Nov. 21, 1950 J. A. BOND 2,530,805

CASING PERFORATING GUN

Filed Oct. 2, 1946

Fig. 1

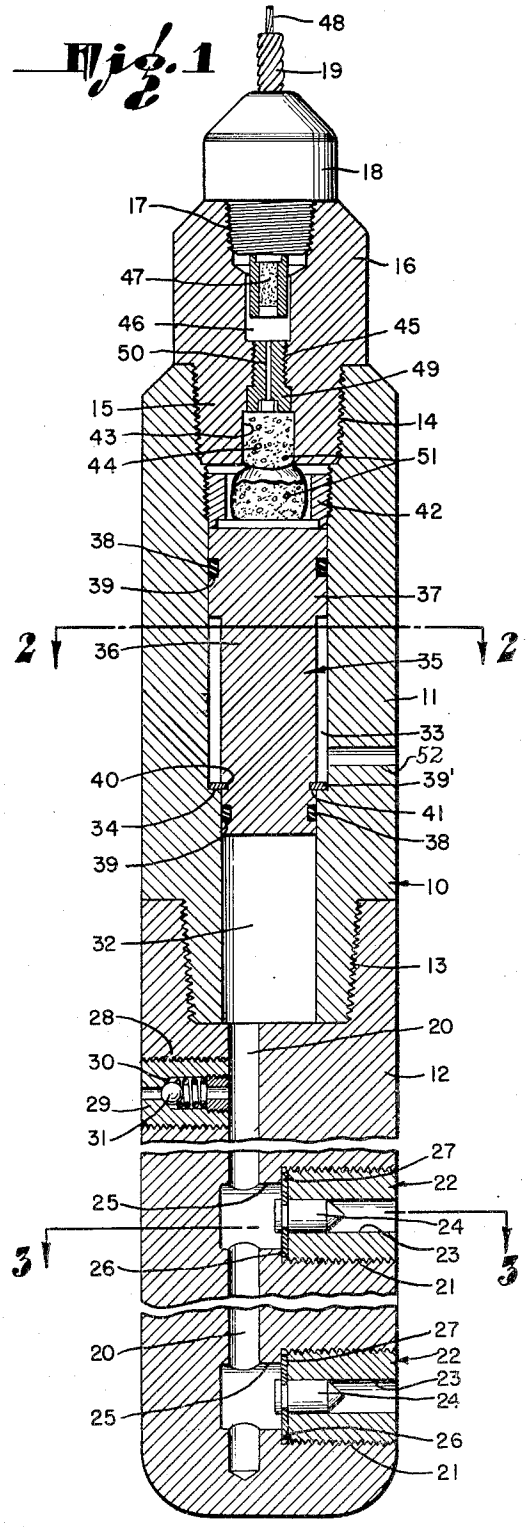


Fig. 2

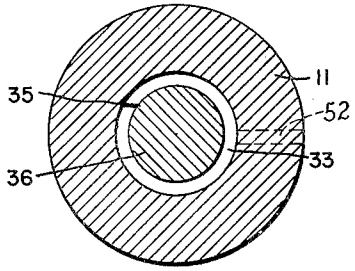
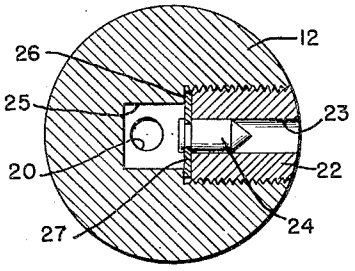


Fig. 3



INVENTOR
JOHN A. BOND

BY Wilson & Stanley
ATTORNEY

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CASING PERFORATING GUN

John A. Bond, Houston, Tex., assignor to McCullough Tool Company, Los Angeles, Calif., a corporation of Nevada

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9 Claims. (Cl. 164—0.5)

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My invention relates in general to guns for firing projectiles, and relates in particular to a simplified and efficient gun for perforating casing in wells so as to provide communication between the interior of the casing and the surrounding formation.

It is an object of the invention to provide a well perforating gun having one or more barrels in which projectiles are supported, each projectile being propelled from its barrel by the explosion of a powder acting through a substantially non-compressible substance of fluid character. In this simplified gun I avoid the intricate and relatively expensive mechanical, electrical and gas or flame-employing firing systems now used in well casing perforating guns.

