudinal substantially central sectional view of one embodiment of the well perforator;

FIGURE 2 is an enlarged cross sectional view through the well perforator, taken substantially along a plane as indicated by the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged end elevational view of one part of the assembly as shown in FIGURE 1;

FIGURE 4 is a fragmentary longitudinal sectional view of another embodiment of the well perforator, and

FIGURE 5 is a cross sectional view thereof taken substantially along the line 5—5 of FIGURE 4.

Referring more specifically to the drawing and first with reference to FIGURES 1, 2 and 3, the well conductor perforator and container assembly as illustrated in these views and designated generally 7 includes a rope or cable socket 8 having a restricted hollow upper portion 9 in which is received and secured the lower end of a conductor cable 10. The socket 8 has an internally threaded lower end 11 to threadedly receive the upper end of an extremely threaded nipple 12 having a bore 13 which extends longitudinally therethrough.

An elongated supporting member 14 depends from the nipple 12 and includes an upper end which is secured in any suitable manner as by brazing, welding or soldering, as seen at 15, to the lower end of the nipple 12 around its bore 13. The supporting member 14, as illustrated, is formed from a strand of coiled wire 16 and said supporting member is of noncircular cross section, being shown as square in FIGURE 2. The wire strand 16 may be of various gauges and may be hardened in any suitable manner so that said supporting or retaining member may be either substantially rigid or relatively flexible. The supporting or retaining member 14 may be made in various lengths and has an externally threaded tubular nipple 17 constituting the lower end thereof and which is secured by brazing, soldering or welding, as seen at 18, to the lower end of the wire strand 16.

A conventional electrical detonator 19 is secured in the

lower end of the bore 13. Electrical conductor wires 20, which extend through the cable 10, project from the lower end thereof through the socket 8 and into the bore 13 and are electrically connected to the detonator 19. As illustrated in the drawing, a length of conventional Primacord 21 extends longitudinally through the bore 22 of the supporting or retaining member 14 and has its upper end connected to the detonator 19, by which said Primacord is supported.

A plurality of well perforating units, each designated generally 23, are supported on the supporting member 14 in spaced apart relation relative to one another. Each unit 23 includes a frangible body 24 having a bore 25 which extends transversely therethrough and which is of the same cross sectional shape but slightly larger than the supporting or retaining member 14. The frangible body 24 has a cavity 26 which is disposed lengthwise thereof and which is flared toward an open end 27 of said body and in a direction away from the transverse bore 25. The cavity 26 contains a shaped charge 28 of an explosive material. A nose or cap 29, and which is likewise formed of a frangible material, is secured in any suitable manner to the open end 27 as by brazing or cementing, as seen at 30, in FIGURE 2, to seal the chamber 26 containing the explosive charge. If the explosive charge 28 is not preformed, a hollow frusto-conical sleeve 31 may be contained in said chamber 26 to maintain the explosive charge 28 properly shaped, and wax paper, not shown, may line the chamber 26 and cover the exterior of the sleeve 31 to prevent adherence of the explosive 28 to said sleeve and the body 24. The inner end of the cavity 26 is disposed in close proximity to the bore 25, as seen in FIGURES 1 and 2.

The perforator units 23 are slidably and nonrotatively mounted on the supporting member 14 and may be disposed in any one of four positions relative thereto. As seen in FIGURE 2, two of the perforating units 23 are shown facing in opposite directions, and it will be apparent that other of said units could be mounted crosswise of the positions of the units as seen in FIGURE 2 and also facing in opposite directions.

Spacing members 32 are disposed on the supporting member 14 between the units 23 for spacing said units different distances apart, as desired. The spacing members or sleeves 32 are each of the same cross sectional shape as the supporting or retaining member 14 and are each larger than said supporting member and larger than the bores 25. The spacing members 32 are likewise preferably formed each of a coiled strand of wire 33 the convolutions of which are at least spaced slightly from one another. By making the spacing members 32 of varying lengths, the perforator units 23 may be spaced at desired distances apart along the depending supporting member 14.

A conventional locknut 34 engages the bottom nipple 17 for supporting the perforating units 23 and spacing elements 32 on the supporting member 14. A weighted body 35 has an upwardly opening threaded socket 36 which detachably engages the nipple 17, below the locknut 34. Said weighted body 35 may be solid, as illustrated, or may constitute a hollow frangible casing filled with a nonmetallic weighted material.

From the foregoing it will be readily apparent that the assembly 7 may be lowered into a well casing or bore, not shown, by suitable equipment located above the surface of the ground and to a desired level. Firing of the detonator 19 is accomplished in a conventional manner from above ground level for detonating the Primacord 21. The exploding Primacord 21 fractures the thin walls 37 of the bodies 24 and which separate the cavities 26 from the bores 25, for practically simulta-

neously detonating the shaped charges 28 of all of the perforating units 23. The bodies 24 and noses or caps 29 are broken into small fragments by the exploding charges 28, which charges perforate the well casing or bore and the surrounding earth strata or formation.

The force of the exploding Primacord 21 escapes through the spaces 38 between the convolutions of the wire strand 16 for fracturing the walls 37, and also to assist in fracturing the bodies 24, and a part of the explosive force of the Primacord escapes through other of the spaces 38 and through the spaces 39 between the convolutions of the spacing elements 32 to prevent damage to the supporting or retaining member 14 and spacing elements 32, since all parts of the assembly 7, except the perforating units 23, the Primacord 21 and detonator 19, are intended to be removed from the well and re-used.

