United States Patent [19]

Alderson

[11] **3,780,720**

[45] **Dec. 25, 1973**

[54] **COMPRESSED AIR SPEAR PROJECTING DEVICE**

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[22] Filed: **Mar. 31, 1971**

[21] Appl. No.: **130,008**

Related U.S. Application Data

[63] Continuation of Ser. No. 826,764, April 28, 1969, abandoned, which is a continuation-in-part of Ser. No. 586,747, Oct. 14, 1966, abandoned.

[52] **U.S. Cl.** ..... **124/11 A,** 124/31, 124/41, 251/263, 273/106 R, 124/30 B

[51] **Int. Cl.** **F41b 11/00**

[58] **Field of Search** ..... 124/11 A, 41, 31, 124/30 B, 13 A, 11 R; 273/95 A, 106 R; 43/6; 251/DIG. 2, 263, 267

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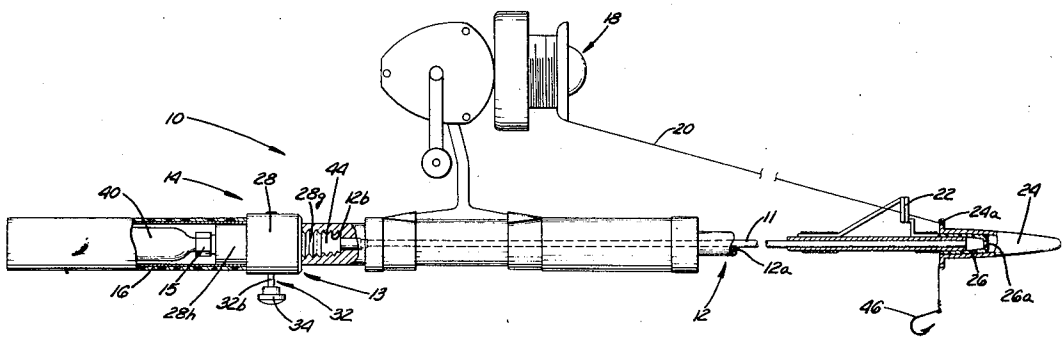
[57] **ABSTRACT**

A valve, connectable to a source of compressed gas, having a closing member movable into and out of a valve closing position, and a triggering mechanism by which the closing member can be moved from that position. Gas pressure in the valve holds the closing member in its valve closing position until the triggering mechanism is actuated. The triggering mechanism includes a cam segment and a cam follower pin, the pin being positioned to unseat the closing member when induced to do so by movement of the cam segment. The valve can be used to control the flow of propulsion gas through a spear-fishing gun. A spear is mounted on a rod through which compressed air is forced. The compressed air is forced out through openings in the side of the rod so as to act on a flexible sleeve which in turn acts against the open end of the spear mounted on the sleeve. The pressure on the open end of the spear holds the spear in place while sufficient pressure for projecting the spear is being built-up in the hollow portion of the spear. The closed end portion of the hollow area of the spear is adjacent the open end of the rod from which the compressed air flows.

1 Claim, 10 Drawing Figures



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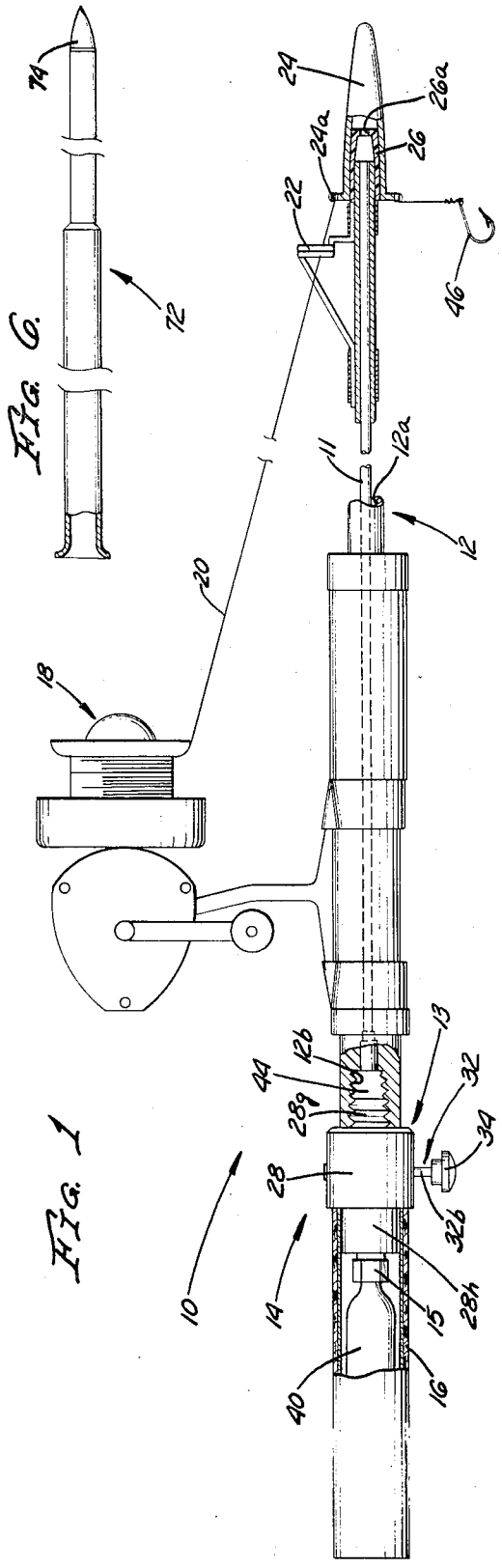

