

Jan. 1, 1946.

G. F. TURECHEK

2,391,932

GUN PERFORATOR

Filed Nov. 24, 1943

2 Sheets-Sheet 1

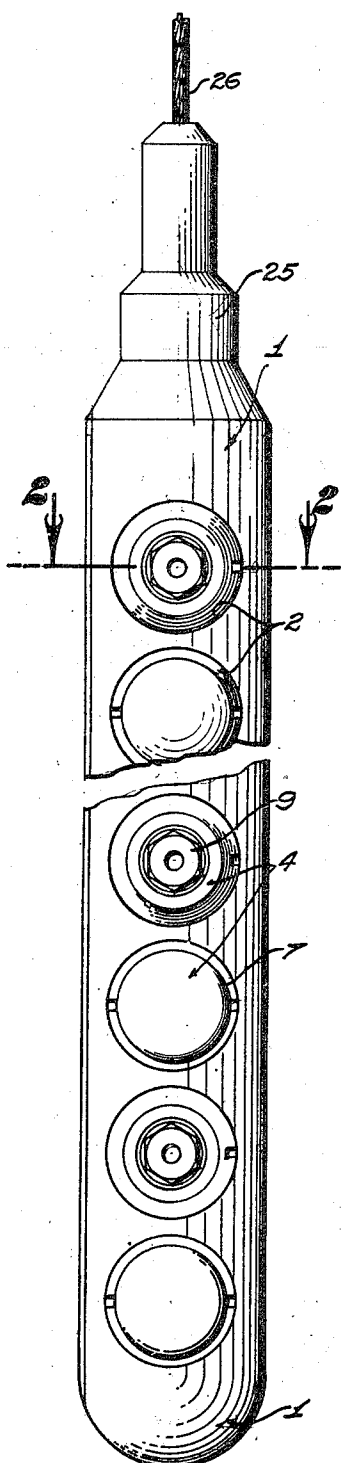


FIG. 1

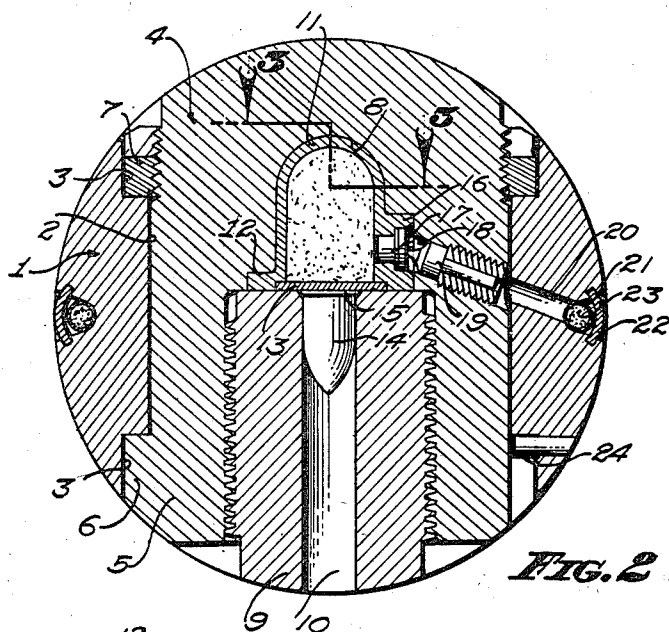


FIG. 2

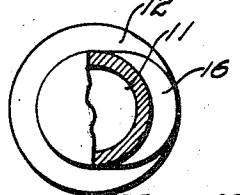


FIG. 3

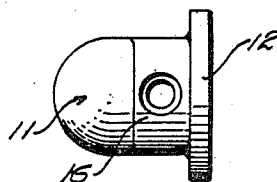


FIG. 4

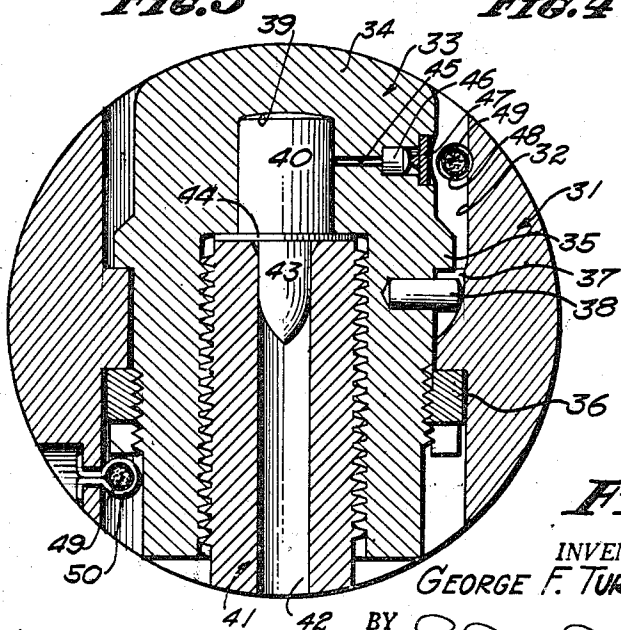


FIG. 5

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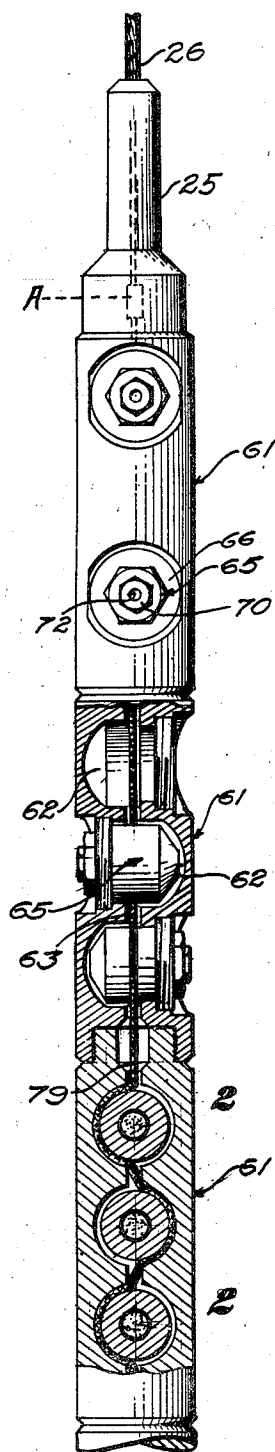


FIG. 6

