Aug. 25, 1959 DE LOSS L. MARSH ET AL 2,900,972

UNDERWATER SPEAR GUN

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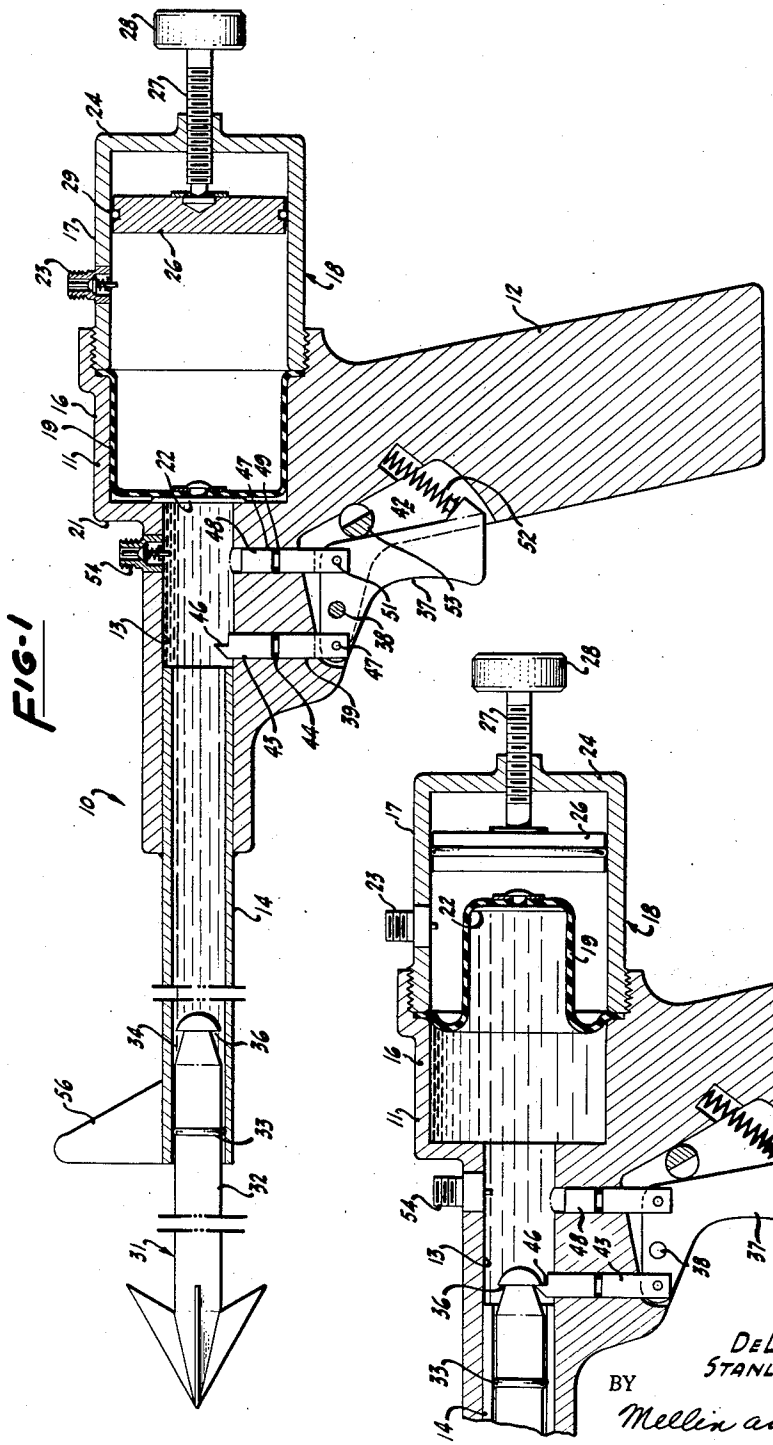