It is an object of the invention to provide a well casing perforating gun having a chamber for a substance of fluid characteristics, this chamber communicating with the rear end of the barrel bores so that when the substance of fluid characteristics is expelled at high velocity and under high pressure by the action of an explosive-driven piston, the projectiles will be propelled from the gun at such high velocity as to perforate the metal wall or walls of a casing or casings set in a well.

It is an object of the invention to provide in a perforating gun a plurality of gun barrels for receiving projectiles, an explosive chamber spaced from the inner ends of the gun barrels in which an explosion may be produced, and an intermediary propellant between the explosive chamber and the inner ends of the gun barrels for transmitting the force of the explosion to the projectiles, to drive the projectiles outwardly through the barrels at high velocity. This intermediary propellant is preferably water, but within the meaning of this term I include all substantially non-compressible substances having the characteristics of a fluid in that they will flow or change shape without shear or rupture. Accordingly, within the meaning of the term "intermediary propellant" I include oil, grease, materials of plastic character capable of flowing, and mixtures having these characteristics.

It is a further object of the invention to provide in a gun a barrel having therein a projectile restrained against outward movement by metallic restraining means which must be deformed or sheared before outward movement of the projectile through the barrel can be effected, a means for producing an explosive force and a substantially non-compressible and flowable

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intermediary propellant for transmitting the explosive force to the rear end of the projectile, to first shear or overcome the effect of the restraining means, and then propel the projectile through the barrel at high velocity.

A further object of the invention is to provide a gun of the character disclosed herein having an explosive chamber, one wall of which is formed by the end of a piston having restraining means such as a shearable washer for restraining the piston from movement until extremely high pressure is built up in the explosive chamber by the burning of an explosive, so that when movement of the piston by the explosive is finally accomplished, the movement of the piston and the intermediary propellant will be substantially instantaneous and under enormous pressure so that a high velocity movement of the projectiles out through the gun barrels will be effected.

Further objects and advantages of the invention may be brought out in the following part of the specification, wherein I have employed very specific description of a preferred form of my invention for the purpose of clearly and fully disclosing the same without placing limitation on the scope of the invention set forth in the appended claims.

Referring to the drawings which are for illustrative purposes only:

Fig. 1 is a longitudinal sectional view of a gun embodying my invention;

Fig. 2 is a cross section taken as indicated by the line 2—2 of Fig. 1; and

Fig. 3 is a cross section taken on the plane indicated by the line 3—3 of Fig. 1.

In the form of the invention shown I provide a body 10 having an upper section 11 and a lower section 12 connected by a threaded joint 13. The upper end of the section 11 has an internally threaded counterbore 14 to receive the threaded plug 15 of a firing sub 16 which at its upper end has a threaded counterbore 17 for connection thereto of a cable socket 18, from which the suspension means for the gun, shown as a cable 19, upwardly extends.

The section 12 of the body 10 has a passage 20 leading downwardly from the counterbore 13, and a plurality of threaded recesses 21 are extended inward from the side of the section 12, for receiving externally threaded gun barrels 22 having barrel bores 23 to receive projectiles 24. At the inner end of each recess 21 there is a cavity or chamber 25 which communicates with the passage 20. Between the outer end of each cavity or chamber 25 and its associated recess

21 there is an annular shoulder 26, against which a shear ring or plate 27 may be clamped by the gun barrel 22 which is threaded into the associated recess 21. These shear rings or plates 27 extend radially from the inner ends of the projectiles 24, and before the projectiles can be moved outwardly through the bores 23 of the gun barrels 22, the inner portions of these radial members 27 must be ruptured or sheared. The section 12 has also an internally threaded opening 28 extending in from a side thereof so as to communicate with the passage 20. Into this threaded opening 28 an inlet check valve 29 is screwed, this inlet check valve 29 having an inwardly faced seat 30 to cooperate with a spring pressed closure 31, to permit entry of water from the exterior into the passage 20, thereby assuring that this passage 20 will be kept full of water, and that the pressure therein will be balanced with the pressure of water outside the gun body.

The section 11 of the gun body 10 has a bore 32 extending upwardly from its lower end, this bore 32 communicating with the upper end of the passage 20. The upper end of the bore 32 communicates with the lower end of a coaxial bore 33 of slightly larger diameter than the bore 32 so that an annular shoulder 34 is formed at the juncture of the bores 32 and 33. In the bores 32 and 33 a piston 35 is slidably disposed. The piston 35 has a body portion 36 corresponding in diameter to the bore 32 and a head portion 37 corresponding in diameter to the bore 33. Sealing means are provided between the piston 35 and the walls of the bores 32 and 33, such sealing means being shown as rings 38 disposed in annular channels 39 in the piston 35. Means for initially restraining downward movement of the piston 35 consists of a shear ring 39' disposed with its inner edge 40 in a channel 41 in the piston 35 and its radially projecting portion engaging the shoulder 34. Upward movement of the piston 35 is limited by a locking ring 42 which is threaded into the upper end of the bore 33.