It will be understood that the supporting member 14 may assume numerous other forms so long as it has an exterior surface of noncircular cross section for mounting a plurality of perforating units 23 at vertically spaced intervals thereon and with the longitudinal axes of said units 23 capable of being disposed in different directions. The supporting member 14 may contain an explosive filled bore in lieu of the Primacord 21 and with said member 14 having various forms of outlets for the escape of the force from its explosive core to effect detonation of the shape charges 28.

The frangible noses or caps 29 are formed of a material capable of withstanding frictional contact resulting from the drag on the side of the well casing or bore in lowering the assembly 7. The complete assembly 7 may be dipped or otherwise coated with a plastic, shellac or similar compound as a sealant.

FIGURES 4 and 5 illustrate another embodiment of the assembly, designated generally 40, which includes all parts of the assembly 7 except the spacing elements 32, and which additionally includes one or more elongated bodies 41. The body 41 has an upwardly opening threaded socket 42 at its upper end and a downwardly extending threaded nipple 43 at its lower end. A bore 44 extends longitudinally through the center of the body 41 from the socket 42 through the nipple 43. The body 41 has transversely disposed cavities 45 each of which is perferably flared toward an open end 46 thereof and which open outwardly of the periphery of the body 41. The cavities 45 extend across and intersect with the bore 44 and are each adapted to accommodate a perforating unit 23. The cavities 45 are disposed in different directions relative to one another so that their open ends 46 are longitudinally and circumferentially spaced relative to one another. After the perforating units 23 have been assembled in the cavities 45 with their bores 25 in alignment with the bore 44, the retaining member 14 is passed downwardly through the bore 44 and through the bores 25. The locknut 34 is applied to the nipple 17 and bears against the lower end of the nipple 43. The lower end of the nipple 12 rests upon the bed of the socket 42 and the upper portion thereof is housed loosely in a hollow coupling member 7 which has an externally threaded nipple 48 at its lower end to threadedly engage in the socket 42, and an externally threaded nipple 49 at its upper end which engages the threaded portion 11 of the cable socket 8. A cap 50 may threadedly engage the nipple 43 for enclosing the nipple 17 and locknut 34. It will also be apparent that a number of the bodies 41 may be assembled together one above the other and the supporting or retaining member 14 may be of a length to extend through the several threadedly connected bodies 41. The body or bodies 41 are preferably formed of a material capable of withstanding the detonation of the Primacord 21 and the explosive charges 28. Since the perforating units 23 are confined against rotation relative to one another by the cavities 45, the member 14 when utilized with one or more of the housings or bodies 41 may be of circular cross section.

Various other modifications and changes are contemplated and may be resorted to, without departing from the function or scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. A well conductor perforator and container assembly comprising an elongated retaining member, means for suspending said retaining member from above, a plurality of perforating units each including a frangible body containing a shaped explosive charge, each of said bodies having a bore extending transversely therethrough and through which a part of the retaining member extends, means holding said perforating units in spaced apart relation to one another on the retaining member, means maintaining said perforating units angularly disposed relative to one another, an explosive core extending longitudinally of said retaining member through the bores of said frangible bodies, an electrical detonator supported by said first mentioned means for detonating the explosive core, and said retaining member having outlets for the escape of the force of the exploded core for fracturing said frangible bodies and detonating the shaped charges contained therein, said retaining member being formed of coiled wire and being of noncircular cross section, said bores being of a shape to nonrotatively engage the retaining member and combining therewith to constitute said means for maintaining the perforating units angularly disposed relative to one another.

2. A well conductor perforator and container assembly as in claim 1, said means for holding the perforating units in spaced apart relation to one another comprising sleeve-like spacing elements mounted on the retaining member between and bearing against adjacent perforating units.

3. A well conductor perforator and container assembly as in claim 2, each of said spacing elements being formed of coiled wire and being of noncircular shape in cross section, the spaces between the convolutions of the coils of the wire forming said retaining member constituting said outlets thereof.

4. A well conductor perforator and container assembly comprising an elongated retaining member, means for suspending said retaining member from above, a plurality of perforating units each including a frangible body containing a shaped explosive charge, each of said bodies having a bore extending transversely therethrough and through which a part of the retaining member extends, means holding said perforating units in spaced apart relation to one another on the retaining member, means maintaining said perforating units angularly disposed relative to one another, an explosive core extending longitudinally of said retaining member through the bores of said frangible bodies, an electrical detonator supported by said first mentioned means for detonating the explosive core, and said retaining member having outlets for the escape of the force of the exploded core for fracturing said frangible bodies and detonating the shaped charges contained therein, an elongated body having a bore extending longitudinally therethrough and including a plurality of cavities disposed transversely of said body, each of said cavities having an open outer end and being of a length to intersect said bore, said perforating units being received in said cavities with the bores thereof in alignment with the longitudinal bore of said body, said retaining member extending through said longitudinal bore and through each of the transverse bores for retaining the perforating units entirely within said body, said cavities being longitudinally spaced relative to one another and constituting the means for holding the perforating units in spaced apart relation to one another.

5. A well conductor perforator and container assembly comprising an elongated retaining member formed of coiled wire, said retaining member being of noncircular shape in cross section, a plurality of perforating units each including a frangible body containing an explosive

charge, each of said bodies having a bore extending transversely therethrough and through which a part of the retaining member extends, said bores being shaped to non-rotatively engage the retaining member, an explosive core extending longitudinally of said retaining member through the bores of said frangible bodies, and at least certain of the convolutions of the coiled wire defining spaces therebetween for the escape of the force of the explosive

core when detonated for fracturing said frangible bodies for detonating the explosive charges contained therein.

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