Dec. 16, 1941. A. J. ZSCHOKKE 2,266,352

GUN PERFORATOR

Filed Jan. 27, 1941

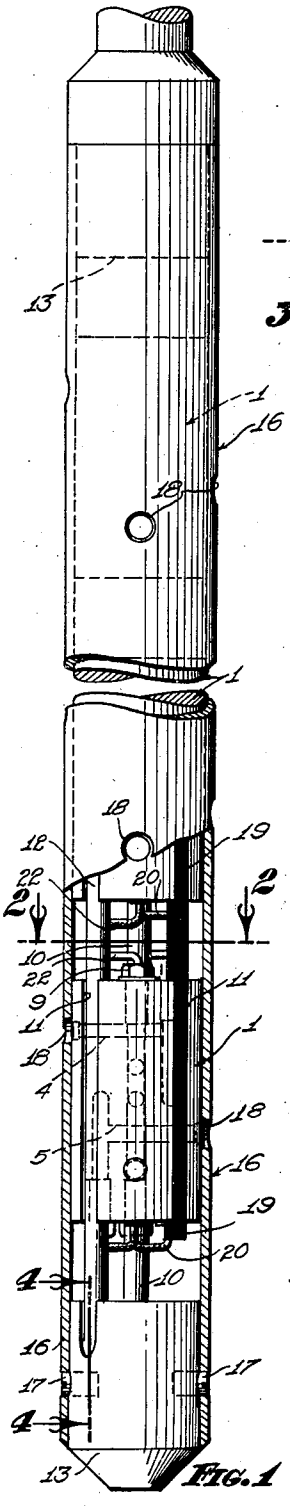


FIG. 1

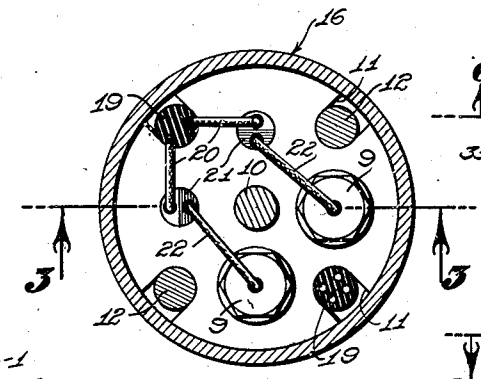


FIG. 2

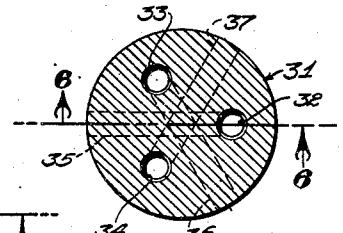


FIG. 5

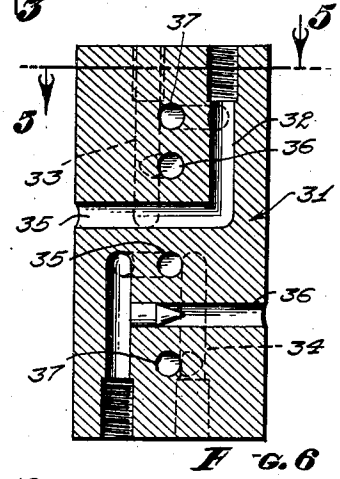


FIG. 6

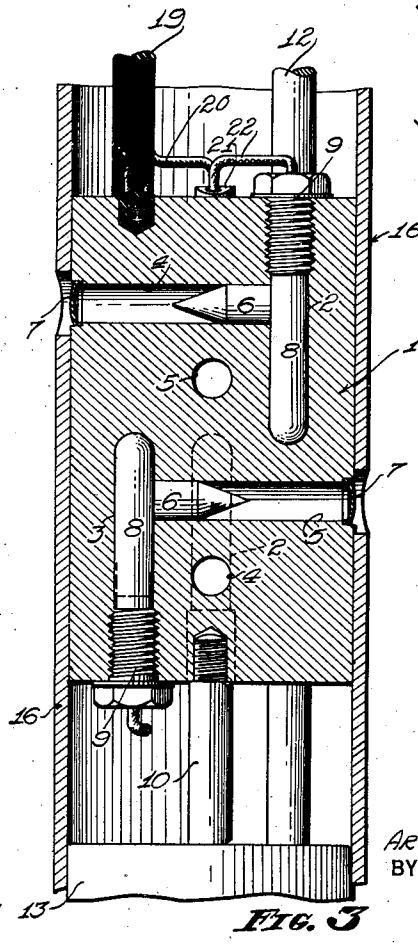


FIG. 3

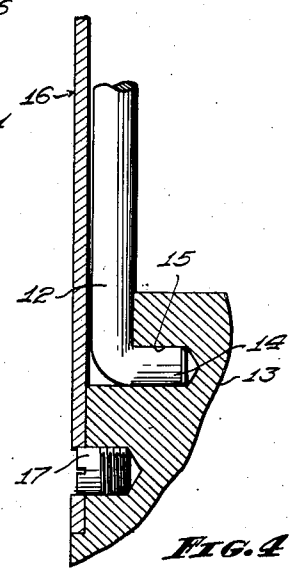


FIG. 4

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GUN PERFORATOR

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17 Claims. (Cl. 164—0.5)

