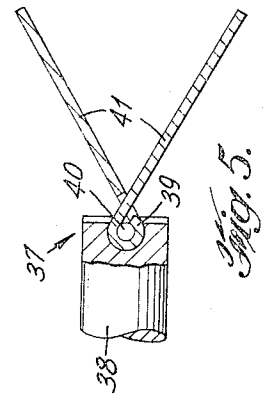
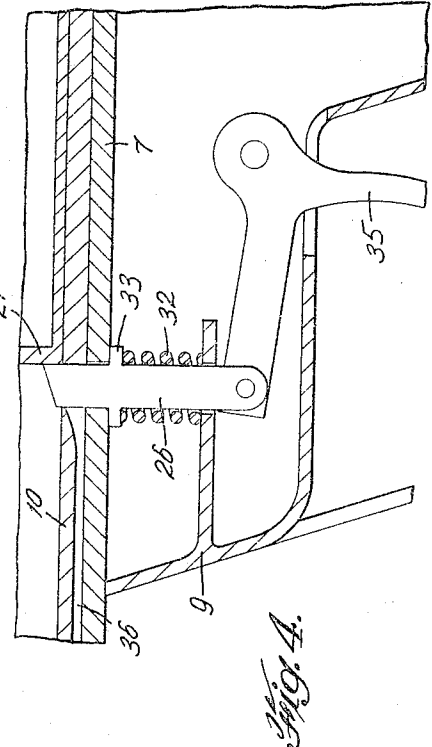
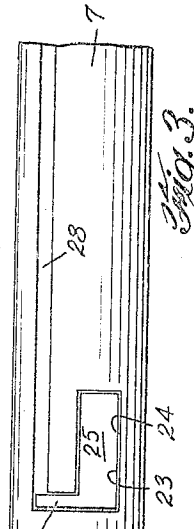
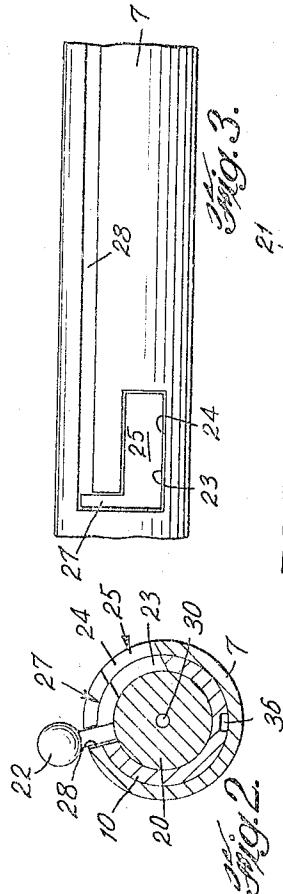
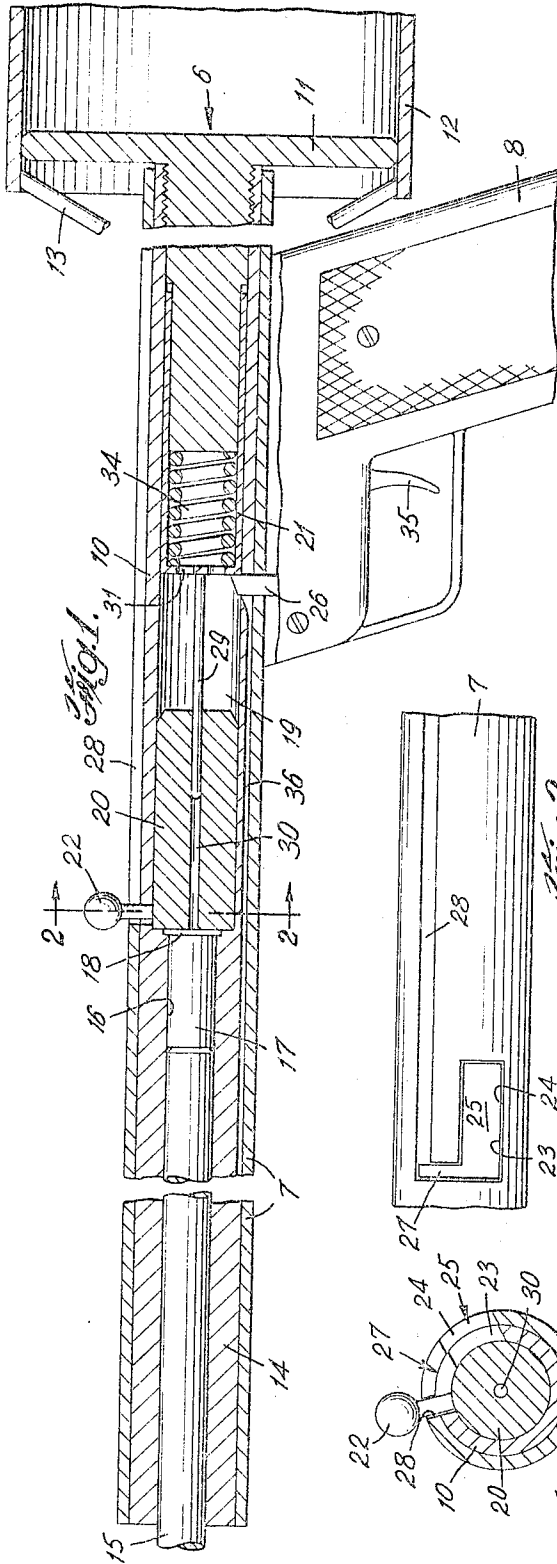


