Dec. 16, 1941. L. SPENCER 2,266,342

GUN PERFORATOR

Filed Feb. 6, 1941

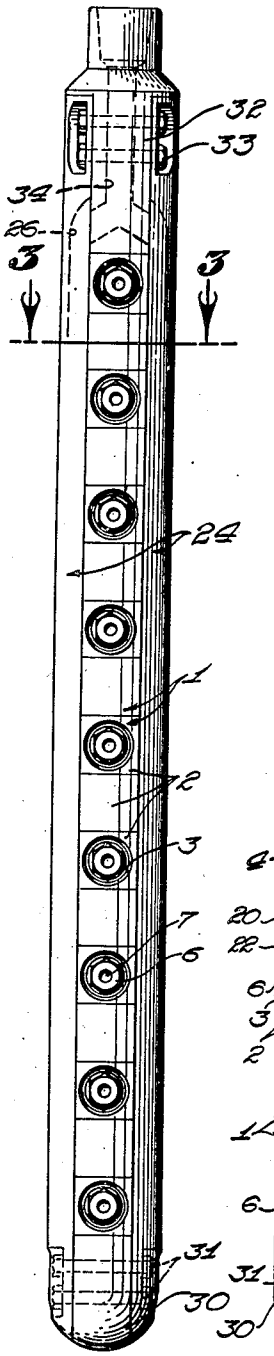


FIG. 1

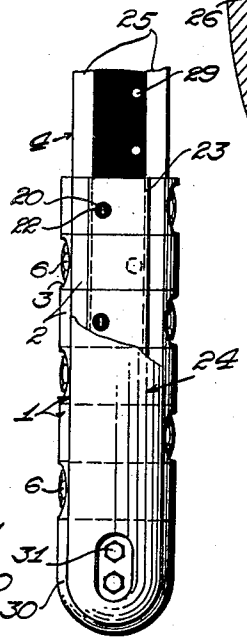


FIG. 2

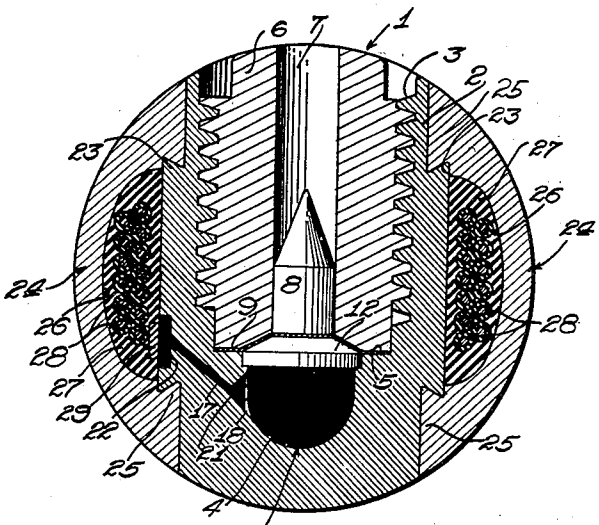


FIG. 3

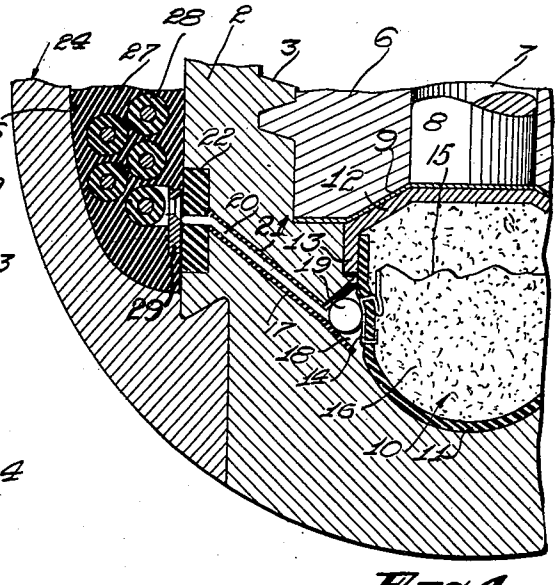


FIG. 4

INVENTOR

Lloyd Spencer.