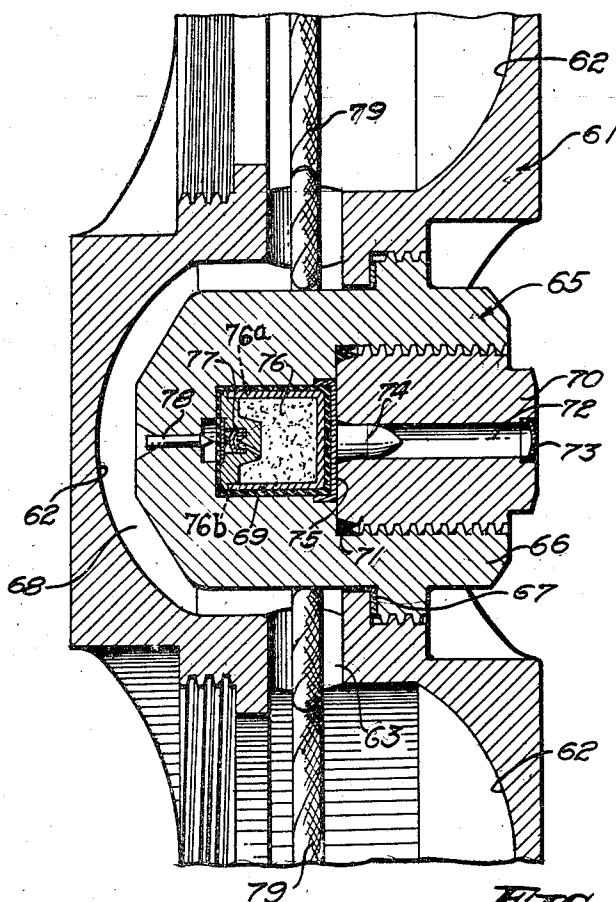


FIG. 7

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2,391,932

GUN PERFORATOR

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14 Claims. (Cl. 164—0.5)

My invention relates to gun perforators, that is, to devices adapted to be lowered in a well casing for the purpose of firing bullets there-through in order to form passages for the entrance of oil or connate fluids. Among the objects of my invention are:

First, to provide a gun perforator wherein the gun units are set off by a concussive wave produced by a high speed fuse cord which extends in proximity to percussion caps incorporated in the gun units;

Second, to provide a gun perforator wherein a plurality of gun units, each complete in itself, are interchangeably and removably mounted in a common holder or carrier;

Third, to provide a gun perforator which may be readily and quickly assembled and disassembled for reloading or servicing;

Fourth, to provide a gun perforator which is inherently so constructed that the gun bores have maximum length commensurate with the diameter of the gun perforator, so that the maximum impetus may be imparted to the bullet;

Fifth, to provide a gun perforator having a substantial wall thickness around its cartridge chambers whereby the inserted cartridges may have high powder loading densities;

Sixth, to provide a gun perforator which may in one form utilize many of the parts of a standard gun perforator now in use, such as that disclosed in the following patents: No. 2,029,454, W. T. Wells, issued February 4, 1936; No. 2,062,974, W. G. Lane, issued December 1, 1936; No. 2,062,975, W. G. Lane, issued December 1, 1936; No. 2,092,294, G. F. Turechek, issued September 7, 1937; thereby providing, in effect, means whereby such a standard electrically fired gun perforator may be converted to a fuse-ignited gun perforator.

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

Figure 1 is a fragmentary elevational view of a gun perforator incorporating one form of my invention;

Figure 2 is an enlarged transverse sectional view thereof taken through 2—2 of Figure 1;

Figure 3 is a partial elevational, partial sectional view of the cartridge case taken through 3—3 of Figure 2;

Figure 4 is a side elevational view of the cartridge case;

Figure 5 is a transverse sectional view similar to Figure 2, showing a modified form of my gun perforator;

Figure 6 is a fragmentary partial elevational, partial sectional view of another form of my gun perforator; and

Figure 7 is an enlarged fragmentary longitudinal sectional view thereof.

A gun carrier 1 is provided which is in the form of a cylindrical member provided with large transverse bores 2. Each transverse bore is provided with counterbores 3 at its extremities and is adapted to receive a gun unit 4. Each gun unit includes a gun body 5 having a flange 6 at one end and threaded at the other end to receive a ring nut 7. The flange 6 and ring nut 7 fit in the counterbores 3 to secure each gun unit in its transverse bore 2.

Each gun body 5 is provided with a socket extending therein, the inner end of which forms a gun chamber 8 and the outer end thereof is enlarged or counterbored and internally threaded to receive a gun barrel 9. The gun barrel 9 is provided with a central gun bore 10. A cartridge 11 fits in the cartridge chamber 8. The cartridge 11 may be die-cast from metal or formed of plastic having good impact characteristics and capable of withstanding oil well temperatures. The cartridge 11 is in the form of a cylinder with a hemispherical inner or closed end and is provided with a flange 12 at its outer or open end. The open end of the cartridge 11 receives a cover 13. The gun bore 10 receives a bullet 14 which is provided with a retainer flange 15 and the inner end of the gun bore is chamfered to accommodate the flange 15, so that the bullet is held at the inner end of the gun bore adjacent the cover 13.

One side of the cartridge 11 is provided with a boss 16 having a lateral opening therethrough which receives a percussion element or cap 17 which may be similar to the type provided in conventional rifle cartridges.

The gun body 5 is provided with a firing pin bore 18 which registers with the percussion element 17 and receives a firing pin 19. The gun carrier 1 is provided with ignition ports 20 which register with the firing pin bores 18 of the several gun units and which intersect a longitudinally extending ignition channel 21 formed in the gun carrier. The ignition channel 21 is provided with a suitable cover plate 22 and is adapted to contain an ignition fuse 23. In order that the gun units may be properly oriented with respect to the respective ports 20, suitable pin and slot means 24 may be provided in the gun carrier and the several gun units.

If it is desired to arrange the gun units so that

they are directed alternately in opposite directions, two ignition channels 21 may be provided along opposite sides, each channel and its fuse servicing alternate gun units. In the structure shown the axes of the several transverse bores 2 occupy a common plane, but it should be noted that the axes of the transverse bores may be spirally arranged so that the holes made by the bullets when the gun perforator is fired form a spiral pattern.