FIG-1

FIG-2

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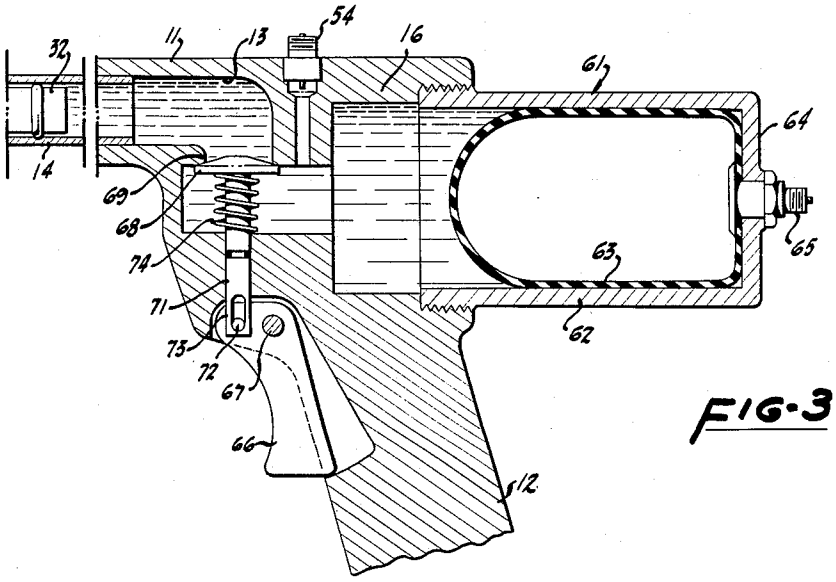

FIG-3

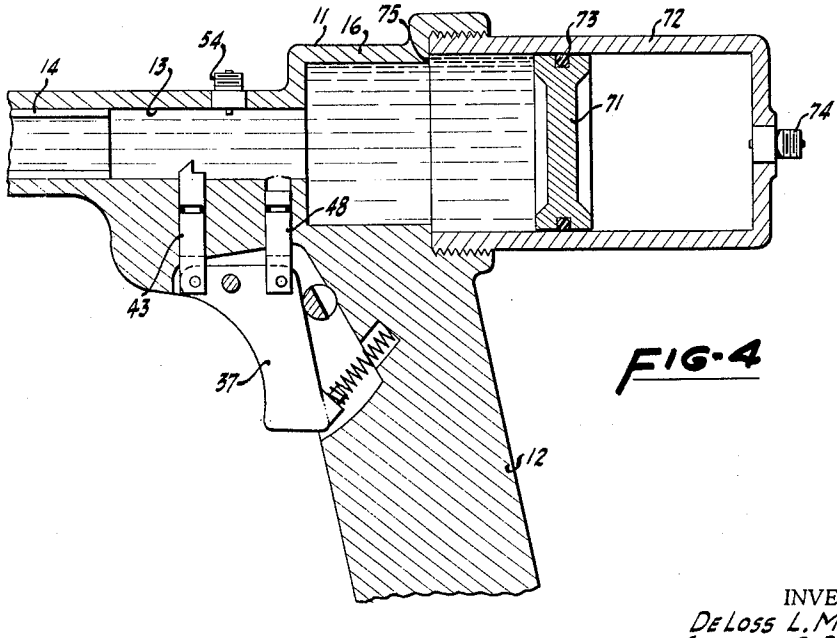

FIG-4

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UNDERWATER SPEAR GUN

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This invention relates to underwater spear guns, and particularly those adapted for use in the support of underwater sport fishing.

Various types of spear guns have been developed for underwater spear fishing, with the propulsive means for the spears being generally classifiable as of the spring type, or of the compressed gas type.

In the spring type gun, rubbers or springs are used to propel the spear from the gun, the energy being stored by forcing the spear into the gun to bias the rubber or springs. The bias is removed by some form of trigger means when it is desired to fire the spear. Of necessity, the spring means must be of considerable mass to store enough energy to propel the spear against the resistance of the water and thus this type gun is relatively heavy. The moving mass of the spring means during firing and the sudden arrest of such motion also produce a kick in the gun which is detrimental to the accuracy of the gun.