FIG. 1

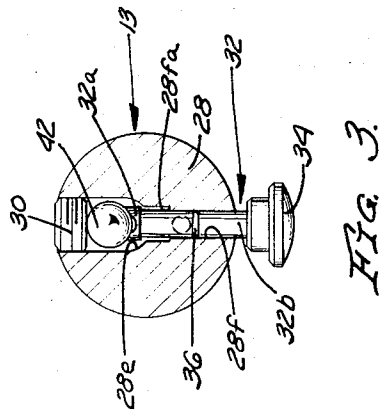

FIG. 3

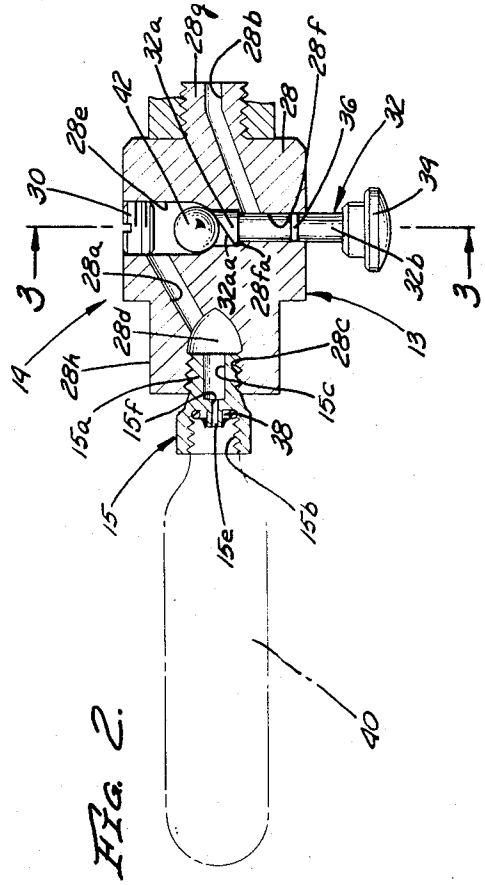

FIG. 2

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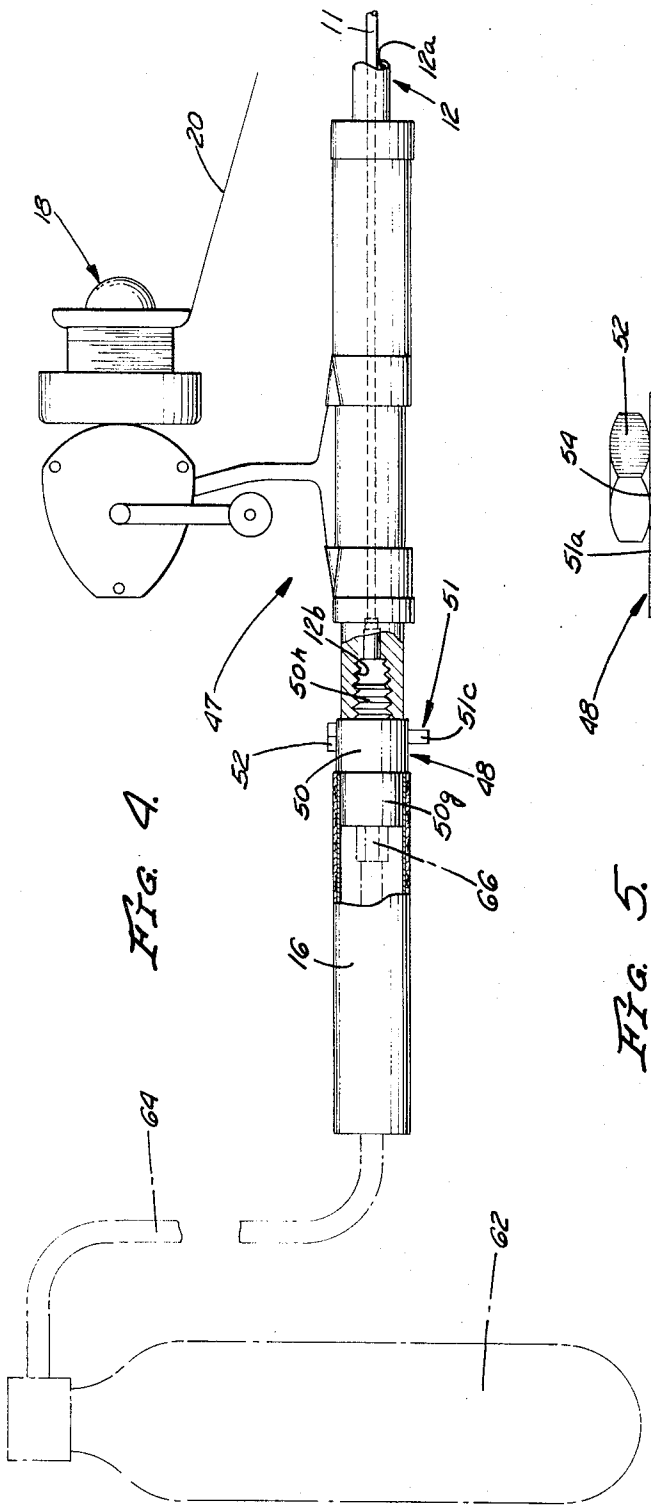

FIG. 4.

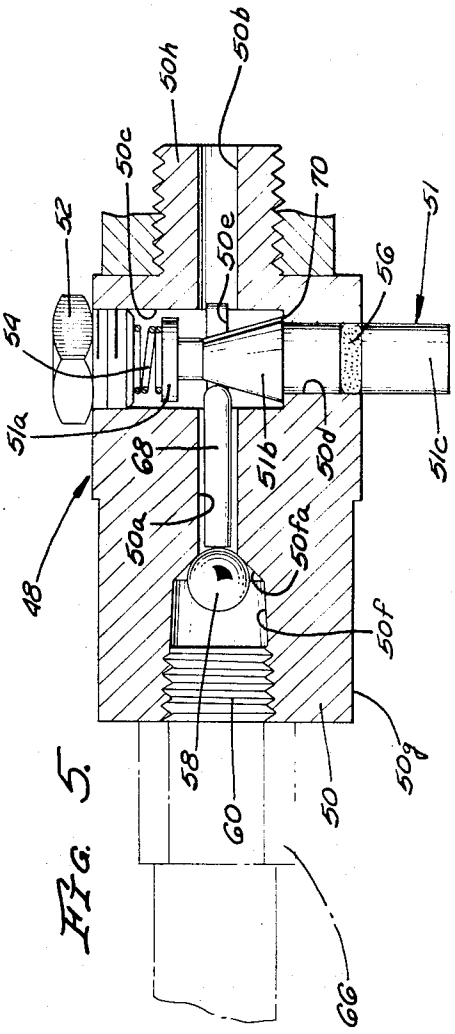

FIG. 5.

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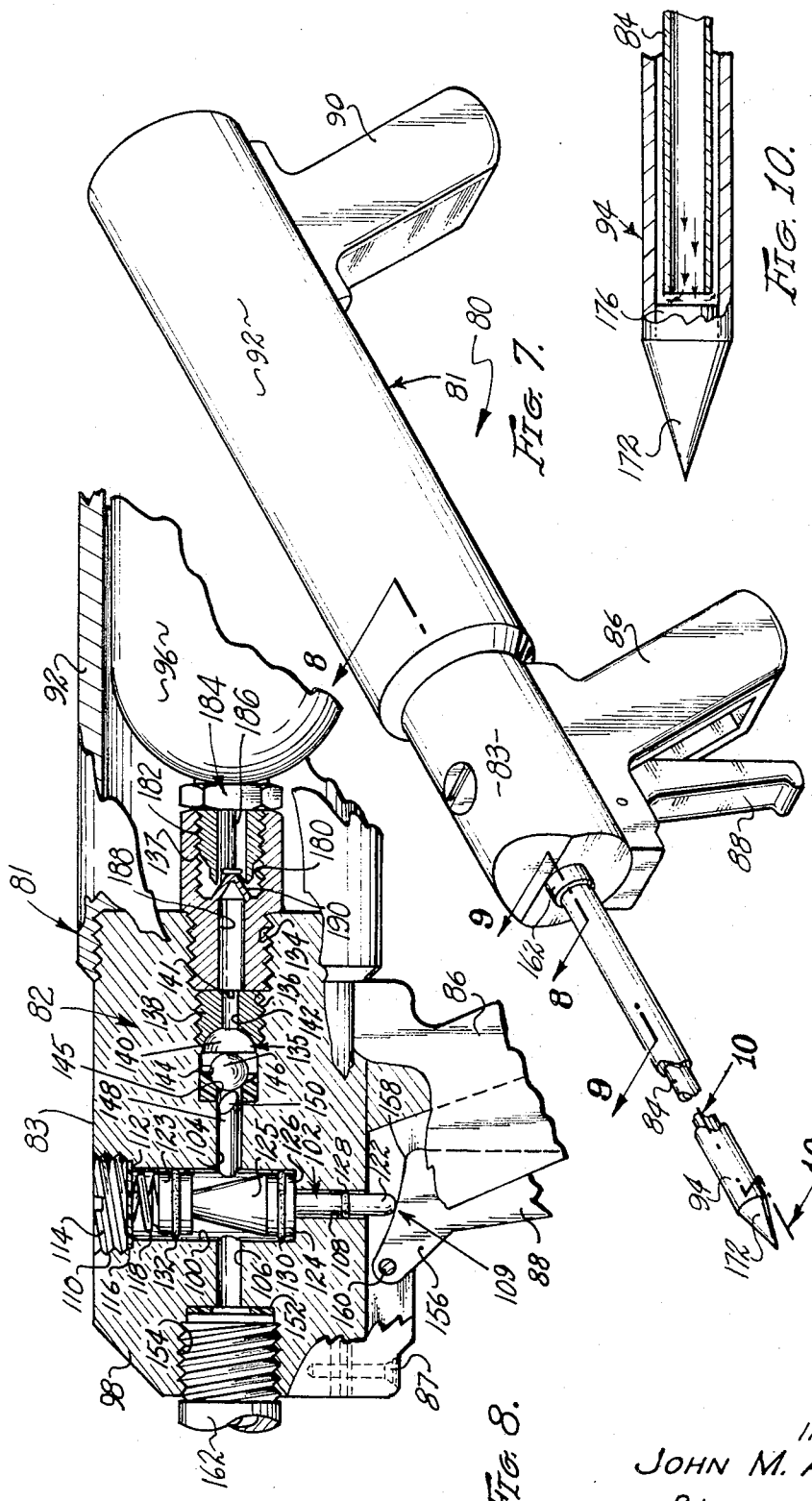

FIG. 7.

FIG. 10.

FIG. 9.

FIG. 8.

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COMPRESSED AIR SPEAR PROJECTING DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of my copending U. S. application Ser. No. 826,764, filed Apr. 28, 1969, now abandoned which is a continuation-in-part of my copending U. S. application Ser. No. 586,747, filed Oct. 14, 1966, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to fluid flow control valves, and more particularly to such a valve of quick-opening character suitable for use in gas-actuated spear guns, and the like, for triggering the flow of propulsion gases therethrough.

Underwater spear fishing is becoming more and more popular, as a sport and hobby, among water enthusiasts. Most presently conventional spear guns are designed to shoot spear-like projectiles with great force, using powerful rubber bands as the spear propelling means. These guns, while quite effective at close range, are relatively ineffective at distances greater than about 25 feet. This puts a spear-fishing diver at a disadvantage when confronted by a dangerous fish, since he must wait until the fish is far too close for comfort before he can use his weapon defensively with any hope of success.

Conventional spear guns of the type referred to above are essentially one-shot weapons, which must be reloaded before every shot. This is a disadvantage, particularly in the case of a diver threatened by a shark, or the like, where a miss with the first shot might not leave him time enough to reload before he is attacked. Also, the short range and single-shot character of such spear guns would make them somewhat unsatisfactory as defensive weapons for underwater demolition specialists (frogmen) in time of war. While it is perhaps unlikely that frogmen would ever engage in underwater combat with an enemy, in the event this should occur, there would be an urgent need, I believe, for an underwater weapon of far greater effectiveness than any conventional spear gun of which I am aware.