The ignition fuse or fuses, as the case may be, are connected with suitable ignition means located within the upper end of the gun carrier. The gun carrier is suitably supported by a cable head 25 and suspended from a conductor core cable 26 which, in addition to supporting the gun perforator, supplies electrical current to the ignition squib A, indicated diagrammatically and by dotted lines in Fig. 6. The squib may be the conventional electric squib commercially used to fire the type of ignition fuse hereinafter described.

The ignition fuse is the instantaneous burning type such as "Primacord." Primacord has an explosive core of Pentaerythritetetrinitrate (PETN) and burns at the rate of about 20,250 feet per second, producing a substantial concussive wave of short duration. This concussive wave has been found sufficient to drive a firing pin such as illustrated against a percussion element similar to the percussion cap used in rifle cartridges with sufficient force to set off the percussion element. This force is sufficient to set off the percussion element when the gun perforator is fired in air. It will be noted, however, that liquid is free to enter the ignition channel and ignition port, consequently, when the gun perforator is fired under liquid, the liquid confines the force of the fuse and materially increases the force available to set off the percussion element. The fast burning ignition fuse is capable of functioning when submerged and exposed to well fluids even though subjected to pressures in the order of several thousand pounds per square inch.

In the construction shown in Figure 5 the gun carrier 31 is constructed similarly to that shown in Figure 1, in that it is provided with transverse bores 32. The extremities of the transverse bores 32 are counterbored to a greater depth than the transverse bores 2. Each transverse bore 32 receives a gun unit 33 which includes a cylindrical gun body 34 of a length sufficient to fit within the projected area of the gun carrier. Each gun body is provided with a flange 35 and a threaded portion which receives a ring nut 36, so that the gun body may be secured within a transverse bore 32. A suitable aligning slot 37 and aligning pin 38 are provided so that the gun body may be oriented in the gun carrier. Each gun body is provided with a socket extending therein, the inner end of which forms a cartridge chamber 39 which receives an explosive cartridge 40. The outer end of the socket is enlarged and internally threaded to receive a gun barrel 41 having a bore 42 therein. The gun bore receives a bullet 43 which is secured to a shear disk 44 adapted to be clamped between the gun body and the inner end of the gun barrel. The shear disk may also serve to seal the cartridge chamber.

The gun body is provided with a lateral port 45 which is enlarged at its outer end to receive a percussion element or cap 46. The outer end of the port 45 is closed by a firing disk 47 having a projection adapted to set off the percussion element when the disk is driven inwardly thereagainst. The firing disk may also serve as a seal-

ing member to exclude entrance of fluid into the cartridge chamber.

The gun body is provided with a longitudinal ignition bore 48 which intersects the transverse bores 32 substantially tangentially. The longitudinal bore receives an ignition fuse 49 and the portions thereof exposed in the transverse bores register with the firing disks 47. If it is desired to alternate the direction of the gun units, two such longitudinal bores and ignition fuses may be provided as indicated in Figure 5. While the longitudinal bores guide and support the ignition fuses, additional clips 50 may be provided, as shown in Figure 5.

The gun perforator illustrated in Figure 5 operates essentially the same as that illustrated in Figure 2. In both structures, whether the gun perforator is in air or submerged in liquid, the concussive force produced upon firing the ignition cord sets off the percussion elements and, therefore, the explosive cartridges. By reason of the speed with which the concussive wave progresses in the ignition cord 33 or 49, the gun units are caused to fire virtually simultaneously. All of the gun units may be fired at once or if two cords are provided, as shown, each corresponding set of gun units may be fired separately.

Reference is now directed to Figures 6 and 7. The mechanical aspects of the gun construction herein illustrated are in many respects similar to the electrically fired gun perforator disclosed in the hereinbefore mentioned patents, but operates in a substantially different manner. In this construction a gun carrier 61 is provided with a series of laterally directed bores 62 which do not pierce through the gun carrier and preferably face alternately in opposite directions. The bores 62 are connected serially by passages 63 located along the longitudinal axis of the carrier. Several gun carriers may be joined together end to end by screw-threaded connections.

Each bore 62 is provided with a screw-threaded portion which receives a gun unit 65. Each gun unit includes a gun chamber block 66. Coacting flanges are provided between the bores 62 and the gun blocks 66, between which are interposed gaskets 67. Cup-shaped clearance chambers 68 are formed between the gun blocks and bores 62, these clearance chambers 68 communicating with the passages 63.