In the compressed gas type spear gun, the spear is propelled from the gun by using a compressed gas cartridge and suddenly opening such cartridge to allow the gas contained therein to escape, the expanding gas acting directly on the butt end of the spear in the gun to force the spear through the water towards the target. Although this type gun has several advantages such as ease of use, lack of kick and lightness in weight, it has several disadvantages which are quite apparent to those using such a gun. The gas cylinders are generally usable for only one shot, and thus for prolonged underwater spear fishing a large number of such cylinders must be carried by the diver. Also, the necessity of using a fresh gas cylinder each time the gun is fired becomes an economic burden. The escaping gas issues from the gun barrel in the form of bubbles, making it difficult for the diver to see and frightening the fish in the vicinity. Further, the gas bubbles following the spear produce cavitation, thereby decreasing the accuracy of the gun.

By utilizing the principles of the present invention, the disadvantages of the former guns enumerated above have been eliminated. The present invention contemplates an underwater spear gun having a barrel open at one end so that it may be filled with water and so that the spear may be inserted therein. The other end of the barrel is closed and contains therein a sealed, collapsible gas reservoir. The reservoir is charged by filling it with a gas, such as air, under pressure. In use, the spear is forced into the barrel and acts as a piston to force the water trapped in the barrel to collapse the reservoir, thus compressing the gas therein to build up the gas pressure thereof. When it is desired to fire the gun, the spear is released by a trigger means, allowing the reservoir to expand, causing the column of trapped water to eject the spear from the barrel. As may be appreciated, no gas escapes from the gun in the firing operation, thereby eliminating the need for recharging the reservoir on each shot. Also, no gas bubbles will issue from the gun with the attendant disadvantages

enumerated above. Further, the column of water following the spear eliminates the cavitation problem. Kick is largely eliminated, as the only moving element in the gun is the collapsible element of the gas reservoir which may be made of very low mass, as will be explained in the detailed description set out below.

A spear gun constructed in accordance with the preceding principles also has a distinct safety feature, as will be realized by those in organized spear fishing groups. These groups have strict rules forbidding the presence of loaded spear guns on the beaches they are using. Since the present gun requires that the barrel be filled with water before it may be loaded, it may be seen that accidental loading while on the beach is practically eliminated.

The present spear gun also has an advantage over conventional spring loaded spear guns other than those mentioned above, in that a higher cocking ratio may be engineered into the gun, thus producing a more powerful and more compact gun. For example, a spring gun may have a spring with a final cocked resistance of 100 lbs. However, the uncocked resistance of the spring is zero pounds, and thus the average resistance is 50 lbs. Assuming that the spear is cocked through a distance of two feet, 100 foot pounds of energy will be stored in the spring for propulsion purposes. However, the present gun may be designed to have the same final cocked resistance of 100 pounds, but the gas reservoir may be charged initially with 50 pounds pressure. The average force exerted on the spear is thus 75 pounds. Assuming the same two foot cocking distance, it is seen that 150 foot pounds of energy are stored for propulsion, thus achieving a higher storage of energy for the same cocking distance and final cocked resistance.

It is an object of this invention to provide an underwater spear gun having a barrel open at one end to receive a closely fitting spear and having a collapsible gas reservoir in the closed end of the barrel, whereby the reservoir may be compressed by the insertion of the spear in the barrel.

It is a further object of the invention to provide an underwater spear gun of the type set forth in the first object with means to admit liquid under pressure to the barrel after the spear is in cocked position to further compress the gas reservoir.

It is a further object of the invention to provide a spear gun as set forth in the first object with means to vary the extensible volume of the gas reservoir.

It is a still further object of the invention to provide a spear gun as set forth in the first object with means to prevent the distention of the air reservoir in its fired, or uncocked, position.

It is a further object of the invention to provide a spear gun as set forth in the first object with a pressure balanced trigger means.

Other objects and advantages will become apparent in the course of the following detailed description.