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J. M. ALBAN
UNDERWATER GUN

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INVENTOR
JOHN M. ALBAN

BY Joseph H. Douglas
AGENT

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UNDERWATER GUN

John M. Alban, 51 Tower Place, Yonkers, N.Y. 10703
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The present invention relates to an underwater gun. More particularly, this invention relates to a recoilless or substantially recoilless underwater gun. In a highly preferred embodiment this application relates to a recoilless underwater spear gun which is powered by the explosion of a powder cartridge.

The basic principle involved in the operation of any gun is that of action-reaction. The projectile is caused to leave the gun by the application of a driving force, for example, the explosive force of a powder charge. The equal and opposite force of the driving force is ordinarily exerted upon the gun. This force must be resisted by the person or object holding the gun and is commonly called "kick" or recoil.

It will be apparent that the magnitude of the recoil force is proportional to the driving force applied to the projectile. The driving force which must be applied to the projectile is dependent upon several factors such as the mass and shape of the projectile, the desired striking force and distance of the projectile's travel, and the resistance offered by the medium through which the projectile is to pass. In the case of a gun which is intended for use on land the projectile is usually very compact and of low mass. In contrast, the projectile used in underwater guns such as those used by skin divers and scuba divers for sport or defense from hostile fish is usually a relatively heavy arrow having "barbs" protruding therefrom and, consequently, it encounters a great deal of resistance in its movement. Moreover, the resistance offered by water is understandably many times greater than that of air. Unless one is prepared to sacrifice the effective striking force or distance of his weapon, the driving force for an underwater spear gun must, therefore, be substantially greater than that required by a gun intended for use on land. Accordingly, the recoil force is also greater.

Thus, while spear guns which are powered by the explosion of a powder charge have been heretofore suggested, they have not found acceptance because of the necessity of sacrificing the greater power potential for an acceptably low level of recoil.

Although the spear guns which have heretofore been used have assumed many forms, those which have attained any appreciable degree of usage may generally be classified as rubber band powered guns, helical spring powered guns and air spring powered guns. Rubber band powered guns are the most common primarily because of their low cost. This type of gun, however, lacks accuracy because no barrel is used. Moreover, the effective range of such gun is usually less than 10 feet. The helical spring guns likewise have a very limited effective range and the springs are subject to loss of tension due to corrosion and they occasionally jam by the action of sand and silt. The air spring guns are relatively powerful and accurate and have a relatively small number of moving parts. However, this type of gun requires accessory equipment such as air pumps and loading handles.

It is an object of this invention to provide a novel underwater gun.

A further object of this invention is to provide a novel underwater gun which is adapted to propel an arrow or harpoon by the explosion of a powder charge.

A still further object of this invention is to provide a recoilless or substantially recoilless underwater spear gun which is relatively accurate and has a desirable effective firing range but which has a small number of moving parts and requires a minimum of accessory equipment.

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Another object of this invention is to permit the use of arrows which are heavier than the usual arrow without sacrificing the effective firing range to obtain an acceptably low level of recoil.

5 These and other objects and advantages of the present invention will be apparent from the following description and the accompanying drawing.

According to the present invention there is provided an underwater gun which comprises a plunger assembly comprising an elongated tube and a plunger which is slidably mounted in said elongated tube, the forward portion of said plunger assembly being a barrel; a chamber adapted to receive a powder cartridge, said chamber being in open communication with said barrel and said plunger; and 10 a means for exploding said powder cartridge. More particularly, the present invention relates to a gun which comprises a plunger assembly comprising an elongated tube having no rigidly affixed end enclosures and a plunger having a plunger stem which is slidably mounted in said elongated tube and having a plunger plate which is affixed to said plunger stem and which protrudes from the rearward end of said elongated tube, the forward portion of said plunger assembly being a barrel; a cartridge chamber adapted to receive a cartridge, said cartridge chamber being in open communication with the rearward end of said barrel; a bolt which is mounted in said plunger stem and which cooperates with the rearward end of said cartridge chamber to house the rearward end of said cartridge; a triggering mechanism mounted on the outside of 15 said elongated tube; and a means for exploding said cartridge, said means being actuated by said triggering mechanism.