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GUN PERFORATOR

Lloyd Spencer, Los Angeles, Calif., assignor to Lane-Wells Company, Los Angeles, Calif., a corporation of Delaware

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11 Claims. (Cl. 164—0.5)

My invention relates to gun perforators designed to be lowered on a cable into a well casing for the purpose of opening the well to fluids contained in the surrounding formation. Among the objects of my invention are:

First, to provide a gun perforator which employs preloaded independent gun units which may be readily assembled for operation and disassembled for cleaning and reloading;

Second, to provide a gun perforator of the sectional or independent gun unit type which is particularly compact, that is, a relatively large number of gun units may be contained in a given length of gun perforator;

Third, to provide a gun perforator which incorporates a novel electrical firing system whereby each gun unit may be fired individually;

Fourth, to provide a gun perforator wherein the gun bore occupies a maximum percentage of the available diameter; and

Fifth, to provide a gun perforator incorporating gun units which, although capable of particularly compact arrangement, have removable gun barrels.

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 my gun perforator;

Figure 2 is a fragmentary elevational view at right angles to Figure 1, with the side plates partially broken away to expose several of the gun units;

Figure 3 is a transverse sectional view through 3—3 of Figure 1; and

Figure 4 is an enlarged fragmentary sectional view in the same plane as Figure 3, showing in section the gun cartridge and its electrical connection with the conductor cable.

My gun perforator comprises a plurality of gun units 1 and each gun unit comprises a gun block 2 which is substantially square in vertical section and which extends laterally from one side to the other of the gun perforator. The gun block is provided with a gun barrel socket 3 which is internally threaded and which extends into the gun block from one end. At the inner end of the gun barrel socket there is formed a cartridge chamber 4 of smaller diameter than the gun barrel socket and forming therewith a shoulder 5. The inner end of the cartridge chamber 4 is preferably spherical and is located as close to the remaining end of the gun block as the explosive forces generated within the cartridge chamber permits.

Each gun block 2 receives a gun barrel 6 which is externally threaded. The gun barrel is provided with a gun bore 7 and receives a bullet 8. The bullet 8 is preferably spotwelded or otherwise secured to a gasket 9 which is adapted to be interposed between the shoulder 5 and the inner end of the gun barrel; the gasket, being imperforate, forms a seal against fluids entering the gun bore or between the threads connecting the gun barrel to the gun block. Preferably the inner end of the gun bore is slightly countersunk and the gasket conforms thereto.

The cartridge chamber 4 receives a cartridge 10 which comprises a shell 11 of insulating material which conforms to the semi-spherical inner end of the chamber. The shell 11 is covered at its outer end by a cap 12 formed of metal and having a skirt 13 which fits into a rudimentary counterbore provided at the outer end of the cartridge chamber, as shown best in Figure 4. The base of the cap 12 is shaped to conform to the countersunk inner end of the bore, and is sufficiently strong to resist hydrostatic pressures. Also, the cap is adapted to resist the initial explosive pressures. This has the effect of increasing the acceleration of the bullet once the cap ruptures and, therefore, for a given length of gun bore, tends to increase the velocity of the bullet and its penetration. The skirt 13 tends to restrict the pressure area against the barrel to the diameter of the cartridge chamber.

The cartridge shell 11 is provided with terminal clips 14 secured in its side walls and between which extends a fuse wire 15. One of the clips (not shown) is grounded. An explosive mixture 16 fills the cartridge.

The cartridge chamber 4 is intersected by a lead port 17 which extends laterally, the inner end of which is countersunk or recessed, as indicated by 18. The recess 18 receives a metal terminal ball 19, while a lead wire 20 extends through the port 17. Insulation 21 is provided between the terminal ball 19 and the recess, as well as around the lead wire. These parts are maintained as small as possible and the ball member forms a valve to seal the lead port when the cartridge is discharged.

At its outer end the lead port communicates with a recess in which is fitted an insulation pad 22. The lead extends outwardly through the pad and is bent along the side of the gun to form a terminal.

The vertical sides of each gun block are provided with dovetail bosses 23 having undercut or dovetail vertical margins. The several gun units are adapted to be mounted between side plates 24 which are provided along their margins with dovetail ribs 25 adapted to coact with the bosses 23, so that the gun blocks may be slipped vertically between the pair of side plates. The gun units and side plates are complementary; that is, they form a structure of circular cross section, the ends of the gun blocks being rounded in conformity with the curvature of the outer sides of the side plates. Between the dovetail ribs 25 each side plate is provided with a conductor channel 26 which receives a cable 27.

Each cable 27 is made of a plurality of conductors 28 and preferably completely fill its channel. Each conductor is connected to a contact plate 29 which may be in the form of a molded insert on the inner surface of the cable. The inner surfaces of the cable contact the sides of the dovetail bosses 23 of the gun block and the contact plates 29 are so positioned that when the gun blocks are fitted between the side plates the contact plates 29 register with the insulation pads 22 and thereby contact the outer ends of the corresponding leads 20.