In the accompanying drawings forming a part of this specification, and in which like numerals are used to designate like parts throughout the same,

Fig. 1 is a side elevation, in section, of a spear gun embodying the invention, illustrating the relation of the parts in an uncocked position;

Fig. 2 is a partial view similar to Fig. 1, illustrating the relation of the parts in a cocked position;

Fig. 3 is a view similar to Fig. 2, illustrating a modified embodiment of the invention; and

Fig. 4 is a view similar to Fig. 2, illustrating a further modified embodiment of the invention.

Referring to the embodiment of the invention illustrated in Figs. 1 and 2, the spear gun, indicated generally by reference numeral **10**, has a body **11** provided with a

handle or pistol grip 12 and an internal bore 13. The internal bore 13 and the elongated tubular barrel extension 14, anchored at one end to the body 11 and extending outwardly therefrom, constitute the barrel of the gun. The internal bore 13 is radially enlarged at 16 at the rear of the body 11, and is internally threaded to receive the externally threaded housing 17 of the collapsible reservoir member 18. The housing 17 may be regarded as providing a closed end for the gun barrel.

The reservoir 18 is provided with a flexible diaphragm 19 sealingly closing the open end of the housing member, the diaphragm in its unstretched state being adapted to lie against the enlarged portion 16 and shoulder 21 of the bore 13. A rigid striker plate 22, preferably made of metal, is riveted, or affixed by other conventional means, to the diaphragm 19 so as to cover and overlap the bore 13. A check valve 23 of the type used on pneumatic tires provides means whereby the reservoir 18 may be filled with a compressible gas. As the reservoir is so charged, the diaphragm 19 will flex away from the rear end 24 of the housing member 17 and will come to rest against the enlarged end 16 and shoulder 21 of the bore. The striker plate 22 prevents the diaphragm from entering into the bore 13. As may be apppreciated, the elements 16, 21 and 22 limit the movement of the diaphragm 19 away from the housing end 24, and thus prevent excessive distention of the diaphragm even though the diaphragm is constantly under pressure when in use.

A piston 26 is mounted in the housing member 17 for longitudinal movement therein, such movement being caused by adjustment screw 27 and knob 28. An O-ring 29 prevents any escape of gas around the side of the piston 26.

A spear 31 is used with the gun 10 and has a shaft 32 adapted to be inserted within the barrel extension 14. An O-ring 33 surrounds the shaft 32 so as to provide a sealing engagement of the shaft 32 within the barrel extension 14. The rear end of the spear 31 is provided with a circumferential groove 34 having a vertically projecting rear face 36.

The trigger means for the spear gun utilizes a pressure balancing system as will now be described. The trigger member 37 is pivoted around a pivot pin 38 mounted on the body 10. Two lateral bores 39 and 41 are provided in the body, extending from the bore 13 to the trigger compartment 42. A trigger latch member or pin 43 is disposed within the bore 39, with an O-ring 44 providing a seal between the trigger latch member 43 and the bore 39. The upper end of the latch member 43 is provided with a vertical latching face 46 adapted to engage the vertical face 36 of the spear groove 34, as illustrated in Fig. 2. The lower end of the latching member 43 is pivoted to the trigger member 37 by pivot pin 47. As the liquid in the bore 13 is under pressure when the gun is cocked, a downward force will be applied on the latch member 43 tending to release it from latching engagement with the spear. To overcome this, a balance pin 48 is provided, this pin being disposed in the lateral bore 41, with an O-ring 49 providing a seal therebetween. The lowered end of the balance pin 48 is pivoted to the trigger member at pivot pin 51. As may be seen, the distance between pivot pins 38 and 51 is greater than the distance between the pivot pins 47 and 38, and thus with an equal downward force applied to both the latch member 43 and the balance pin 48, a resultant force will be applied to the trigger member 37 tending to bias it in a clockwise direction around the pivot pin 38, thus maintaining the trigger member in cocked position. This will be true regardless of the amount of pressure in the bore 13.

If desired, a compression spring 52 may be used to bias the trigger member 37 to cocked position. A half-round cam stud 53 is mounted in the body 11 to maintain the trigger in safety position, the stud being turned to a position as shown in Fig. 2 when it is desired to load the gun or pull the trigger.