The underwater gun of this invention obviates the necessity of sacrificing the effectiveness of the weapon to obtain an acceptably low level of recoil. When the powder charge is exploded, the expanding gases exert their driving force upon the projectile. All or substantially all of the reaction force is exerted upon a member which is herein referred to as a plunger. The plunger, as indicated above, is slidably mounted in the elongated tube and, therefore, moves rearwardly relative to the elongated tube. This rearward motion of the plunger is resisted by the water in which it is immersed.

The primary forces upon the elongated tube are the frictional forces exerted by the rearward motion of the plunger and, when the projectile is in contact with the elongated tube, the frictional forces exerted by the forward motion of the projectile. Since these frictional forces oppose each other, their net effect can be effectively reduced to zero by proper design of the arrow and/or plunger. Consequently, by holding the elongated tube the swimmer experiences substantially no recoil when firing the underwater gun of this invention.

For the purpose of illustration, a preferred spear gun of this invention is shown in the accompanying drawing in which:

FIGURE 1 is an elevational view partially in section showing the spear gun in a cocked position with an arrow shaft in the barrel and a cartridge in the cartridge chamber;

FIGURE 2 is a section taken along line 2—2 of FIGURE 1;

FIGURE 3 is an exterior detail of the plunger slot and the tube slot when the plunger is in its forward position;

FIGURE 4 is a detail of the firing mechanism; and

FIGURE 5 is a detail of a collapsible plunger plate.

With reference to the drawing, the spear gun illustrated comprises, in general, a plunger 6, an elongated tube 7 in which said plunger 6 is slidably mounted, and a hand-grip 8 which is attached by any suitable means to the elongated tube 7 and which contains a trigger housing 9.

The plunger 6 includes a plunger stem 10 and a plunger plate 11 which is threadably attached to the rearward end of the plunger stem 10 and which protrudes from the rearward end of the elongated tube 7. The plunger guard 12 is a cylinder open at both ends which is attached by struts 13 to the elongated tube 7 and which encompasses the plunger plate 11 to prevent the swimmer's contact therewith. As shown, the forward portion of the plunger stem 10 is a barrel 14 into which an arrow shaft 15 is slidably fitted. Immediately to the rear of the barrel 14 and in open communication therewith is a cartridge chamber 16 into which a cartridge 17 may be slidably fitted. The rim 18 of the the cartridge 17 is received by a recess in the rearward end of the cartridge chamber 16.

The rearward portion of the plunger stem 10 has a bore 19 which is coaxial with but larger in diameter than the cartridge chamber 16. A bolt 20 and a spring housing 21 are slidably mounted in the bore 19. A bolt handle 22 is rigidly affixed as by threaded joint to the bolt 20 and protrudes through an L-shaped plunger slot 23 in the plunger stem 10 and a U-shaped tube slot 24 in the elongated tube 7 which is superimposed on the plunger slot 23 when the plunger 6 is in its forward position. The loading segment 25 of the plunger slot 23 and the tube slot 24 is of dimensions which permit the replacement of the cartridge 17 and which permit the bolt 20 to be moved sufficiently rearward for the rearward face of the bolt 20 to move past the sear 26. The locking segment 27 of the plunger slot 23 and the tube slot 24 and the guide segment 28 of the tube slot 24 need only be wide enough to serve as guides for the movement of the bolt handle 22. The guide segment 28 has a length which is greater than the distance that the plunger 6 moves relative to the elongated tube 7 when the spear gun is immersed in water and fired. The plunger slot 23 is so positioned that the forward face of the bolt 20 is pressed firmly against the rearward face of the cartridge 17 when the bolt handle 22 is manually pushed to its forward position in the loading segment 25 and rotated along the locking segment 27 to the forward end of the guide segment 28.

A firing pin 29 is slightly longer than the bolt 20 and is slidably fit in a guide bore 30 along the longitudinal axis of the bolt 20. The rearward end of the firing pin 29 is integral with the spring housing 21, the rearward portion of which is slidably received by the annular recess between the forward portion of the plunger plate 11 and the bore 19. Water ports 31 are provided in the spring housing 21 to permit movement thereof in the event water enters the bore 19.