It is common knowledge that a certain amount of strength and skill is required to accurately cast fishing lures with conventional tackle. This is particularly true under conditions of rough weather, or where space is cramped, as in small boats, on crowded piers, etc. Many of the pleasures of fishing are thus lost to older persons, invalids, small children, etc., who, for one reason or another, are incapable of properly casting bait with a rod and reel, but are otherwise capable of handling a fishing line. Moreover, even where fishermen are high skilled at such bait casting, there is always an element of danger from flying hooks, especially where such individuals are fishing in close quarters. Consequently, although it can bring much joy and pleasure to experienced fishermen under ideal circumstances, the conventional rod and reel has certain shortcomings which prevent its full use and enjoyment by a relatively large segment of the fishing community.

SUMMARY OF THE INVENTION

The novel valve of this invention is designed primarily for use in pressurized gas systems, wherein it is normally maintained in the closed position by gas pressure, yet can be opened instantaneously through the triggering of a unique opening mechanism, hereinafter to be described. The valve has a body with an internal seat for a closing member, typically a ball, and, in its preferred form, has a movable cam and cooperating cam follower pin. The cam and cam follower pin are arranged so that movement of the cam urges the follower pin into unseating contact with the closing member, when the latter is in its seated position within the valve body. Such contact unseats the closing member and causes the valve to open. The cam and cam follower pin thus comprise the valve opening mechanism referred to above.

To make the above-described action possible, the closing member is positioned upstream of the valve seat, in the valve body, and the cam follower pin is positioned downstream of that member so as to unseat the latter against the force of the upstream pressure of the fluid, when actuated to do so by movement of the cam. As will be evident from this description of the manner of functioning of the parts of the valve, the aforesaid seat for the valve closing member is disposed about a passageway for the fluid in the valve body, and the cam follower is positioned to ride back and forth in the opening defined by the seat as it moves between its valve-open and valve-closed positions in use.

While this summary is necessarily brief, it will, it is believed, be evident that fluid pressure on the valve closing member keeps it firmly positioned in the valve seat, to shut off fluid flow through the valve, when the valve is installed for service in a fluid system. It should also be evident that actuation of the valve opening mechanism in the above-indicated manner causes the valve to open and permit an instantaneous surge of fluid to pass. While the valve has many applications, it is particularly useful as a control valve for gas-powered propulsion devices. One such device, which I have built and successfully tested, is adapted for use as an underwater spear gun. The gun has a throw range substantially greater than that of a conventional spear gun, and is of simple and lightweight construction and attractive appearance. A similar type of device, described in detail hereinafter, is adapted to cast bait automatically. This device requires almost no strength or skill for successful operation and poses substantially no hook-snagging hazard to nearby persons, as does the casting technique employed with a conventional rod and reel.

It is a principal object of this invention to provide a highly sensitive, quick-response valve for use in high pressure fluid systems.

It is another object of the invention to provide such a valve particularly suitable for use as a triggering means for gas-powered propelling devices.

It is still another object of the invention to provide a lightweight underwater spear gun of simpler construction, and greater ease and convenience of use, than presently available spear guns.

Yet another object of the invention is to provide such a spear gun having a range much greater than can be achieved with a conventional spear gun.

A still further object of the invention is to provide such a spear gun capable of rapid reloading for emergency purposes.

Another object of the invention is to provide a gas-powered fishing rod which can be made to cast bait with a minimum of skill and effort, and substantially no snagging hazard to nearby persons.

Other objects, features and advantages of the invention will become apparent in the light of subsequent disclosures herein.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an interrupted side view, partly in section and partly in elevation, of a lure casting device in accordance with my invention loaded for casting purposes, certain hidden details being shown in dashed lines.

FIG. 2 is an enlarged view, mostly in longitudinal section, of a valve and adaptor constituting part of the FIG. 1 casting device, showing, in phantom outline, a small cartridge of compressed gas in coupled relationship with the adaptor, and illustrating the valve in its closed position.

FIG. 3 is a view, mostly in cross section, of the aforesaid valve, taken along line 3—3 of FIG. 2, but showing the valve in an open position.

FIG. 4 is a fragmentary side view, partly in elevation and partly in section, of a second lure casting device in accordance with my invention, having a different valve from that of the FIG. 1 device, and coupled with a relatively large container of powering gas by means of a hose, the hose being shown in interrupted view and both the container and illustrated portions of the hose being shown in phantom lines.

FIG. 5 is an enlarged, fragmentary view, mostly in longitudinal section, of the FIG. 4 device and an adaptor by means of which it is connected to the aforesaid hose, an end segment of the hose with an attached fitting to permit it to be fastened to the adaptor being shown in phantom lines.

FIG. 6 is an interrupted longitudinal view, mostly in elevation, but partly in section, of a spear suitable for use with an underwater spearfishing gun in accordance with this invention.

FIG. 7 is an interrupted perspective view of a preferred embodiment of a loaded spear gun in accordance with this invention.

FIG. 8 is an enlarged, fragmentary view, mostly in longitudinal section, of the spear gun, taken along line 8—8 of FIG. 7 and showing a fragmentary portion of a container of powering gas coupled to the gun for spear firing purposes.

FIG. 9 is an enlarged, fragmentary view, taken mostly in longitudinal section along line 9—9 of FIG. 7 of a segmentary portion of the spear gun.

FIG. 10 is an enlarged, fragmentary view, taken mostly in section along line 10—10 of FIG. 7, of the forwardmost part of the loaded spear gun.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Considering now the drawings in greater detail, with emphasis first on FIGS. 1, 2 and 3, there is shown generally at 10 a fishing rod apparatus in accordance with this invention, referred to hereinafter as fishing rod 10. Fishing rod 10 is shown with a conventional spinning reel 18 attached, on which is wound a length of fishing line 20. The outer end of the line is fastened to a cap-like projectile 24, subsequently to be described. Fishing rod 10 comprises a rod section 12, referred to hereinafter as rod 12, a gas control valve section 14 and a handle 16.

Rod 12 tapers towards its outer end similarly to the way a conventional fishing rod does, and has a concentric bore 12*a* which diminishes in cross section in a pattern corresponding to the taper pattern of the rod. While the rod is shown to be of metal construction, it could be made of any other material suitable for fishing rod purposes, such as fiberglass, glass spar, and the like. Running throughout bore 12a of the rod is a metal tube 11. Tube 11 is sized to fit tightly within the bore of rod 12 at its smaller (outer) end, and is concentrically supported within the larger end of the bore by a shouldered sleeve, in the manner illustrated in FIG. 1. The fit of tube 11 within this sleeve is gas-tight, and the same is true of the fit between the sleeve and bore 12*a*. A suitable cement, or other sealant, can be employed to insure an effective seal between the contacting surfaces of the tubular parts, if desired. Tube 11, similarly to rod 12, can be made of any suitable material, metal or nonmetal, within the scope of my invention.

While the size of tube 11 is not critical, so long as it is sufficient to permit a fairly rapid flow of gas through the tube for a reason hereinafter appearing, I have found a tube of approximately 1/16-inch i.d. very satisfactory for use in a six-foot rod with a hollow core such as described above. It is not necessary that the rod be six feet long, and it can, if desired, be substantially shorter than this because of the unique manner, soon to be described, in which my fishing rod device functions. A rod of more conventional length might, however, be preferred to a shorter one, because of the familiar feel and balance, and possibly greater effectiveness in playing a hooked fish, of the former.

Fishing rod 10 utilizes compressed gas from any convenient source, such as a CO_2 cartridge, to propel cap-like projectile 24, and a baited hook, or lure, to a desired spot on the water for bait casting purposes. A CO_2 cartridge of this type is shown coupled to the fishing rod at 40 in FIGS. 1 and 2 of the drawings. The propulsion gas for cap-like projectile 24 travels from cartridge 40, or an equivalent source such as will presently be described, through tube 11, in amounts controlled by the action of a unique valve 13 comprising, as will be seen, the major component of control valve section 14.

Control valve section 14 comprises the heart of fishing rod 10, serving to feed gas from a pressurized source, such as cartridge 40, to cap-like projectile 24. The control valve section consists of valve 13 and an adaptor 15, coupled together in a manner soon to be described, the adaptor being present to provide a means of communication between cartridge 40 and valve 13 for fishing rod powering purposes. Valve 13 is preferably made of a lightweight, oxidation-resilient metal, such as aluminum, but can, if desired, be constructed of any other suitable metal. The valve has, as essential parts, a body 28 and a valve opening pin 32, the pin being mounted to slide within a shouldered bore in the body in a manner, and for a purpose, hereinafter appearing.

In addition to the above-mentioned parts, valve 13 has a threaded plug 30 which fits into a threaded opening at the top of a chamber or cavity 28*e* within the valve body, later to be described, and a metal ball 42 sized to fit loosely within the cavity. Ball 42 is preferably made of steel, although it can be formed of any other material (metal, plastic, or the like) which permits it to block an internal opening in the valve body (hereinafter to be described) in gas-tight relationship.

The right end of valve 13, as seen in FIG. 1, is connected to the butt of rod 12 by means of a threaded

boss 28*g*, which mates with a threaded socket 12*b* in the rod in the illustrated manner. A gas-tight fit between the mating threads of the boss and socket is, of course, necessary for proper functioning of the fishing device. To provide greater assurance of such a fit, these threads can be tapered and, if desired, cemented together with a satisfactory sealant, such as, for example, a suitable epoxy resin.