Each gun block has a socket therein, the inner end of which forms a cartridge chamber 69. The outer end of the gun block socket is enlarged and internally threaded to receive a gun barrel 70. A gasket 71 seals the connection between each gun barrel and gun block. Each gun barrel is provided with a centrally positioned gun bore 72, the outer end of which is closed by a cap 73. A bullet 74 fits within the gun bore and is held at the inner end thereof by a shear disk 75 which covers the cartridge chamber 69. The cartridge 76 comprises a metal shell 76a which is enclosed in an envelope of insulation 76b and which contains an explosive charge. Fitted in the base or inner end of the cartridge 76 is a percussion element 77. The gun block is provided with a small bore communicating from its inner end to the cartridge chamber in registry with the percussion element. This bore is fitted with a firing pin 78.

A fuse cord 79 is threaded through the connecting passages 63 and around the gun block through the clearance chambers 68. As in the previously described structures, the fuse cord is a fast burning fuse cord of the type known com-

mercially as "Primacord." When the fuse cord is ignited by suitable means (not shown), sufficient pressure is generated within the clearance chambers 68 to drive the firing pins forwardly against their respective percussion elements to set off the several gun units. The connecting passages 63 and clearance chambers 68 may be filled with an inert liquid so that the force due to ignition of the fuse cord may be transmitted more efficiently to the firing pin. However, actual operation of a gun constructed substantially as shown in Figures 6 and 7 demonstrated that these passages do not need to be filled with liquid in order for the gun units to fire. The pressure created by discharge or ignition of the fuse cord is sufficiently high to force the firing pins against their percussion caps with the requisite impact; yet this pressure is well within the strength of the parts of the gun perforator.

It is possible to so arrange the hereinbefore described gun perforators so that they will not operate in air. With regard to the construction shown in Fig. 2, the cover plate 22 may be arranged to blow out, when the gun perforator is in air, before the force is great enough to actuate the firing pin 18. When in liquid, however, the hydrostatic pressure against the plate 22 is sufficient to maintain it in position, and the incompressibility of the liquid filling the port 23 insures efficient transmission of the force against the firing pin 18.

With regard to the arrangement shown in Fig. 5, the member 47 may be designed to withstand the pressure thereagainst when the ignition cord is fired in air due to dissipation of the percussive force. In water, the force is concentrated, is much greater, and sufficient to cause the member 47 to give way.

With regard to the arrangement shown in Fig. 7, the interior of the gun perforator body may be provided with openings top and bottom for circulation of the liquid in which the gun perforator is immersed. Because of the distance between the firing pin 78 and the ignition fuse 79, the dissipation of energy in air is materially greater than when a liquid is present, the strength of the percussion cap may be designed to withstand the force available in air, but give way when liquid is present.

It should be pointed out however, that while any feature which can add safety to the gun perforator is desirable, that the gun perforator hereinbefore described may be so arranged as to fire in air as well as water and still not be dangerous. The conventional ignition cord described is not easily set off and is not capable of being set off by the discharge of any gun unit. The only means which will set off the ignition cord is the ignition squib A. The conventional squib developed commercially for use with the conventional fast burning ignition cord herein described is inherently safe. There can be no accidental firing of the gun perforator without accidental ignition of the ignition squib.

It is quite possible to provide safety features in the electrical ignition circuit so that any accidental ignition is reduced to a virtual impossibility.

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.

I claim:

1. A gun perforator comprising: a gun unit carrier having a plurality of transversely

directed bores; gun units fitting said bores, each gun unit defining a cartridge chamber and gun bore and including a cartridge for said cartridge chamber, a bullet for said gun bore and percussion responsive means for firing said cartridge, said means being exposed toward a wall of said transversely directed bores; and a continuous percussion generating cord extending along said gun unit carrier and passing in proximity to the exposed ends of said percussion responsive means to set off said percussion responsive means.

2. A gun perforator comprising: a gun unit carrier having a plurality of transversely extending bores; gun units fitting said transverse bores; a percussion responsive element and a striking means therefor carried by each gun unit, said striking means being exposed to pressures externally of said gun unit; and a pressure generating means extending along said gun unit carrier and passing in proximity to said striking means.