My invention relates to gun perforators; that is, to devices adapted to be lowered into a well bore for perforating a well casing by gunfire, and among the objects of my invention are:

First, to provide a gun perforator in which a plurality of gun units are arranged in a particularly compact manner so that a large number of gun units may be provided in a gun perforator of a given length;

Second, to provide a gun perforator which, for a given diameter of gun, provides diametrically extending gun bores of maximum length;

Third, to provide a gun perforator which is divided into readily separable and replaceable sections, each carrying a plurality of gun units;

Fourth, to provide an electrically operated gun perforator in which the wiring is entirely shielded from the effect of fluid around the gun while the gun is being moved through well fluid or while the gun is being fired; and

Fifth, to provide a gun perforator section incorporating a plurality of gun units, all formed by simple boring and drilling operations, whereby the gun perforator section is comparatively economical of manufacture.

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

Figure 1 is a fragmentary elevational view of my gun perforator with a portion of the gun perforator case broken away and in section;

Figure 2 is an enlarged transverse sectional view through 2—2 of Figure 1 showing in elevation an end of one of the gun sections;

Figure 3 is a fragmentary longitudinal sectional view through 3—3 of Figure 2;

Figure 4 is a fragmentary sectional view substantially through 4—4 of Figure 1;

Figure 5 is a transverse sectional view of a modified form of a gun section through 5—5 of Figure 6; and

Figure 6 is a longitudinal sectional view thereof through 6—6 of Figure 5.

My gun perforator comprises a plurality of gun body blocks 1. Each block is in the form of a cylinder with flat ends, into which are bored cartridge sockets 2 and 3 which are parallel to, but offset from the axis of the gun body block; that is, in the construction shown in Figures 1, 2 and 3, two cartridge sockets are provided in each end of the gun body. The members of each pair of sockets are displaced 90° from each other with respect to the longitudinal axis of the gun body. Each pair of sockets 2 and 3 are intersected by gun bores 4 and 5, respectively, which extend diametrically therefrom and intersect the far side of the gun body block. The gun bores are thus arranged at right angles to each other, but are disposed in axially offset planes. The sockets 2 and 3 are located as near the periphery of the gun block as possible so that the gun bores may have maximum length. By offsetting the sockets in the lower end of the block 180° from those in the upper end of the block, the inner ends of the several sockets may terminate in a common transverse plane or axially overlap slightly as there is ample metal between them to resist the explosive forces. In the arrangement shown in Figures 1, 2 and 3, the four gun bores of each gun body block 1 point in four directions.

Each gun bore receives a bullet 6 and is closed at its outer end by a sealing cap 7. Each cartridge bore 2 receives a cartridge 8 and the outer end of each cartridge bore is screw-threaded to receive a sealing plug 9.

The gun body blocks are adapted to be stacked one on top of the other and are spaced from each other by spacer stems 10 which are centrally located. Each gun body block is provided with four equally spaced longitudinal channels 11 in its periphery. Two of these channels receive guide rods 12 which are long enough to accommodate all of the gun body blocks constituting the gun perforator and are adapted to be anchored into end blocks 13. This may be accomplished by providing inturned ends 14 at the extremities of the guide rods, which fit into radial sockets 15 provided in the end blocks, as shown best in Figure 4. The guide rods prevent relative rotation of the gun body blocks.

The upper end block is suitably attached to a cable. A suitable sequencing switch or controller may be incorporated for firing the gun units one at a time. The conductor cable and sequencing switch are old in the art and hence are not shown.

The several gun body blocks 1 are encased in a sleeve 16 which extends between the end blocks and may be secured thereto by screws 17. The sleeve is provided with ports 18 in registry with the muzzle ends of the several gun bores.

The remaining two channels 11 accommodate conductor cables 19 which extend from the cable head or controller downwardly past the several gun sections. Each conductor cable is provided with a plurality of leads 20 which fit into terminal blocks 21 set into the ends of the gun body block 1. Other leads 22 from the terminal block extend through the corresponding sealing plugs

9 for electrical connection with the cartridges 8. By reason of the sleeve 16 the conductor cables and leads are protected against the violent flow of liquid around the gun sections. It is not necessary to effect a sealing connection between the sleeve and gun sections as the electrical connections are covered with insulation material.