The length of boss 28*g* of the valve body is less than that of socket 12*b* in rod 12, so that a space 44 is formed between the outer end of the boss and the bottom of the socket when the rod and valve body are fastened together. This space serves as a plenum chamber to reduce pressure and flow turbulence in the gas passing through the rod. The presence of such a chamber is not critical to proper functioning of the fishing rod, however, and the chamber can be eliminated entirely from the rod, if desired.

As FIGS. 2 and 3 illustrate, chamber 28e extends upwardly from about the vertical midpoint to an opening in the top of the body of valve 13. The valve body has, in addition to chamber 28*e*, an inlet passageway 28*a* opening into the chamber; a shouldered downbore 28*f* extending vertically downwardly from the bottom of the chamber; and an outlet passageway 28*b* running off of the downbore and extending upwardly, and to the right, as seen in FIG. 2, to form a concentric opening in the exposed face of boss 28*g*. Chamber 28*e* is of cylindrical shape and round cross section throughout most of its length, with walls which converge at its bottom to form a hemispherical seat for the metal ball 42. The seat is sized to loosely receive the ball and guide it to a sealing fit over the upper opening of downbore 28*f*, which latter is, as FIGS. 2 and 3 illustrate, coaxial with chamber 28*e*.

The upper part of chamber 28*e* is tapped to receive the threaded plug 30 in gas-sealing relationship. The threaded plug is designed to fit almost completely within the chamber opening and leave substantially no part extending outwardly from the surface of the valve body. The plug serves the principal purpose of affording easy access to chamber 28*e*, but is not a critical part of the valve. Consequently, the plug could be dispensed with and the upper end of chamber 28*e* permanently closed, if desired, within the scope of my invention.

Running inwardly from the left face of valve body 28, as viewed in FIGS. 1 and 2, is a cavity with a threaded portion 28*c*, tapering slightly to the right, and a smooth-sided portion forming a sharply converging chamber 28*d* of bullet-shaped configuration. Inlet passageway 28*a* of the valve is in open communication with chamber 28*d*, and runs diagonally upwardly from the upper part of the latter to a point well above the seated position of ball 42 in chamber 28*e*, all as illustrated in FIG. 2.

The valve opening pin 32 has a push button configuration 34 (hereinafter push button 34) at its lower end, an elongate shaft segment 32*b* and an enlarged head 32*a*. The enlarged head 32*a* of the pin has a beveled face 32*aa* which slopes from an apex at one edge of its cross section to the diagonally opposite edge of the cross section at a point above the base of the head. Valve opening pin 32 is positioned to move vertically within downbore 28*f*, and the latter is divided between upper and lower portions of differing diameter separated by a shoulder 28*fa*. The dimensions of the downbore are such that the pin can fit loosely therein with the bottom edge of its head resting on shoulder 28*fa*. When the valve opening pin is so positioned, ball 42 can seat itself in the hemispherical lower end of chamber 28*e* to seal off the upper opening of the downbore, and close the valve. The axial dimensions of head 32*a* and the enlarged portion of downbore 28*f* are such as to assure barely touching contact between the upper tip of pin 32 and ball 42, when the pin and ball are in the closed-valve positions just described.

The upper and lower segments of downbore 28*f*, the base of the head of pin 32 and the shaft segment of pin 32, are all of round cross section. The mating segments of the downbore and pin are sized to permit sufficient clearance therebetween to allow gas to flow around the pin in the downbore, when valve 13 is open, to the open end of outlet passage 28*b* in the wall of the downbore. The position of this oppn end, as FIGS. 2 and 3 illustrate, is below shoulder 28*fa* in the downbore. There is a rubber O-ring 36 seated in a mating groove around the shaft portion of pin 32. The groove is positioned to permit up-and-down movement of the O-ring in the lower portion of downbore 28*f* between the bottom of the valve body and the end of outlet passage 28*b* in the wall of the downbore. The O-ring serves as a seal to prevent gas leakage from the valve body through downbore 28*f*.

The flow of operating gas for fishing rod 10 from a suitable gas source is manually controlled by means of valve 13. When the valve is opened, inflowing gas from the gas source passes through adaptor 15 and enters chamber 28*d*, from whence it travels through inlet passage 28*a* and into chamber 28*e*. Where the gas source is a CO_2 cartridge, such as cartridge 40, its initial pressure will ordinarily be within the range from about 850 to 1100 psi, depending upon the temperature, and as it fills chamber 28*e* it exerts sufficient pressure on ball 42 to hold the latter in its seat in the chamber, and thereby maintain the valve in its closed position. This automatic shut-off feature sharply distinguishes the action of the valve from that of a conventional ball-check, or similar type of, valve, in which fluid pressure acts against an internal valve force to open the valve, at a predetermined pressure level, rather than to keep the valve closed.

To open valve 13, it is only necessary to press push button 34 hard enough to move the head of pin 32 upwardly and dislodge ball 42 from its seated position within the valve body. Very little force is required to do this, even where there is a relatively high gas pressure within chamber 28*e*, since the ease of ball dislodgement is greatly benefited by the tangential manner in which the head of pin 32 contacts the ball. As soon as ball 42 is moved away from its seat in chamber 28*e*, the gas within the chamber is free to escape into the annular space between downbore 28f and pin 32, and through outlet passage 28*b*, from whence it flows into tube 11 of rod 12. A mere tap of push button 34 is sufficient to provide a rapid flow of gas through valve 13 and into tube 11, and a quick build-up of gas pressure within the tube. The release of upward pressure on pin 32 causes it to drop once more into its lowermost position within downbore 28*f*, with the bottom of its head resting on shoulder 28*fa*, thus permitting ball 42 to again seat itself over the upper opening of the downbore and close the valve. FIG. 3 shows the valve in its wide open position, with pin 32 pushed upwardly to its fullest extent and ball 42 in contact with the underside of threaded

plug **30**. It is generally unnecessary to hold the valve open for very long for bait casting purposes, a light tap on push button **34** being adequate, in most cases, for successful operation of the fishing rod.

Adaptor **15** has a male segment **15***a* and a female segment **15***b*. The male segment is threaded to engage the tapped portion **28***c* (referred to hereinafter as passageway **28***c*) of the cavity terminating in chamber **28***d* in the valve body. The adaptor has a concentric bore **15***c* running through its male segment to open communication with chamber **28***d* when it (the adaptor) is threadedly engaged with passageway **28***c* in the above-indicated manner. Extending from the bottom of, and concentrically within, the female segment of adaptor **15** is a thin tubular projection **15***e*. Projection **15***e* has a hollow bore which is continuous with a bore **15***f* of the same size penetrating an inner web of the adaptor to communication with bore **15***c* of male segment **15***a*, as illustrated in FIG. **2**.

Female segment **15***b* of the adaptor is designed to receive the neck of cartridge **40** in threaded engagement, as best illustrated in FIG. **2**. Cartridge **40** is a commonly available type of CO_2 cartridge, intended primarily for fire extinguisher, pellet rifle, seltzer bottles, etc., use, containing approximately 16 grams of carbon dioxide. Cartridges of this type have relatively thick walls, except for their discharge ends, which have thin, frangible enclosures. Fishing rod **10** is prepared for loading with cartridge **40** by first screwing adaptor **15** tightly into passageway **28***c* of valve **13**. Cartridge **40** is then screwed tightly into female segment **15***b* of the adaptor, as a result of which the tubular projection **15***e* penetrates the frangible covering over the front end of the cartridge, allowing carbon dioxide to escape therefrom and flow through bore **15***f* of the adaptor, from whence it passes through bore **15***c* and into chamber **28***d* of the valve. From chamber **28***d*, the carbon dioxide passes through inlet passage **28***a* and into chamber **28***e* of the valve body. Fitted around the outer periphery of the bottom of female segment **15***b* of the adaptor is a rubber O-ring **38**, which serves as a gas seal between the adaptor and cartridge when they are coupled together.

Cartridge **40** fits inside handle **16** of fishing rod **10**, when the rod is loaded for use as described above. To make this possible, handle **16** is of round cylindrical shape, open at both ends, and sized to frictionally engage a reduced segment **28***h* of the body of valve **13**. The handle comprises a metallic inner cylinder, preferably of aluminum or other lightweight metal construction, covered by a layer of cork. It will be apparent that cartridge **40** can be easily attached to the fishing rod by simply removing the handle from the rod, screwing the cartridge into female segment **15***b* of adaptor **15** and then replacing the handle on the rod.