When the plunger stem 10 is in its forward position, a sear 26 extends upwardly through sear apertures in the elongated tube 7 and the plunger stem 10 and is held in its upward position by a trigger spring 32 acting between a sear flange 33 and the trigger housing 9. When the sear 26 is in its uppermost position it acts to prevent movement of the plunger 6 relative to the elongated tube 7 and the rearward edge of the sear 26 engages the forward end of the spring housing 21 to hold a spring 34 in compression. The lower end of the sear 26 is pivotally attached to a trigger 35 which is pivotally mounted in the trigger housing 9.

The sear 26 and the forward edge of the sear aperture in the plunger stem 10 are beveled to ensure that the forward edge of the sear 26 will not interfere with the rearward motion of the plunger 6 when the sear 26 disengages the spring housing 21. The edge of the rear face of the bolt 20 is also beveled to permit the sear 26 to engage the forward face of the spring housing 21 when the bolt handle 22 is pulled rearwardly in the loading segment 25 of the plunger slot 23 and the tube slot 24.

A groove 36 having the same width as the sear aperture in the plunger stem 10 extends forward from the sear aperture along the outer surface of the plunger stem 10 for a length equal to the length of the guide segment

28 of the tube slot 24. In this manner rotation of the plunger 6 relative to the elongated tube 7 is prevented.

In operation, the trigger 35 is squeezed toward the hand-grip 8 causing a downward force on the sear 26 which compresses the trigger spring 32 until the spring housing 21 clears the sear 26 and is thrust forward by the stored energy of the spring 34 causing the firing pin 29 to strike the cartridge 17. The expanding gases resulting from the ensuing explosion of the cartridge 17 thrust the arrow shaft 15 forward and the plunger 6 rearward. The bolt handle 22 moves rearwardly along the guide segment 28 of the tube slot 24 and the sear 26 follows the groove 36 to prevent rotation of the plunger 6 in the elongated tube 7.

To reload one need only push the bolt handle 22 forward along the guide segment 28 of the tube slot 24, rotate it along the locking segment 27 of the plunger slot 23 and the tube slot 24, and pull it rearward in the loading segment 25 of the plunger slot 23 and the tube slot 24 until the sear 26 engages the forward end of the spring housing 21. The spent cartridge 17 may then be replaced and an arrow shaft 15 inserted in the barrel 14. The bolt handle 22 is then returned to its position at the forward end of the guide segment 28 of the tube slot 24 and the spear gun is again ready to be fired.

Although the plunger plate 11 may assume many shapes and sizes, it preferably has a size and shape which offers a substantially greater resistance to movement in water than does the arrow. A particularly preferred plunger plate is a collapsible plunger plate 37 as illustrated in FIGURE 5 and consists of a rod 38 and a flap hinge 39 which is securely fastened to the rearward end of the rod 38. The forward end of the rod 38 is adapted for mounting in the rearward end of the plunger stem 10. The flap hinge 39 consists of a pin 40 which is rigidly fixed in the rearward end of the rod 38 perpendicular to the axis thereof, and two semicircular flaps 41 which are rotatably mounted on the pin 40. The flaps 41 are so designed that when they are rotated away from each other their forward edges come to rest on the rearward face of the rod 38 and when they are rotated toward each other their rearward faces engage each other at an angle so as to prevent total collapse of the flap hinge 39. Thus, when the collapsible plunger plate 37 is moved forward in water as when the swimmer is moving forward the resistance of the water will cause the flaps 41 to rotate toward each other until their rearward faces engage each other and thereby provide less resistance to the forward movement of the swimmer. When the collapsible plunger plate 37 is moved rearward in water as when the spear gun is fired, the resistance of the water will cause the flaps 41 to rotate away from each other until their forward edges engage the rearward face of the rod 38 and thereby provide maximum resistance to the rearward motion of the plunger 6.

In the specific embodiment of the invention illustrated by the drawing the shaft of the arrow does not come into contact with the elongated tube. It will be readily apparent, however, that the forward portion of the elongated tube may itself function as the barrel. For example, a substantially recoilless spear gun within the scope of the invention would result if the forward end of the plunger stem 10 of the spear gun illustrated in the drawing were flush with the forward end of the cartridge 17 and an arrow having a diameter equal to that of the plunger stem 10 were slidably fit in the forward end of the elongated tube 7.