3. A gun perforator comprising: a plurality of gun units, each including a percussion responsive element and a striker therefor, said striker being exposed to pressures external of said gun units; and a pressure generating means extending continuously past said gun units in proximity to said strikers.

4. A gun perforator comprising: a carrier structure; a plurality of independent gun units adapted to be mounted in said carrier structure, each including a percussion responsive element and a striker therefor, said striker being exposed to pressures external of said gun units; and a pressure generating means extending along said carrier structure in proximity to said strikers for driving said strikers against said percussion responsive elements.

5. A gun perforator comprising: a carrier structure pierced by a plurality of laterally directed bores, said bores having internal flanges; a plurality of gun units having external flanges and ring nuts for coaction with said internal flanges to secure said gun units in said bores; a pressure generating means extending along said carrier past the several gun units; a percussion responsive means and a striker therefor incorporated in each gun unit, said striker being exposed to said pressure generating means.

6. A gun perforator comprising: a plurality of gun units, each including a gun body having a socket therein, a gun barrel fitting said socket, and a cartridge chamber formed by said socket at the inner end of said barrel, a cartridge for said socket, a bullet for said gun barrel, and a percussion ignition means for said cartridge, including a striker exposed to the side of said gun unit; a cylindrical carrier structure having a plurality of cross bores adapted to receive said gun units; and a percussion generating means extending along said carrier past said gun units in proximity to said strikers.

7. A gun perforator comprising: a plurality of gun units, each including a percussion ignition means and an exposed striker therefor; a carrier for said gun units; and a pressure generating ignition cord extending along said carrier and passing in proximity to the strikers of said gun units.

8. A gun perforator comprising: a plurality of gun units arranged in a column and each including a percussion ignition means and an exposed striker therefor; and a pressure generat-

ing ignition cord common to said gun units and passing in proximity to said strikers.

9. A gun perforator comprising: a gun carrier having a plurality of laterally directed bores extending part way therethrough and longitudinally directed connecting passages; a gun unit fitting each of said bores, their inner ends clearing the walls of said bores; each gun unit including an explosive cartridge, a detonator for said cartridge, a firing means for said detonator, said firing means exposed to the space between said gun unit and its bore; and a fuse cord threaded through said passages and socket around said gun unit.

10. A gun perforator comprising: a gun carrier having a plurality of laterally directed gun units removably mounted therein and defining with said carrier clearance spaces surrounding the inner ends of said gun units, said carrier having passages connecting said clearance spaces; each gun unit including an explosive cartridge, a detonator for said cartridge and firing means for said detonator, said firing means being exposed to said clearance spaces; and means for generating a momentary pressure in said passages and clearance spaces for driving the firing means of said gun units against said detonators.

11. A gun perforator comprising: a gun barrel having a bore for containing a projectile and a propulsive powder charge; a percussion cap for igniting said powder charge; an explosive element positioned in proximity to said percussion cap and of such character as to explode with sufficient violence to detonate the said percussion cap by the pressure created; and means for exploding said explosive element.

12. A gun perforator comprising: a carrier; a plurality of independent gun units removably

mounted in said carrier, each gun unit including a gun barrel having a bore for containing a projectile and a propulsive charge and a percussion cap for igniting said propulsive charge; a continuous explosive element extending along said carrier in proximity to said percussion caps in said gun units, exposed to fluid pressure external to said perforator and of such character as to explode with sufficient violence to detonate the percussion caps by the pressure created; and means for exploding said explosive element.

13. A gun perforator comprising: a gun unit for containing a projectile, a chamber associated with said unit for confining a propulsive charge for said projectile, and a percussion cap for igniting said propulsive charge; an explosive element positioned in proximity to said percussion cap and of such character as to explode with sufficient violence to detonate said percussion cap by the pressure created through the explosion of said element, and means for exploding said explosive element.

14. A gun perforator comprising: a carrier having a plurality of gun units for containing projectiles, each gun unit having associated therewith a chamber for containing a propulsive charge for the projectile in the unit, and a percussion cap for igniting the propulsive charge in the unit; a continuous explosive element associated with said carrier and extending in proximity to the percussion caps in said units, said explosive element being of such character as to explode with sufficient violence to detonate said percussion caps by the pressure created through the explosion of said element, and means for exploding said explosive element.

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