A check valve 54, also of the type used on pneumatic tires, is provided on the body 11 to allow fluid to be injected into the bore 13, for a purpose to be hereinafter described. If desired, a front sight 56 may be provided on the forward end of the barrel extension 14. The check valve 23 may be used as a back sight in cooperation with the front sight 56 to obtain an alignment of the spear gun on a target.

The manner of operation of the spear gun is as follows. The reservoir 18 is charged with a compressed gas, preferably air, through the check valve 23, to a desired pressure. The gun is then taken by the diver underwater to allow the barrel to be filled with water. The spear 31 is now inserted into the open end of the barrel extension 14, as shown in Fig. 1. The gun is cocked to firing position by manually forcing the spear through the barrel towards the rear of the gun. The O-ring 33 on the spear shaft 32 prevents the water in the barrel from leaking past the spear, and thus the spear shaft acts as a piston to force the water in the barrel towards the closed end of the barrel. This forced water will exert a pressure on the diaphragm 19, compressing the air in the reservoir and causing the diaphragm 19 to flex towards the closed end 24 of the reservoir, as shown in Fig. 2. As the shaft is pushed into the gun, the rear end of the shaft will engage the trigger piston 43 to hold the spear in cocked position.

It may be desirable to vary the cocked pressure exerted by the compressed air in the reservoir to meet various needs of the diver. This may be done by a manual adjustment of the piston 26 in the reservoir 18. To increase the internal pressure the diver may turn the adjusting knob 28 to force the piston 26 to move to the left, causing a further compression of the entrapped air. The mechanical advantages obtained by the adjustment screw 27 enable the reservoir pressure to be increased easily. Conversely, the internal reservoir pressure may be decreased by causing the piston 26 to move to the right, allowing the enclosed air to expand while the gun is in cocked position. As may be seen, this movement of the piston 26 varies the extensible volume of the reservoir 18.

Alternatively, or in addition, the initial cocked pressure may be increased by forcing water, by means of a hand pump (not shown) into the gun bore 13 through the check valve 54, after the gun is cocked. The additional water added to the gun bore will cause the diaphragm 26 to be forced further towards the right, thereby increasing the internal pressure of the reservoir.

The gun is fired from its cocked position by pulling the trigger member 37. This releases the latching member 43 from engagement with the spear which is now free to move through the barrel of the gun under the force of the compressed air in the reservoir 18. The diaphragm 19 moves toward the spear shaft forcing the water in the barrel to eject the spear from the gun. After the gun is fired, it may be reloaded simply by inserting another spear in the barrel and forcing it into the gun. As no air is lost on each shot, it is not necessary to recharge the reservoir 18 for each shot. Rather, the gun may be used for as many shots are are desired without requiring any addition of gas into the reservoir.

It is important to note that the diaphragm 19 may be made very light in weight, for it is subjected only to compressive forces, and is not subjected at all to stretching forces. With the gun unloaded but the reservoir charged with compressed gas, the diaphragm will lie against the enlarged bore section 16, and the only stress will be a compressive force causing the diaphragm to snugly fit the bore section 16. In the cocked position the diaphragm will have flexed towards the rear of the gun, but the pressure on both sides of the diaphragm will be equal, with the diaphragm merely acting as a separation wall between the liquid and the gas. The lack of stretching

forces on the diaphragm greatly lengthens the life of the diaphragm. Also, at no time is there any contact of the diaphragm by the spear shaft, eliminating any possible damage to the diaphragm by the shaft.

The embodiment illustrated in Fig. 3 utilizes the same principles disclosed above, but further illustrates the manner in which the gun may be modified to obtain the same results. The reservoir **61** comprises a housing **62** screw threaded into the body **11** as before, and a collapsible bladder **63** secured to the rear wall **64** of the housing. A check valve **65** enables the bladder to be charged with a compressible gas as before.