As previously indicated, gas from a source other than cartridge **40** can, if desired, be employed to power fishing rod **10**. For example, a relatively large bottle or cylinder of CO_2 could be employed in lieu of cartridge **40**, in which case adequate coupling means between the cylinder or bottle and valve **13** would have to be provided. Such a bottle of CO_2 is shown in coupled relationship with a modified form of fishing rod **10** in FIG. **4**. Although the valve of the FIG. **4** fishing rod is different in detail from valve **13** of fishing rod **10**, it is designed to receive an adaptor similarly to the way the latter does, as FIG. **5** illustrates. The CO_2 bottle and fishing rod (FIG. **4**) are connected by means of a hose and an adaptor designed to permit coupling of the hose to the rod. The same type of arrangement could, of course, be provided for use in conjunction with fishing rod **10**, to permit the latter to be fed from a gas bottle such as shown in FIG. **4**.

Tightly fitted over the outer end of rod **12** is a plastic thimble **26**. The thimble is pushed only partway onto the rod so that a portion is left to extend outwardly from the rod tip. This outwardly extending portion of the thimble tapers gradually to a flat outer end, which has a round, concentric opening **26***a* through which gas can pass. The cap-like projectile **24**, previously mentioned, is adapted to fit frictionally over plastic thimble **26** and is enclosed at its outer end. The projectile is of metallic construction and tapered toward its outer end to permit a gradually tightening friction fit with the thimble as it is pushed further thereonto. As previously indicated, the projectile is shot from the rod by gas pressure, for bait casting purposes, when push button **34** of valve **13** is pressed. The projectile can be pushed to varying degrees of tightness on thimble **26** for control of its throw range, since the tighter its friction fit on the thimble, the higher will be the gas pressure required to force it off, and the farther the projectile will subsequently travel.

As will be evident from FIG. **1**, there is a hollow space in cap-like projectile **24** between its enclosed end and the forward end of thimble **26**, when the projectile is installed on the thimble as described above. This is advantageous in providing wall surface within the projectile for gas pressure to work against when the fishing rod is "fired." The gas pressure causes the projectile to expand radially outwardly so that its friction fit on thimble **26** is loosened to the point at which it (the projectile) is freed from gripping contact therewith.

Thimble **26** is made of plastic to provide a low-friction surface of contact for cap-like projectile **24**, since it is essential to proper functioning of the fishing rod that there be enough lubricity at the projectile-thimble interface to assure effective separation of the projectile from the rod tip when fishing rod **10** is triggered for use as taught herein. In order to assure such lubricity at the projectile-thimble interface, either the projectile, thimble, or both, can be of plastic construction. Where neither part is plastic, adequate lubricity can still be achieved by modifying the thimble as necessary and installing one or more rubber or plastic O-rings around its outer wall, or by employing equivalently suitable modifying means.

Extending diametrically outwardly from the wall of cap-like projectile **24**, adjacent its open end, are two projections of equal size, each having a small eyelet **24***a* near its outer extremity. The two eyelets **24***a* are adapted to receive a fishing line, such as line **20**, to permit the fastening of projectile **24** to the line. In the FIG. **1** fishing rod assembly, fishing line **20** passes through both eyelets **24***a*, and then extends for a short distance to provide an end to which a fishing hook **46** is tied, all as illustrated in the drawings. When hook **46** is baited, and fishing rod **10** is triggered for bait casting purposes, cap-like projectile **24** is forced from the end of rod **12** and propelled, along with the baited hook, through the air to a particular spot on the water. The projectile acts as a sinker to carry the bait underwater, and the fisherman can thereafter manipulate the line in much the

same way he would play a similarly baited line cast in the conventional manner.

Line **20** is guided to cap-like projectile **24** through an eyelet guide **22** fastened to rod **12** near its outer end in the manner illustrated in FIG. **1.** It is within the scope of my invention to employ several eyelet guides along rod **12,** and this would, in fact, be preferred to the use of only one guide in some instances. Fishing rod **10** is not limited to use with a spinning reel, such as illustrated at **18,** and can be employed in conjunction with any other type of fishing reel within the scope of this invention.

Fishing rod **10** is operated by aiming it in the proper direction and pressing push button **34** of valve opening pin **32.** This opens the valve **13** and permits gaseous carbon dioxide to flow rapidly into tube **11** of rod **12.** The carbon dioxide then flows through opening **26*a*** of thimble **26,** and into the hollow space beyond the end of the thimble in cap-like projectile **24.** The resulting gas pressure within cap-like projectile **24** forces it from the end of the fishing rod and imparts sufficient thrust thereto to propel it in the direction in which the rod is aimed. The travel distance of the projectile is determined, in large part, by the tightness of friction fit between the projectile and the thimble, and the gas pressure inside the projectile. The fishing rod is capable of propelling the projectile substantial distances, even under relatively light gas pressures. For example, the projectile can be thrown from about 200 to about 300 feet at gas pressures within the range from about 150 to about 250 psi.

FIGS. **4** and **5** show generally at **47** a modified form of fishing rod **10,** referred to hereinafter as fishing rod **47.** Fishing rod **47** differs primarily from fishing rod **10** in the structural particulars of its valve, shown at **48** in coupled relationship with an adaptor **60.** Adaptor **60** is, as previously indicated, of a type designed to receive a high pressure hose from a gas bottle, such a hose and gas bottle, as well as a fitting on the hose to permit its coupling with the adaptor, being shown in phantom lines at **64, 62** and **66,** respectively, in FIGS. **4** and **5.** Fishing rod **47** has a reel **18,** identical to reel **18** of fishing rod **10,** attached thereto in the manner illustrated in FIG. **4.**

Valve **48,** similarly to valve **13,** is maintained in its closed position by the pressure of gas from a feed source (here gas bottle **62**) and has a unique cam-pin mechanism, operable by push botton means, for dislodging a ball **58** from a gas-sealing position within the valve body for valve opening purposes, all as hereinafter explained. Valve **48** consists of a slightly elongate valve body **50,** the aforesaid ball **58,** a cam pin **51,** a cam follower pin **68,** an O-ring **56** (seated on the cam pin), a biasing spring **54** (for the cam pin) and a threaded plug **52.** Valve body **50** is of round cross section throughout its length, and shouldered upstream of its longitudinal center in such fashion as to provide a diametrically reduced segment **50*g***, sized to receive a hollow cylindrical handle **16** in the manner illustrated in FIG. **4.**

In addition to its reduced segment **50*g***, valve body **50** has a concentric downstream boss **50*h***, externally threaded and properly sized for substantially gas-tight coupling with a socket **12*b*** in the butt end of a rod **12** forming a part of fishing rod **47.** Rod **12,** as well as the remaining parts of fishing rod **47,** other than valve **48,** are similar to the corresponding parts of fishing rod **10,** hence are identified on the drawings by the respective reference numerals of the latter parts.

Valve body **50** has a concentric chamber **50*f*** openly accessible through an opening in its upstream face. The wall of chamber **50*f*** tapers slightly inwardly for most of its length and is threaded for slightly more than half of this distance, all as shown in FIG. **5.** The threaded portion of the chamber is adapted to receive a first threaded segment of adaptor **60** in mating relationship. When adaptor **60** is screwed into the valve, it has a second threaded segment projecting outwardly from the valve body, by means of which it (the adaptor) can be coupled with the fitting **66** on high pressure hose **64.** Hose **64** is connected, at its outer end, to the gas bottle **62.** The slight taper, indicated above, of the screw fit between adaptor **60** and the threaded portion of chamber **50*f*** of the valve body helps to insure a gas-tight connection between the adaptor and valve **48.**

Downstream of its slightly tapering portion, chamber **50*f*** converges sharply to form a funnel-like segment **50*fa*** in valve body **50.** Funnel-like segment **50*fa*** has a downstream opening coincident with the upstream end of a concentric passageway **50*a*** in the valve body, hereinafter referred to as inlet passageway **50*a*.** Funnel-like segment **50*fa*** serves as a seat for ball **58,** which, similarly to ball **42** of the valve of fishing rod **10,** is preferably of steel construction but can be made of any other suitable material, such as, for example, a suitably hard plastic. Ball **58** is sized to fit snugly over the downstream opening of the funnel-like segment of chamber **50*f*** and block the passage of gas into inlet passageway **50*a*.** As will be seen, the ball is easily held in this position by the pressure of gas from bottle **62** until forced out of its seat by the movement of a cam follower pin **68** (which fits loosely within passageway **50*a***) under an actuating influence later to be described.

Inlet passageway **50*a*** terminates at, and opens into, a relatively large chamber **50*c***, hereinafter referred to as cam chamber **50*c***, extending vertically downwardly within valve body **50,**from an opening at its top, to a shoulder separating the chamber from a concentric downbore **50*d*** extending from the bottom of said chamber to an opening in the bottom of the valve body. Cam chamber **50*c*** and downbore **50*d*** are coaxial, and the axis of the former perpendicularly intersects the longitudinal axis of valve body **50.**

Opening diametrically opposite the opening of inlet passageway **50*a*** in the wall of cam chamber **50*c***, and running downstream from the chamber concentrically within valve body **50** to termination at the outer end of boss **50*h***, previously mentioned, is a bore **50*b***, hereinafter referred to as outlet passageway **50*b*.** The upward end of cam chamber **50*c*** is threaded to receive the aforesaid threaded plug **52,** which latter has a short threaded shaft and an enlarged head, as shown in FIG. **5.** The inner end of the threaded plug is flattened to provide a surface of thrust for the above-mentioned biasing spring **54.** When the threaded plug is screwed into the upper threaded portion of chamber **50*c*** as far as it will go, in the manner illustrated in FIGS. **4** and **5,** it serves as a sealing plug for the chamber. A suitable thread sealant can be employed on the plug, to insure against gas leakage from the cam chamber, if desired.