Sufficient space may be provided between the several gun sections so that not only may the sealing plugs 9 be removed without separating the gun sections, but also the cartridges 8 may be inserted. Thus it is possible to service the gun and reload the same by merely removing the sleeve 16. On the other hand, if it is desirable to separate the sections this may be readily done as both the conductor cables and guide rods may be readily removed.

It is possible to provide more than two gun units in each end of the gun body. For example, as shown in Figures 5 and 6, a gun body block 31 may be provided with three cartridge sockets 32, 33 and 34 in each end, which are connected respectively with gun bores 35, 36 and 37 arranged in 120° separated planes and offset axially. This can be done without materially increasing the length of the gun body over that shown particularly in Figure 3.

The gun perforator is fired in the usual manner; that is, it is lowered on a conductor cable and through the operation of a selector switch the several gun units are fired in sequence or, if desired, the gun may be so wired that a single unit from each of the gun sections may be fired simultaneously.

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 comprising: a gun body of cylindrical form and having in each end a plurality of axially extending sockets, and having in its side walls diametrically extending gun bores intersecting said sockets, there being one gun bore for each socket, said gun bores being located in different transverse planes; cartridges and sealing plugs for said sockets; and bullets for said gun bores, whereby each socket and its gun bore forms an independent gun unit.

2. A gun perforator comprising: a gun body in the form of a solid cylindrical block and having therein a plurality of diametrically extending gun bores, each intersecting one side of the gun body and its inner end terminating adjacent the opposite side of said gun body, said gun bores located in offset transverse planes and arcuately positioned with respect to each other so that the axis of each bore crosses its neighbor; said gun body also having in each end a plurality of sockets of similar depth, each intersecting an inner end of a gun bore; cartridges and sealing plugs for said sockets; and bullets for said gun bores.

3. A gun perforator comprising: a plurality of gun bodies, each gun body being in the form of a cylindrical block and having therein a plurality of diametrically extending gun bores each intersecting one side of the gun body and its inner end terminating adjacent the opposite side of said gun body, said gun bores located in offset transverse planes and arcuately positioned with respect to each other so that the axis of each bore crosses its neighbor; said gun body also having in each end a plurality of sockets of similar depth, each intersecting an inner end of a gun bore; cartridges and sealing plugs for said sockets; bullets for said gun bores; means for mounting said gun bodies end to end; and conductors extending longitudinally of said gun bodies, including lateral leads electrically connected with said cartridges.

4. A gun perforator, as set forth in claim 2, which comprises a plurality of said gun bodies disposed end to end; and a retaining sleeve fitting said gun bodies, said sleeve having ports in registry with the muzzle ends of said gun bores.

5. A gun perforator, as set forth in claim 1, which comprises: a plurality of said gun bodies arranged end to end; means spacing said gun bodies; and electrical conductors extending longitudinally of said gun bodies and electrically connected with said cartridges through said sealing plugs.

6. A gun perforator, as set forth in claim 1, which comprises: a plurality of said gun bodies arranged end to end; means spacing said gun bodies; electrical conductors extending longitudinally of said gun bodies and electrically connected with said cartridges through said sealing plugs; and a case fitting over said gun bodies and protecting said conductors.

7. A gun perforator, as set forth in claim 1, which comprises: a plurality of said gun bodies arranged end to end; means spacing said gun bodies; electrical conductors extending longitudinally of said gun bodies and electrically connected with said cartridges through said sealing plugs; retainer rods extending longitudinally of said gun bodies, there being grooves in said gun bodies to receive said rods; and end blocks for anchoring the extremities of said retainer rods.

8. A gun perforator, as set forth in claim 1, which comprises: a plurality of said gun bodies arranged end to end; means spacing said gun bodies; electrical conductors extending longitudinally of said gun bodies and electrically connected with said cartridges through said sealing plugs; retainer rods extending longitudinally of said gun bodies, there being grooves in said gun bodies to receive said rods; end blocks for anchoring the extremities of said retainer rods; and a case fitting over said gun bodies, said case having ports therein in registry with said gun bores.

9. A gun perforator comprising: a plurality of gun bodies arranged end to end, each gun body having diametrically extending gun bores intersecting its side walls and having at its ends cartridge sockets extending longitudinally into the gun body and intersecting said gun bores; and a case covering said gun bodies, said case having ports in registry with said gun bores.

10. A gun perforator comprising: a plurality of gun bodies arranged end to end, each gun body having diametrically extending gun bores intersecting its side walls and having at its ends cartridge sockets extending longitudinally into the gun body and intersecting said gun bores; a case covering said gun bodies, said case having ports in registry with said gun bores; bullets for said gun bores; cartridges and sealing plugs for said cartridge sockets; and conductors extending longitudinally of said gun bodies, there being channels in said gun bodies to accommodate said conductors, said conductors including lateral branches extending between the adjacent ends of said gun bodies and electrically connected with said cartridges through said sealing plugs.