The trigger means illustrated in this embodiment comprises a trigger member **66** pivotally mounted on the body **11** on pivot pin **67**. A valve **68**, adapted to seat on valve seat **69**, has a valve stem **71** extending through the body to cooperate with pivot pin **72** on the trigger member **66**. The valve stem **71** has a longitudinal slot **73**, allowing the valve to open without moving the trigger member. The valve **68** is disposed between the bladder **63** and the rearmost position of the spear shaft **32**.

The operation of this embodiment is essentially the same as described above. As the spear is forced into the barrel the water in the barrel will be forced past the valve **68**, which opens against the relatively slight bias of compression spring **74**, into the reservoir housing **62** to collapse the bladder **63**, thereby further compressing the gas enclosed therein. After the spear is in position the gun is again ready to fire. The pressure exerted on the lower face of the valve **68** maintains the valve in closed position to prevent loss of pressure. If desired, additional water under pressure may be forced into the reservoir housing **62** by means of the check valve **54**, to increase the cocked pressure.

Firing the gun is accomplished by pulling the trigger member **67**, thereby causing the valve stem **71** to move downwardly under the influence of pivot pin **72**. As the valve **68** is cracked open the escaping water forces the valve to open suddenly, allowing the water to pass freely into the gun barrel from the housing member **62** to eject the spear.

Fig. 4 illustrates a further modification of the reservoir. In this embodiment, a free piston **71** is mounted for axial movement in the reservoir housing **72**, the O-ring **73** preventing fluid flow between the piston and the housing. Air is charged into the reservoir housing **72** through the check valve **74**, forcing the piston **71** to the left, where it comes to rest against the stop shoulder **75** of the body **11**. As the gun is loaded, the column of water in the barrel will force the piston **71** rearwardly to compress the gas enclosed in the reservoir housing **72** to build up the cocked pressure. This movement of the piston **71** in effect collapses the air enclosing reservoir. The further operation of the gun is identical to that of the embodiment shown in Figs. 1 and 2.

As may be appreciated the various forms of collapsing reservoirs may be used with either the trigger means shown in Figs. 1 and 2 or with the trigger means shown in Fig. 3, as the overall operation of the gun will be the same.

It is to be understood that the forms of the invention, herewith shown and described, are to be taken as preferred samples of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of the invention, or the scope of the attached claims.

Having thus described our invention, we claim:

1. An underwater spear gun comprising a tubular barrel closed at one end and adapted to be filled with liquid, a collapsible reservoir enclosing a compressible gas carried in said barrel, a spear having a shaft closely fitting in the other end of said barrel, whereby when said spear is inserted in said barrel the shaft acts as a piston to cause the liquid in said barrel to collapse said reservoir and compress said gas enclosed therein, said shaft of said spear having a notch therein adjacent one end thereof, a first lateral bore in said barrel, a latch pin carried in said first bore and having one end thereof adapted to engage said notch to hold said spear in inserted position in said barrel, a trigger member pivotally connected to the other end of said latch pin, a second lateral bore in said barrel spaced longitudinally thereof from said first bore, a balance pin carried in said second bore and having one end thereof pivotally connected to said trigger member and the other end exposed to the interior of said barrel, said trigger member being pivotally mounted on the exterior of said barrel with the pivotal connection of said trigger member to said barrel being between the pivotal connection of the trigger member and the latch pin and balance pin and closer to the latch pin.

2. An underwater spear gun comprising a tubular barrel having a bore therethrough, said bore being closed at one end thereof, a movable member in said bore spaced from said closed end and sealed with respect to said bore to form a compressible reservoir in said barrel, a piston in said bore disposed between said movable member and said closed end, manually operable means to move said piston towards and away from said closed end, and a spear having a shaft closely fitting in the other end of said bore.

3. A device as set forth in claim 2 further including check valve means in said barrel to admit gas under pressure between said movable member and said piston.

4. A device as set forth in claim 2 wherein said movable member is a diaphragm disposed across said bore and sealed thereto.

5. A device as set forth in claim 2 further including releasable latching means engaging said shaft to hold said spear in said bore after insertion therein.

6. A device as set forth in claim 5 further including a check valve means in said barrel to admit fluid under pressure between said held spear and said movable member.

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