Slidably disposed within cam chamber **50*c*** and concentric with downbore **50*d*** within valve body **50** is a cam pin **51.** Cam pin **51** has an upper part and a lower part, the upper part having a cam segment **51*b*** and a

round flat head **51***a* concentrically joined by a segment of reduced cross section, all as shown in FIG. **5.** Cam segment **51***b* is in the form of a truncated cone, having a base from which an integral shaft **51***c*, of reduced cross section, extends concentrically downwardly. Shaft **51***c* comprises the lower part of the cam pin, referred to above, and is sized to fit slidably within downbore **50***d* of the valve body. The base of cam segment **51***b* of the cam pin is sufficiently larger than shaft **51***c* to permit the cam segment to rest on the shoulder bridging cam chamber **50***c* and downbore **50***d*, in the manner illustrated at **70** in FIG. **5.** This cam pin orientation represents the closed position of valve **48.** The cam pin is normally held in its closed-valve position by the downward force of biasing spring **54** acting on its flat head. The spring exerts its downward pressure as a result of being caught in compression between the cam pin and the lower end of threaded plug **52,** when the latter is tightened in place in the upper part of cam chamber **50***c* as taught herein.

Follower pin **68** is sized to fit loosely within inlet passageway **50***a*, with its upstream end in lightly touching contact with ball **58** when the latter is in its fully seated position within conical segment **50***fa* of chamber **50***f*. When the follower pin is so positioned, its downstream end, which is of rounded form, as illustrated in FIG. **5,** is in lightly touching contact with cam segment **51***b* of cam pin **51.** When finger pressure is applied to the lower end of cam pin **51,** the cam pin is forced upwardly within valve body **50** against the pressure of biasing spring **54.** This causes the follower pin to move to the left, as seen in FIG. **5,** as a result of cam action of the cam pin on its right end, and move ball **58** slightly out of its seat in the funnel-like inner end of chamber **50***f*. This displacement of the ball permits the escape of gas from chamber **50***f* into inlet passage way **50***a*.

As previously indicated, ball **58** is normally held in its seat at the inner end of chamber **50***f* by gas pressure from gas bottle **62.** When the ball is dislodged from its seat by follower pin **68,** the gas from chamber **50***f* flows through inlet passageway **50***a* and into cam chamber **50***c*, then into outlet passageway **50***b*, from whence it passes into tube **11** in rod **12.** Two equally sized grooves **50***e*, one of which can be seen in FIG. **5,** extend around opposite sides of the wall of chamber **50***c* from the opening of inlet passageway **50***a* to that of outlet passageway **50***b* therein. These grooves provide additional space for gas flow around the cam segment of the cam pin in chamber **50***c*, but they are not critically necessary for proper functioning of the fishing rod. To help seal the valve against gas leakage, shaft **51***c* of cam pin **51** has a resilient O-ring **56** mounted in the position shown in FIG. **5** therearound.

Gas bottle **62** is a conventional CO_2 bottle of the type employed for the inflation of two-man life rafts, containing about half a pound of CO_2. This size bottle can be easily carried by a fisherman, as for example in a snug-fitting pouch or bag attached to the belt. The fishing rod can also be employed with gas bottles or containers other than gas bottle **62,** such as one-pound, or larger, bottles of CO_2 cylinders or tanks of oxygen or compressed air; cylinders of nitrogen; etc. where such a gas container is too large to be effectively carried in a belt pouch or the like, it can be stowed within hose length of the fishing rod; supported on a fisherman's back, (similarly to the way cylinders of compressed air are carried on the back of a scuba diver); or otherwise supported or carried in a convenient position of use. In this connection, the back-support method of carrying gas cylinders just referred to finds particular applicability for use with the spear gun embodiments of my invention hereinafter described.

Carbon dioxide is a preferred powering gas for my novel fishing rod because it is packaged in liquid form, hence can be dispensed from smaller and lighter containers than suffice for compressed gasses. While, as previously indicated, the initial gas pressures of certain commercially available CO_2 bottles run from about 850 to about 1,100 psi, depending upon the temperature, much lower pressures, as for example, within the range from about 150 to about 250 psi, are adequate for satisfactory operation of the fishing rod. This pressure differential between typical gas sources and fishing rod operating requirements accounts, in large part, for the quick responsiveness of the fishing rod to a light tap on its valve opening pin. More specifically, a relatively high pressure in the gas upstream of the fishing rod valve induces a rapid buildup of gas pressure downstream of the valve, when the latter is opened for use as taught herein. Since the fishing rod requires relatively low gas pressure for successful operation, this rapid pressure buildup triggers it into fast action, after which no additional gas pressure is needed until the rod is again ready for "firing." Consequently, a mere tap on its valve opening pin will usually suffice for instantaneous response from the fishing rod.

High pressure hose **64** is preferably standard 3000 psi hose, although it can be of any other type suitable for the purpose. Where a hose is required for connection of my novel fishing rod to a relatively large container of gas, the hose can be passed through the rod handle, to the rod valve, so long as the handle is open at both ends, like handle **16** of fishing rod **10** or **47.** Where the handle is enclosed at one end, however, it can be used only when the gas container is small enough to fit inside of it, similarly to the way cartridge **40** fits inside of handle **16** of fishing rod **10.**

FIGS. **7** through **10** illustrate a preferred embodiment of a spear gun in accordance with this invention. The spear gun is shown at **80,** and comprises a generally cylindrical body **81,** front and rear piston grips **86** and **90,** respectively, and a forwardly extending barrel **84,** sized to receive a hollow spear **94,** and hold it in firing position, in the below-described manner.

The cylindrical body **81** of the spear gun has a forward, valve section **83** and an enlarged, rearwardly disposed tubular section **92,** sized to receive a gas bottle **96** for spear propelling purposes. The valve section **83** consists of a valve **82,** to the underside of which the front piston grip (**86**) is fixedly secured by means of a pair of machine screws, one of which is shown at **87** in FIG. **8.** Valve **82** is somewhat similar in its internal construction to valve **48** of fishing rod **47,** but differs therefrom in certain particulars, as will be seen. The valve has a valve body **98** with a cam chamber **100** for a cam pin **102,** and inlet and outlet passageways **104** and **106,** respectively, for routing powering gas for the spear gun through the valve.

Cam chamber **100** is of round cross section, and extends part way through the valve body, from top to bottom, as seen at FIG. **8.** The cam chamber is in open communication with a restricted downbore **108,** also of round cross section, running from a concentric opening

in the bottom of the cam chamber to the bottom of the valve body. There is an annular shoulder **112** near the upper end of the cam chamber, above which the chamber is of enlarged cross section and tapped to receive a threaded plug **114** in countersunk relationship with the top of the valve body, all as illustrated in FIGS. **7** and **8.** Seated on shoulder **112** is a sealing washer **116,** made of nylon, Teflon, or other material suitable for the purpose. The bottom of plug **114** is flat, to permit the washer **116** to fit flush thereagainst, and serve as a firm surface of support for the upward thrust of a spiral biasing spring **118,** positioned as shown in FIG. **8** within the cam chamber.

Cam pin **102,** similarly to cam pin **51** of valve **48,** has an upper cam segment (**120**) and a lower shaft segment (**122**), the latter being sized to fit slidably within downbore **108** in the cam body. The cam segment has a cylindrical base portion **124,** of round cross section; a cam portion **125** which tapers conically upwardly therefrom, from the base portion; and an integral piston head **123,** positioned concentrically atop the small end of the conically tapering portion of the cam pin, all as illustrated in FIG. **8.** There is an annular shoulder **126** at the juncture of the cam chamber and downbore **108,** and the base portion of cam segment **120** is sized and shaped to fit slidably within the cam chamber and rest flush, around its bottom, on this shoulder. Piston head **123** is similarly sized to fit slidably within the cam chamber. Seated in annular grooves around the walls of the lower shaft segment **122,** cylindrical base segment **124** of the cam segment **124** of the cam segment and piston head **123,** of cam pin **102,** are three resilient O-rings, **128, 130,** and **132,** respectively. FIG. **8** shows the lowermost position of the cam pin within valve body **98,** corresponding to the closed position of the valve, the clearances between the involved parts being exaggerated for better illustrative effect. When the cam pin is in this position, the biasing spring **118** bears downwardly thereon to help hold it in place until a valve opening force is brought to bear on the pin, through a trigger **88,** in the manner hereinafter described.