The lower ends of the side plates are joined by a foot spacer member 30 which may have the same transverse section as the gun block and through which extend bolts 31. Similarly, the upper ends of the side plates are joined to a head member 32 and held there by bolts 33. The conductor channels 26 preferably overlap the sides of the head member and communicate with a central passage 34 provided therein.

The head member is joined to a case containing a stepping switch or similar controller (not shown) which in turn is connected with a single conductor cable. The stepping switch is adapted to connect each of the gun units through their respective conductors 28 to a source of electrical energy so that they may be fired in sequence.

The gun perforator is assembled as follows: The several gun units are preloaded with cartridges and bullets, and the lead wires 20 are positioned. The gun units are then slipped between the side plates from the bottom and the lower spacer member 30 is secured in place. The multiple conductor cables 27 remain permanently in the side plates.

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 plurality of gun units adapted to be stacked in a column; retainer plates extending axially along the sides of said gun units; and longitudinally extending interlocking rib and channel means incorporating said gun units and said retainer plates.

2. A gun perforator comprising: a plurality of independent gun blocks, each having therein a bullet and a powder charge and adapted to be stacked to form a composite column; electrical means for firing said cartridges including a lead from each cartridge to a side of the corresponding block; retainer plates covering opposite sides of said blocks; means interlocking said blocks and retainer plates to form a unitary assembly; and electrical connector means carried by said retainer plates along the sides of said blocks and electrically associated with said leads.

3. A gun perforator comprising: a plurality of gun blocks, each gun block defining a gun barrel socket and a cartridge chamber at the inner end of said socket, said block being substantially square in vertical section; a gun barrel having a gun bore and adapted to fit each socket; a bullet for each barrel; a cartridge for each chamber; said gun blocks adapted to be stacked; longitudinally extending side plates; and channel and rib means incorporating the sides of said gun blocks and said side plates, said side plates and stack of gun blocks being complementary to define a cylinder of circular cross section.

4. A gun perforator comprising: a plurality of gun blocks, each gun block defining a gun barrel socket and a cartridge chamber at the inner end of said socket, said block being substantially square in vertical section; a gun barrel having a gun bore and adapted to fit each socket; a bullet for each barrel; an electrically responsive cartridge for each chamber; a lead extending from each chamber through a side wall of said block; said gun blocks adapted to be stacked; retaining means coacting with the sides of said gun blocks, said retaining means and stack of gun blocks being complementary to define a cylinder of circular cross section; and means carried by said retaining means and adapted to make electrical connection with said leads.

5. A gun perforator comprising: a plurality of gun blocks; a gun unit incorporated in each gun block; said gun blocks adapted to be stacked in abutting relation with each other, said gun blocks defining jointly longitudinally extending rib elements on their opposite sides; and longitudinally extending cover plates adapted to coact with said ribs.

6. A gun perforator comprising: a pair of longitudinally extending side plates of substantially segmental cross section, defining therebetween a slot having along its side walls longitudinally extending interlocking elements; and a plurality of gun units each including a gun block complementary to said side plates and adapted to slide axially between said side plates and having coacting interlocking elements, said gun blocks adapted to be stacked one on top of the other to form a column substantially the length of said cover plates.

7. A gun perforator construction, as set forth in claim 5, wherein said side plates incorporate electrical conductors and terminal means, and said gun units are adapted to be fired electrically and incorporate coacting terminal means.

8. A gun perforator construction, as set forth in claim 6, wherein said side plates incorporate electrical conductors and terminal means, and said gun units are adapted to be fired electrically and incorporate coacting terminal means.

9. A gun perforator comprising: a pair of longitudinally extending side plates of substantially segmental cross section; conductors extending longitudinally in said side plates; a plurality of gun units adapted to be stacked between and complement said side plates to form a cylindrical gun structure; each gun unit including an electrically responsive cartridge; and connecting means for joining the gun units to the conductors when said gun units are positioned between said side plates.

10. A gun perforator comprising: a pair of longitudinally extending side plates of substantially segmental cross section, each side plate having marginal dovetail ribs; a plurality of gun units including gun blocks adapted to fit between and complement said side plates to form a gun structure of generally cylindrical form, said side plates having ribs along each side adapted to dovetail with the marginal ribs of said side plates to tie said side plates together, but permitting longitudinal movement of said gun units therealong.

11. A construction, as set forth in claim 10, wherein channels are formed in said side plates for the accommodation of conductors, and said gun units are electrically responsive and electrically connected by terminal elements to said conductors when placed between said side plates.

LLOYD SPENCER.