The threaded pin 15 of the firing sub 16 has a recess 43 in its lower edge which cooperates with the space in the bore 33 above the head 37 of the piston 35 in the formation of an explosive chamber 44 in which a charge of powder may be placed. The recess 43 communicates through a threaded opening 45 with an upwardly faced recess 46 in the firing sub 16, which recess 46 is adapted to receive an electrically ignited fuse or priming charge 47 which is exploded at the proper time by electrical current delivered through a conductor 48 which extends through the cable 19, in accordance with known practices of operating electrical devices or firing electrical fuses in a well. A screw 49 having an axial passage 50 of small diameter therethrough is threaded into the opening 45 of the firing sub 16, to provide communication between the recess 46 and the explosive chamber 44, through which flame from the electrically operated fuse or priming charge 47 may pass into the explosive chamber 44 to ignite the explosive charge 51 which has been placed therein.

In one use of the gun, the parts may be assembled as shown in the drawings, with the projectiles 24 in the barrel bores 23, with a body of water in the passage 20 and the chamber formed at the upper end of the passage 20 by the portion of the bore 32 below the piston 35, and with the required powder and priming charges 51 and 47 properly installed. Then the gun is lowered into the well by means of the cable 19, and when it enters the fluid in the well, the pressure of such fluid will be exerted through the inlet check valve 29 to substantially completely fill the interior of the gun between the lower end of the piston 35 and the inner ends of the projectiles 24 and/or balance the internal pressure therein with respect to the external fluid pressure. When the firing charge 51 in the explosive chamber 44 is exploded and the piston 35 thereby driven downwardly with great force, the force of the explosion will be transmitted substantially instantaneously through the intermediary propellant comprising water to the inner ends of the projectiles 24. There will be a substantially instantaneous build up of pressure against the inner ends of the projectiles 24 which will cause the rupture or shear of the restraining rings 27 whereupon the projectiles 24 will be propelled through the gun barrels 22. In the wall of the body section 11 I have shown a pressure release passage 52 connecting the exterior of the gun body with the bore 33 at a point spaced from the upper end thereof. This opening 52 is positioned so that when the piston 35 is driven down by the force of the explosion in the explosive chamber 44, to perform its useful work of propelling the intermediary propellant so that the projectiles 24 will be driven through the bores 23 in the manner hereinbefore described, the pressure of the explosive gases above the head 37 of the piston 35 may be released to the exterior.

If it is not desired to use water as the intermediary propellant, the selected propellant may be placed in the passage 20 and the bore 32 before the gun is lowered into the well. This intermediary propellant may be any of the substantially non-compressible substances of flowable character hereinbefore indicated.

Among the advantages of the present invention are that safety in handling is brought to a maximum because it is necessary to install only one firing charge 51; whereas, the commonly used well perforating guns require the installation of a separate powder charge behind each projectile. Also, the wear on the gun barrels is greatly diminished in the present invention, so that the frequency of gun barrel replacement is reduced. Furthermore, the need for replacement of parts as a result of burning by the explosion of powder is minimized.

I claim as my invention:

1. In a gun of the character described, the combination of: a body structure having a gun barrel to receive a projectile, an explosive chamber spaced from the inner end of said barrel to receive a firing charge, and a passage connecting the inner end of said gun barrel with said explosive chamber; and means in said passage for transmitting force from the explosion of the firing charge in said explosive chamber to the inner end of the projectile, comprising a substantially non-compressible intermediary propellant of flowable character, and a piston disposed between said explosive chamber and said intermediary propellant.

2. In a gun of the character described, the combination of: a body structure having a gun barrel to receive a projectile, an explosive chamber spaced from the inner end of said barrel to receive a firing charge, and a passage connecting the inner end of said gun barrel with said explosive chamber; and means in said passage for transmitting force from the explosion of the firing chamber in said explosive chamber to the

inner end of the projectile, comprising a substantially non-compressible intermediary propellant of flowable character, a piston disposed between said explosive chamber and said intermediary propellant, and means for restraining movement of said piston until high pressure has been built up in said explosive chamber.