Running coaxially inwardly into valve body **98,** from its upstream face, is a tapped socket **134,** sized to receive an adaptor **137.** Adaptor **137** has a rearwardly extending socket **180** for the threaded end **182** of a tire valve **184** attached to an end of the gas bottle **96** to provide communication between the gas bottle and spear gun valve for gun powering purposes. The tire valve **184** is of conventional type, having a core with a spring-loaded stem **186** which can be depressed to open the valve and permit the escape of gas from bottle **96.** Adaptor **137** has a bore **188** extending concentrically through that part which fits into socket **134** of the valve body. This bore allows the passage of gas from bottle **96** into a ball housing chamber **135,** hereinafter described in greater detail, for spear gun operating purposes.

Extending from the bottom, toward the mouth, of socket **180** of adaptor **137** is a thin valve stem depressor **190,** which arches out over the upstream opening of bore **188** as shown in FIG. **8.** As will be apparent, the valve stem depressor is designed to contact, and depress, valve stem **186** of the tire valve **184** when the threaded end **182** of the latter is screwed into socket **180** of the adaptor. When the adaptor and tire valve are thus connected, the spear gun is powered for use, with the valve held open by valve stem depressor **190** to permit gas flow from bottle **96** into the gun, until the connection is broken. When the gas is exhausted from bottle **96,** another bottle can easily be substituted therefor, even under water, by merely unscrewing the exhausted bottle from the adaptor and tightening the new bottle in place therein.

In open communication with socket **134,** in valve body **98,** is a ball housing chamber **135,** having a threaded upstream segment **136,** as shown in FIG. **8.** Threadedly engaged with this upstream segment of chamber **135** is a plug **138.** Plug **138** is sized to occupy the full length of the threaded segment of the ball housing chamber, and it has a concave downstream face **140,** a center bore **142** and a screwdriver slot **141** in its upstream face, all as illustrated in FIG. **8.** The upstream face of plug **138** is flat, to permit it to come even with the downstream end of adaptor **137,** for reasons soon to appear. The downstream end of the ball housing chamber **135** is flat, and inlet passageway **104,** previously mentioned, which has a substantially smaller cross-sectional area than does chamber **135,** extends from a concentric opening in the bottom of the latter into cam chamber **100,** again as illustrated in FIG. **8.** Housed within inlet passageway **104** is a follower pin **148,** presently to be described in greater detail.

Positioned flush against the downstream end of ball housing chamber **135** is an annular seat **144** for a ball **146.** The seat has a concave upstream face, to accommodate the ball, which latter serves as a valve closing member similarly to the way ball **58** serves as such a member in valve **48,** of fishing rod **47.** Ball seat **144** is preferably made of Teflon, or other suitable plastic, but is not limited to such a material and can, for example, be made of a relatively soft metal, such as brass, for optimum service under high pressure conditions of service. The ball seat has a concentric opening **145,** of substantially the same cross-sectional area as that of passageway **104,** and long enough to receive the upstream end of follower pin **148** and permit contact of the pin with ball **146** for valve opening purposes. Follower pin **148** is sized to fit loosely within inlet passageway **104,** and extend into cam chamber **100** sufficiently far, at its downstream end, to ride on the cam portion of cam pin **102,** for valve opening purposes soon to be discussed, when the cam pin is moved upwardly within cam chamber **100** under the actuating influence of trigger **88.** To assure smooth operation of the valve, with minimal frictional resistance between the cam and follower pin during such operation, the downstream end of the follower pin is rounded, as shown in FIG. **8.** The upstream end of the follower pin has a tapered face **150,** again as shown in FIG. **8.** This tapered face contributes to high sensitivity in the trigger mechanism of the spear gun, since it provides leveraged contact between the follower pin and ball **146,** as a result of which the ball is movable out of its seat **144** under the influence of minimal trigger force. Follower pin **148** fits loosely enough within inlet passageway **104** to leave sufficient room for gas to pass freely through the valve, when the latter is open.

Extending inwardly into valve body **98,** from the downstream face of the valve body, is a tapped socket **154,** adapted to receive the barrel of the spear gun in the below-described manner. Socket **154** has a flat bottom, and is provided with a sealing washer **152,** preferably made of Teflon or nylon, which fits flat against this bottom to seal the downstream end of the valve against

gas leakage between it and the gun barrel. FIG. 8 shows the barrel in position in socket 154, and the washer sealingly sandwiched between the barrel and bottom of the socket. Communication is provided between socket 154 and cam chamber 100 by outlet passageway 106. The outlet passageway is of the same size as, and aligned with, inlet passageway 104, and has a downstream opening in the center of the bottom of socket 154, all as illustrated in FIG. 8.

The front pistol grip 86 has an upper portion designed to fit comformably against the bottom of valve body 98, as illustrated, and a dependent handle portion. The pistol grip is hollowed as necessary to permit the pivoted support, and use, of trigger 88 taught herein. The trigger is sharply angled near its top, to provide a forwardly, and slightly upwardly, projecting segment 156. A pivot pin 160, fastened between the walls of the hollow in the upper portion of pistol grip 86, pivotally supports the trigger near the forward tip of its upper segment 156, as illustrated in FIG. 8. Thus supported, trigger 88 hangs downwardly, disposed, for the most part, in front of the dependent handle portion of pistol grip 86, when the spear gun is positioned as shown in FIGS. 7 and 8. The top surface of segment 156 of the trigger is smooth and gently curving, as illustrated at 158 in FIG. 8, and positioned under the lower end of shaft segment 122 of the cam pin, when the trigger is in the normal hanging position described above.

When trigger 88 is pulled to the rear, the cam-like surface 158 of its upper segment urges cam pin 102 upwardly within cam chamber 100, which has the effect of opening the valve. The lower end of shaft segment 122 of the cam pin is rounded to permit optimal riding contact between the cam pin and trigger when the trigger is pulled in this manner. The above-indicated hollow in pistol grip 86 is of a size and shape to receive the trigger without binding as the latter is pulled backwardly for valve-opening purposes. The rear pistol grip 90 is fastened to the underside of the body of the spear gun, near the rear end of its tubular section 92, smilarly to the way pistol grip 86 is fastened underneath valve 82.

Barrel 84 is an elongate tube, externally threaded from the rear to receive a collet 162, which is also threaded from the rear, for a portion of its length, as best shown in FIG. 9 at 163. The threaded part of the collet is sized to screw into the socket 154 of valve body 98, to provide the above-indicated connection between the barrel and valve body. The barrel has a concentric bore 166 running throughout its length. As FIG. 8 makes clear, this bore comes into alignment with outlet passageway 106 in valve body 98, when the barrel is fastened to the spear gun body in the above-described fashion. The sealing washer 152 has a concentric opening sized to permit unimpeded movement of gas in the spear gun from outlet passageway 106 into bore 166 of the barrel 84. The outer surface of the barrel is recessed for a distance of roughly 25 percent of its length forward of collet 162, to provide a seat for a plastic sealing sleeve 168. Sleeve 168 is made of polyethylene, or other suitable plastic, and is sized to fit snugly around the barrel, in the recessed seat just described, as illustrated in FIG. 9. Penetrating that portion of the barrel wall encased by sleeve 168 are four holes 170. These holes are distributed 90 degrees apart around a perpendicular plane through the barrel, for a purpose hereinafter appearing.

The bottom of the recessed seat for plastic sleeve 168 around barrel 84 tapers gradually, from rear to front, as does the outer surface of sleeve 168, since the thickness of the sleeve is essentially the same throughout and its surface therefore follows the contour of the barrel surface. The spear gun is loaded for firing by fitting the hollow spear 94, previously referred to, over barrel 84, and pushing it as far as it will go, or until its rear end abuts the forward face of collet 162, around plastic sleeve 168. The forward taper of the outer sleeve surface assures a gradual tightening of the frictional fit between the spear and sleeve, as the spear is urged further to the rear along the sleeve. When the spear is pushed as far back as it will go on the sleeve, there is relatively tight contact between the spear and sleeve at the rear, and a progressive loosening of this contact between the rear and front, of the sleeve. FIG. 7 shows spear 94 in its fully installed position of use on the spear gun, and FIG. 9 illustrates the interfit between the barrel, sealing sleeve and spear in the loaded gun.

As will be evident from the foregoing, and FIGS. 7, 9 and 10 of the drawings, spear 94 is a hollow projectile of generally cylindrical form, open at the rear and having a solid, pointed head enclosing its front end. The gun barrel can be almost as long as, or quite a bit shorter than, the spear. The spear must, however, be long enough to leave space between its enclosed end and the front end of the barrel, when it is installed for use on the spear gun, such a space being illustrated at 176 in FIG. 10. The spear must also be of sufficiently greater diameter than barrel 84 to provide an annular space between its inner wall and the outer wall of the barrel, when it is so installed. This annular space is best illustrated in FIG. 9, and its purpose will shortly be explained. While spear lengths can vary within the scope of this invention (subject to the above-noted condition), I have found the preferred length, for most practical purposes, to be within the range from about 25 to about 30 inches.