11. A gun perforator comprising: a plurality of gun bodies arranged end to end, each gun body having diametrically extending gun bores intersecting its side walls and having at its ends cartridge sockets extending longitudinally into the gun body and intersecting said gun bores; bullets for said gun bores; cartridges and sealing plugs for said cartridge sockets; conductors extending longitudinally of said gun bodies, there being channels in said gun bodies to accommodate said conductors, said conductors including lateral branches extending between the adjacent ends of said gun bodies and electrically connected with said cartridges through said sealing plugs; and a case covering said gun bodies for protecting said conductors, said case having ports therein in registry with the muzzle ends of said gun bores.

12. A gun perforator comprising: a plurality of gun bodies arranged end to end, each gun body having diametrically extending gun bores intersecting its side walls and having at its ends cartridge sockets extending longitudinally into the gun body and intersecting said gun bores; a case covering said gun bodies, said case having ports in registry with said gun bores; bullets for said gun bores; cartridges and sealing plugs for said cartridge sockets; conductors extending longitudinally of said gun bodies, there being channels in said gun bodies to accommodate said conductors, said conductors including lateral branches extending between the adjacent ends of said gun bodies and electrically connected with said cartridges through said sealing plugs; restraining rods extending longitudinally of said gun bodies, there being longitudinal channels in said gun bodies to accommodate said rods; and end blocks for anchoring the extremities of said restraining rods.

13. A gun perforator comprising: a plurality of gun bodies arranged end to end, each gun body having diametrically extending gun bores intersecting its side walls and having at its ends cartridge sockets extending longitudinally into the gun body and intersecting said gun bores; bullets for said gun bores; cartridges and sealing plugs for said cartridge sockets; conductors extending longitudinally of said gun bodies, there being channels in said gun bodies to accommodate said conductors, said conductors including lateral branches extending between the adjacent ends of said gun bodies and electrically connected with said cartridges through said sealing plugs; restraining rods extending longitudinally of said gun bodies, there being longitudinal channels in said gun bodies to accommodate said rods; end blocks for anchoring the extremities of said restraining rods; and a case covering said gun bodies for protecting said conductors, said case having ports therein in registry with the muzzle ends of said gun bores.

14. A gun perforator comprising: a plurality of gun bodies arranged end to end, each gun body having diametrically extending gun bores intersecting its side walls and having at its ends cartridge sockets extending longitudinally into the gun body and intersecting said gun bores; bullets for said gun bores; cartridges and sealing plugs for said cartridge sockets; conductors extending longitudinally of said gun bodies, there being channels in said gun bodies to accommodate said conductors, said conductors including lateral branches extending between the adjacent ends of said gun bodies and electrically connected with said cartridges through said sealing plugs; restraining rods extending longitudinally of said gun bodies, there being longitudinal channels in said gun bodies to accommodate said rods; end blocks for anchoring the extremities of said restraining rods; a case covering said gun bodies for protecting said conductors, said case having ports therein in registry with the muzzle ends of said gun bores; and spacers between said gun bodies to permit access to said cartridge sockets for removing said sealing plugs and inserting new cartridges.

15. A gun perforator comprising: a plurality of gun bodies arranged end to end, each gun body having diametrically extending gun bores intersecting its side walls and having at its ends cartridge sockets extending longitudinally into the gun body and intersecting said gun bores; bullets for said gun bores; cartridges and sealing plugs for said cartridge sockets; conductors extending longitudinally of said gun bodies, there being channels in said gun bodies to accommodate said conductors, said conductors including lateral branches extending between the adjacent ends of said gun bodies and electrically connected with said cartridges through said sealing plugs; restraining rods extending longitudinally of said gun bodies, there being longitudinal channels in said gun bodies to accommodate said rods; end blocks for anchoring the extremities of said restraining rods; spacers between said gun bodies to permit access to said cartridge sockets for removing said sealing plugs and inserting new cartridges; and a case covering said gun bodies for protecting said conductors, said case having ports therein in registry with the muzzle ends of said gun bores.

16. A gun perforator comprising: a gun body in the form of a solid cylindrical block and having therein a plurality of transversely extending gun bores, each intersecting one side of the gun body and its inner end terminating adjacent the opposite side of said gun body, said gun bores located in offset planes and pointing in different directions; said gun body also having a plurality of sockets, each communicating with an inner end of a gun bore; cartridges and sealing plugs for said sockets; and bullets for said gun bores.

17. A construction, as set forth in claim 16, which comprises a plurality of said gun bodies; means for mounting said gun bodies end to end; and conductors extending longitudinally of said gun bodies, including lateral leads electrically connected with said cartridges.

ARTHUR J. ZSCHOKKE.