3. In a gun of the character described, the combination of: a body structure having a gun barrel to receive a projectile, an explosive chamber spaced from the inner end of said barrel to receive a firing charge, and a passage connecting the inner end of said gun barrel with said explosive chamber; means in said passage for transmitting force from the explosion of the firing chamber in said explosive chamber to the inner end of the projectile, comprising a substantially non-compressible intermediary propellant of flowable character, and a piston disposed between said explosive chamber and said intermediary propellant; and walls forming a duct connecting the exterior of said gun body structure with said passage, said duct having therein an outwardly closing check valve.

4. In a gun of the character described, the combination of: a body structure having a gun barrel to receive a projectile, an explosive chamber spaced from the inner end of said barrel to receive a firing charge, and a passage connecting the inner end of said gun barrel with said explosive chamber; means in said passage for transmitting force from the explosion of the firing chamber in said explosive chamber to the inner end of the projectile, comprising a substantially non-compressible intermediary propellant of flowable character, a piston disposed between said explosive chamber and said intermediary propellant, and means for restraining movement of said piston until high pressure has been built up in said explosive chamber; and walls forming a duct connecting the exterior of said gun body structure with said passage, said duct having therein an outwardly closing check valve.

5. In a gun of the character described, the combination of: a body structure having a gun barrel to receive a projectile, an explosive chamber spaced from the inner end of said barrel to receive a firing charge, and a passage connecting the inner end of said gun barrel with said explosive chamber; means for restraining outward movement of the projectile in the barrel until a high pressure is applied to its inner end; and means in said passage for transmitting force from the explosion of the firing chamber in said explosive chamber to the inner end of the projectile, comprising a substantially non-compressible intermediary propellant of flowable character, and a piston disposed between said explosive chamber and said intermediary propellant.

6. In a gun of the character described, the combination of: a body structure having a gun barrel to receive a projectile, an explosive chamber spaced from the inner end of said barrel to receive a firing charge, and a passage connecting the inner end of said gun barrel with said explosive chamber; means for restraining outward movement of the projectile in the barrel until a high pressure is applied to its inner end; means in said passage for transmitting force from the explosion of the firing chamber in said explosive chamber to the inner end of the projectile, comprising a substantially non-compressible intermediary propellant of flowable character, a piston disposed between said explosive chamber and said intermediary propellant, and means for restraining movement of said piston until high pressure has been built up in said explosive chamber; and walls forming a duct connecting the exterior of said gun body structure with said passage, said duct having therein an outwardly closing check valve.

7. In a gun of the character described, the combination of: a body structure having a gun barrel to receive a projectile, an explosive chamber spaced from the inner end of said barrel to receive a firing charge, and a passage connecting the inner end of said gun barrel with said explosive chamber, for receiving a body of substantially non-compressible intermediary propellant of flowable character, having the function of transmitting the force of the explosion of a firing charge in said explosive chamber to the inner end of the projectile positioned in the gun barrel; and a piston disposed in the body structure contiguous to the juncture of said passage with said explosive chamber for transmitting the force of the explosion to the intermediary propellant.

8. A method of operating a perforating gun having a gun barrel to receive a projectile and a chamber to receive a firing charge, the steps of: exploding a firing charge in said chamber; restraining the force of said exploded firing charge until a heavy pressure is built up and then releasing the force of the explosion from said chamber; and transmitting the force of the thus released explosion to the inner end of said projectile by disposing a substantially non-compressible intermediary propellant of flowable character so that one portion thereof is exposed to the force of said explosion and another portion thereof is disposed behind said projectile, and confining said intermediary propellant so that it will direct the force which it receives from said explosion to the rear end of said projectile.

9. A method of operating a perforating gun having a gun barrel to receive a projectile and a chamber to receive a firing charge, the steps of: exploding a firing charge in said chamber; restraining the force of said exploded firing charge until a heavy pressure is built up and then releasing the force of the explosion from said chamber; transmitting the force of the thus released explosion to the inner end of said projectile by disposing a substantially non-compressible intermediary propellant of flowable character so that one portion thereof is exposed to the force of said explosion and another portion thereof is disposed behind said projectile, and confining said intermediary propellant so that it will direct the force which it receives from said explosion to the rear end of said projectile; and restraining the projectile from outward movement in said barrel until a relatively high pressure is applied to its rear end.

JOHN A. BOND.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,144,208	Van Meter	Jan. 17, 1939
2,185,303	Kinley	Jan. 2, 1940
2,315,496	Boynton	Apr. 6, 1943