The manner in which spear gun 80 functions will now, it is believed, be apparent. After the gun is provided with powering gas, in the above-indicated manner, and spear 94 is fitted over barrel 84 in gas-sealing contact with plastic sleeve 168, it is ready for firing. The firing is accomplished by a quick pull on the trigger, which forces cam pin 102 upwardly in cam chamber 100. As the cam pin moves upwardly, its cam segment 120 comes into contact with the downstream end of follower pin 148, to urge the pin to the right, as seen in FIG. 8, and into contact with ball 146. A very slight movement of the follower pin in this manner is sufficient to dislodge ball 146 from its seat 144, and permit the flow of gas through inlet passageway 104 and into cam chamber 100. From here the gas travels through outlet passageway 106, and into the hollow core of barrel 84. As the gas proceeds through that part of the barrel encased by plastic sleeve 168, some of it passes out through openings 170 in the barrel wall, to force the plastic sleeve tightly against the inner wall of the spear, and thus increase the frictional contact between the spear and the sleeve. This results in a momentarily tighter grip of the spear by the sleeve. The effect is short-lived, however, since the gas rapidly flows through the length of the barrel, and around its end into the annular space between the barrel and spear, as indicated by the directional arrows on FIG. 10. Finally, the gas passes rearwardly within the spear, to fill said annu-

lar space, until it reaches the forward end of the plastic sleeve. Further backward progression of the gas in the spear causes equilization of the pressure on the outer and inner surfaces of the plastic sleeve **168**, whereby the latter relaxes its tight contact with the inner wall of the spear hollow, except toward the rear, where the larger diameter of the barrel and sleeve still provides relatively tight frictional contact between the spear and sleeve. The gas pressure within the spear is now sufficient, however, to propel the spear forwardly from the sleeve, and away from the spear gun.

The above-described flow of gas through the spear gun takes place so rapidly that the spear is fired almost instantaneously with actuation of the trigger. The working parts of the spear gun valve and trigger assembly are designed to cooperate smoothly and effortlessly, with minimal frictional resistance, to thereby provide a fast-acting, dependable mechanism, highly sensitive to the slightest actuation of the spear gun trigger. The tapered face **150** of the ball contacting end of follower pin **148** contributes importantly to the high sensitivity of the triggering mechanism by providing off-center contact of the ball by the pin for valve opening purposes. This off-center contact gives the follower pin the advantage of tilting leverage when forcing the ball out of its seat, and permits rapid response of the follower pin to a light trigger pressure, regardless of the gas pressure behind the ball in the valve body. Although FIG. **9** shows plastic sleeve **168** to be in touching contact with the internal wall of spear **94** throughout its length, the contact, as will be clear from the foregoing explanation, is looser toward the front of the sleeve than at its rear. There could, incidentally, be some actual clearance between the sleeve and spear wall toward the front of the sleeve, so long as this clearance is not so great as to interfere with effective operation of the spear gun as taught herein.

Spear **94** is of metal, and preferably stainless steel, construction. Suitable metals for use in such spears should, for obvious reasons, have good corrosion resistance. Additionally, they should be relatively heavy, for imporved throw effect. Stainless steel, previously mentioned, and brass, exemplify typically suitable metals for use in the manufacture of spears in accordance with this invention. The object propelling devices of this invention are not, of course, limited to those specifically disclosed, but can take many other forms, differing in noncritical details therefrom, and serve various pruposes other than those specifically discussed above, as well. Such versatility makes possible the use of a variety of projectiles, including arrows, darts, spears of different shapes, etc., with the propelling device in its numerous modifications. One such projectile, in the form of a hollow spear, is illustrated at **72** in FIG. **6**. Projectile **72**, similarly to spear **94**, has a pointed head (**74**), but differs in other respects from the latter. Spears with recovery lines attached, to aid in their retrieval after they have been fired from spear guns, permit the pulling in of speared fish, etc., can, if desired, be employed within the scope of the present invention.

The unique valve of this invention, as will be evident from an understanding of the manner in which it functions, is adaptable for use with high pressure fluids, hence has wide applicability for use in oil wells, aircraft systems, and other high pressure environments. The valve is readily operable at gas pressures up to 6,000 psi (and even higher), as I have determined by experimentation with a valve similar to that illustrated in FIG. **8**. The cam pin version of the valve, illustrated in FIGS. **5** and **8**, can have more than one inlet fluid accessway (each with a ball closing member and cam follower pin disposed therein) to the cam chamber in the valve body and/or more than one outlet fluid passageway from this chamber, within the scope of my invention. The valve so modified has use potential in many applications involving the flow of more than one stream of gas or fluid, such as, for example, the proportioning of gases (N_2, O_2, etc.), compressor applications, carburetion or fuel injection applications (where a single fuel-air ratio setting for an automobile engine would suffice for all driving conditions, regardless of altitude), paint mixing applications, various hydraulic applications, etc.

My novel valve can, of course, be provided with automatic (solenoid-operated) controls, for use in high pressure oil well, or other, systems. In its multi-passageway form, just described, various means, such as, for example, cam follower pin length adjustments, cam taper variations, multi-level inlet passageway positioning, etc., can be employed to provide particular flow sequence patterns, or the like, as desired. Since the ball sealing member of the valve automatically seats itself in position under the influence of gas pressure, it will be appreciated by those skilled in the art that the other working parts of the valve mechanism can have imprecise tolerances without adverse effect on the valve's effectiveness. Also, for the same reason, the valve's operability is not deleteriously affected by the influence of high temperatures. This makes the valve particularly effective for use in aerospace systems, and the like, designed for operation under harsh environmental conditions. Because its working parts are few and simple, and subject to minimal wear in use, plus the fact that sloppy tolerances between the parts do not prevent effective operation of the valve, the valve is inherently capable of long-continued usage without leakage. I have demonstrated this feature of the valve by firing a spear gun with a valve similar to that illustrated in FIG. **8** 5,000 times with no incident of valve leakage at any time. Because of its foregoing characteristics, the materials of construction for most of the component parts of my novel valve are not particularly critical, and can be tailored, to a certain extent, to suit various use environments. For example, these parts can be made of plastic where the valve is intended for use in salt water, as in the case of a spear gun valve.

While I have shown and described in considerable detail what I believe to be preferred embodiments of my invention, it will be understood by those skilled in the art that the invention is not limited to, and may take various forms other than, these particular embodiments.

I claim:

1. An object propelling device comprising in combination:

an elongated hollow projectile;

an elongated rod with a passageway running longitudinally there-through and having a recessed seat around the rear portion of its outer wall, said seat having a bottom that diverges slightly from the front to the rear of the rod,

a flexible sleeve seated snugly in said seat, said sleeve diverging from the front to the rear of the sleeve as a result of the divergence of the bottom of said seat;

said rod and sleeve receiving said elongated hollow projectile, said projectile being open at the rear end and enclosed at the front end, said projectile being in frictional gas-tight contact with said sleeve;

the hollow opening within said projectile, when said projectile is mounted on the sleeve, being sufficiently long to leave a space between the front of said rod and the enclosed front end of the projectile, and being of large enough cross-sectional diameter to provide an annular space between the inner wall of the projectile and the outer wall of said rod, said annular space being forward of the sleeve,

a valve comprising:

a valve body having an inlet fluid opening and an outlet fluid opening, internal passageway means affording fluid communication therethrough, and an internal valve seat;

said valve body having a ball chamber; said internal passageway means comprising said chamber, an inlet fluid accessway between the inlet fluid opening of said body and said chamber and an outlet fluid conduit connecting said chamber with said outlet fluid opening in said body; and said internal valve seat being disposed about said outlet fluid accessway;

a valve closing member being held on said internal valve seat by fluid forced through the inlet fluid opening of the valve body under pressure to close the valve, said valve closing member being a ball;

first valve opening means for moving said valve closing member out of seating engagement with said internal valve seat and second valve opening means, under the influence of a properly directed outside force, for causing the first valve opening to move said valve closing member out of said seating engagement, said first valve opening means being normally free of interference with the seating engagement of said valve closing member with said internal valve seat;

the first valve opening comprising, a cam follower pin slidably disposed in said inlet fluid accessway downstream of said valve seat; said second valve opening means comprising a cam pin having a conical segment and disposed within the cam chamber in said valve body and a projecting shaft segment with an end disposed outside of the valve body for receiving a valve opening force applied axially thereto;

said valve further including internal resilient means of sufficient strength to automatically move said cam pin from valve open position to a position of rest;

the conical surface area of said first valve opening means providing a camming surface for the cam follower pin; said cam follower pin being a rod member with one end rounded off and the other end being beveled, said rod member being positioned with its rounded end adjacent the conical surface area of the cam segment of said cam pin and its beveled end adjacent said ball so that said rounded end rides against the conical surface area of said cam segment and the tip of said beveled end comes into off-center contact with said ball when a valve opening force is applied to the end of said projecting shaft segment disposed outside of said valve body; and

said portion of the wall of said rod forming said recessed seat having means for permitting gas first entering the passageway in the rod, when the projectile is fired, to exert pressure on the inner wall of said sleeve so that it momentarily expands into firmer contact with the inner wall of said projectile and holds said projectile in place until sufficient projectile propelling pressure is built up behind the projectile.

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