Moreover, the cartridge chamber and firing mechanism need not be situated in the plunger. A handgrip such as that illustrated in FIGURE 4 of United States Patent No. 2,499,379 may contain the cartridge chamber and firing mechanism. In such a case the handgrip would be suitably attached to the elongated tube with a small tube extending from the cartridge chamber to the interior of the elongated tube. The plunger stem, which is thus permitted to

be a solid cylindrical piece, may be slidably fitted into the rearward end of the elongated tube and the arrow shaft may be slidably fitted into the forward end of the elongated tube so that the cartridge chamber is in open communication with the forward end of the plunger stem and the rearward end of the arrow.

Many modifications and variations of the specific embodiments referred to above will be readily apparent to those in the art. The scope of the present invention is not limited to the specific embodiments discussed and includes all variations and modifications which may properly be considered the equivalent thereof.

What is claimed is:

1. An underwater gun, which comprises an elongated tube having a U-shaped slot in the side thereof, said U-shaped slot comprising a guide segment and a loading segment which are parallel to the longitudinal axis of said elongated tube and a locking segment which connects the forward ends of said guide segment and said loading segment; a plunger stem which is slidably mounted in said elongated tube, said plunger stem having in its forward portion a barrel adapted to receive the shaft of an arrow, a cartridge chamber which is adapted to receive a cartridge and which is rearward of and in open communication with said barrel, and a bore which is rearward of and larger in diameter than said cartridge chamber and which bore has an L-shaped slot so positioned in the side thereof that said U-shaped slot in the side of said elongated tube will be superimposed on said L-shaped slot when said plunger stem is in its forward position in said elongated tube; a plunger plate which is rigidly affixed to the rearward end of said plunger stem and which protrudes from the rearward end of said elongated tube; a bolt which is slidably mounted in said bore, said bolt having a guide bore the axis of which is parallel to the longitudinal axis of said plunger stem and a bolt handle rigidly affixed to the side thereof, which bolt handle protrudes through said U-shaped slot in said elongated tube and said L-shaped slot in said bore of said plunger stem and which is so positioned on said bolt that when a cartridge is placed in said cartridge chamber and said bolt handle is moved along the locking segment of said U-shaped slot in said elongated tube the forward face of said bolt will be firmly against the rearward face of said cartridge; a firing pin which is slidably mounted in said guide bore in said bolt and which is longer than said bolt; and a means for causing said firing pin to move forward in said guide bore to strike and explode a cartridge after said cartridge has been placed in said cartridge chamber.

2. An underwater gun as claimed in claim 1, in which the plunger plate is a collapsible plunger plate.

3. A gun which comprises a plunger assembly comprising an elongated tube having no rigidly affixed end enclosures and a plunger having a plunger stem which is slidably mounted in said elongated tube and having a plunger plate which is affixed to said plunger stem and

which protrudes from the rearward end of said elongated tube, the forward portion of said plunger assembly being a barrel; a cartridge chamber adapted to receive a cartridge, said cartridge chamber being in open communication with the rearward end of said barrel; a bolt which is mounted in said plunger stem and which cooperates with the rearward end of said cartridge chamber to house the rearward end of said cartridge; a triggering mechanism mounted on the outside of said elongated tube; and a means for exploding said cartridge, said means being actuated by said triggering mechanism.

4. An underwater gun as claimed in claim 3, in which the plunger plate is a collapsible plunger plate.

5. A gun which comprises an elongated tube having no rigidly affixed end enclosures; a plunger comprising a plunger stem which is slidably mounted in said elongated tube and which has a barrel in its forward portion, a cartridge chamber which is adapted to receive a cartridge and which is in open communication with the rearward end of said barrel, a bolt which cooperates with the rearward end of said cartridge chamber to house the rearward end of said cartridge, and a plunger plate which is affixed to said plunger stem and which protrudes from the rearward end of said elongated tube; a triggering mechanism mounted on the outside of said elongated tube; and a means for exploding said cartridge, said means being actuated by said triggering mechanism.

6. A gun which comprises an elongated tube having no rigidly affixed end enclosures, the forward portion of said elongated tube being a barrel; a plunger comprising a plunger stem which is slidably mounted in the rearward portion of said elongated tube, and a plunger plate which is affixed to said plunger stem and which protrudes from the rearward end of said elongated tube; a cartridge chamber adapted to receive a cartridge, said cartridge chamber being in open communication with the rearward end of said barrel; a bolt which is mounted in said plunger stem and which cooperates with the rearward end of said cartridge chamber to house the rearward end of said cartridge; a triggering mechanism mounted on the outside of said elongated tube; and a means for exploding said cartridge, said means being actuated by said triggering mechanism.

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SAMUEL W. ENGLE, *Primary Examiner*.

BENJAMIN A. BORCHELT, *Assistant Examiner*.