June 2, 1953 L. K. SPINK 2,640,476

PNEUMATIC GUN

Filed July 22, 1949 3 Sheets-Sheet 1

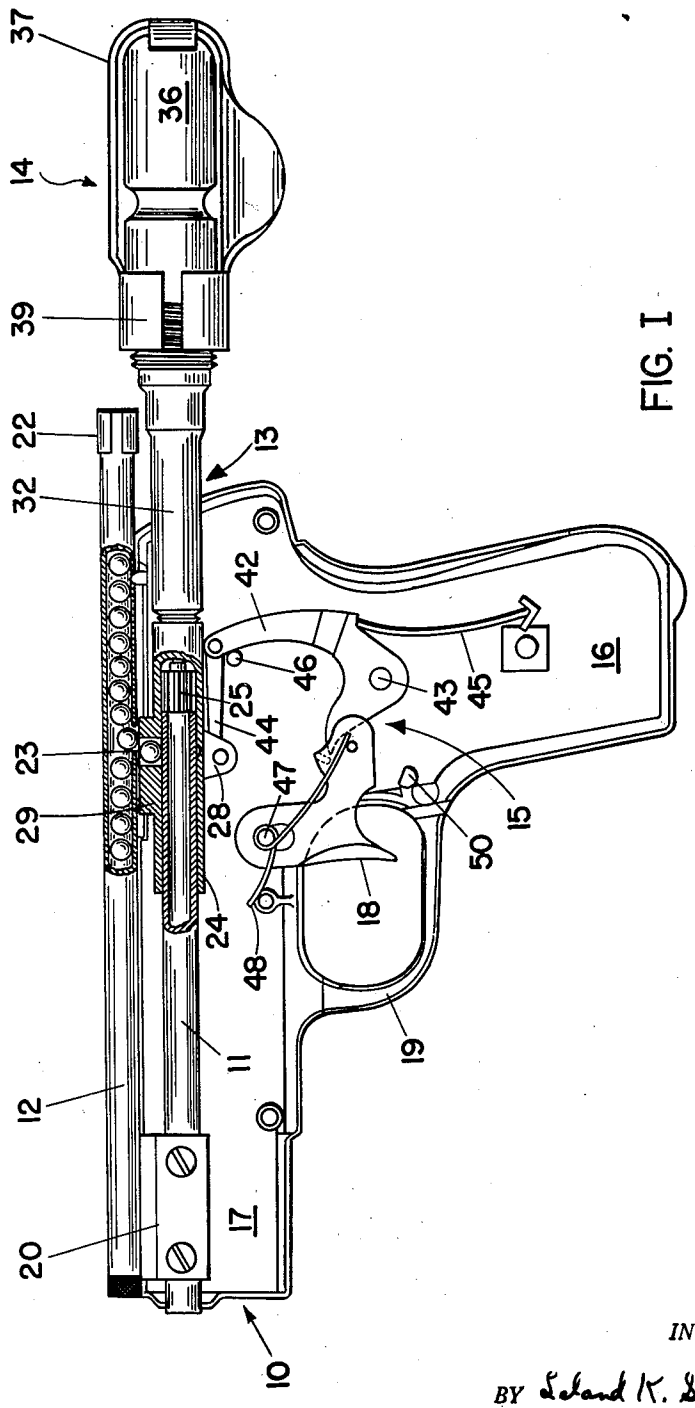


FIG. I

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Filed July 22, 1949 3 Sheets-Sheet 2

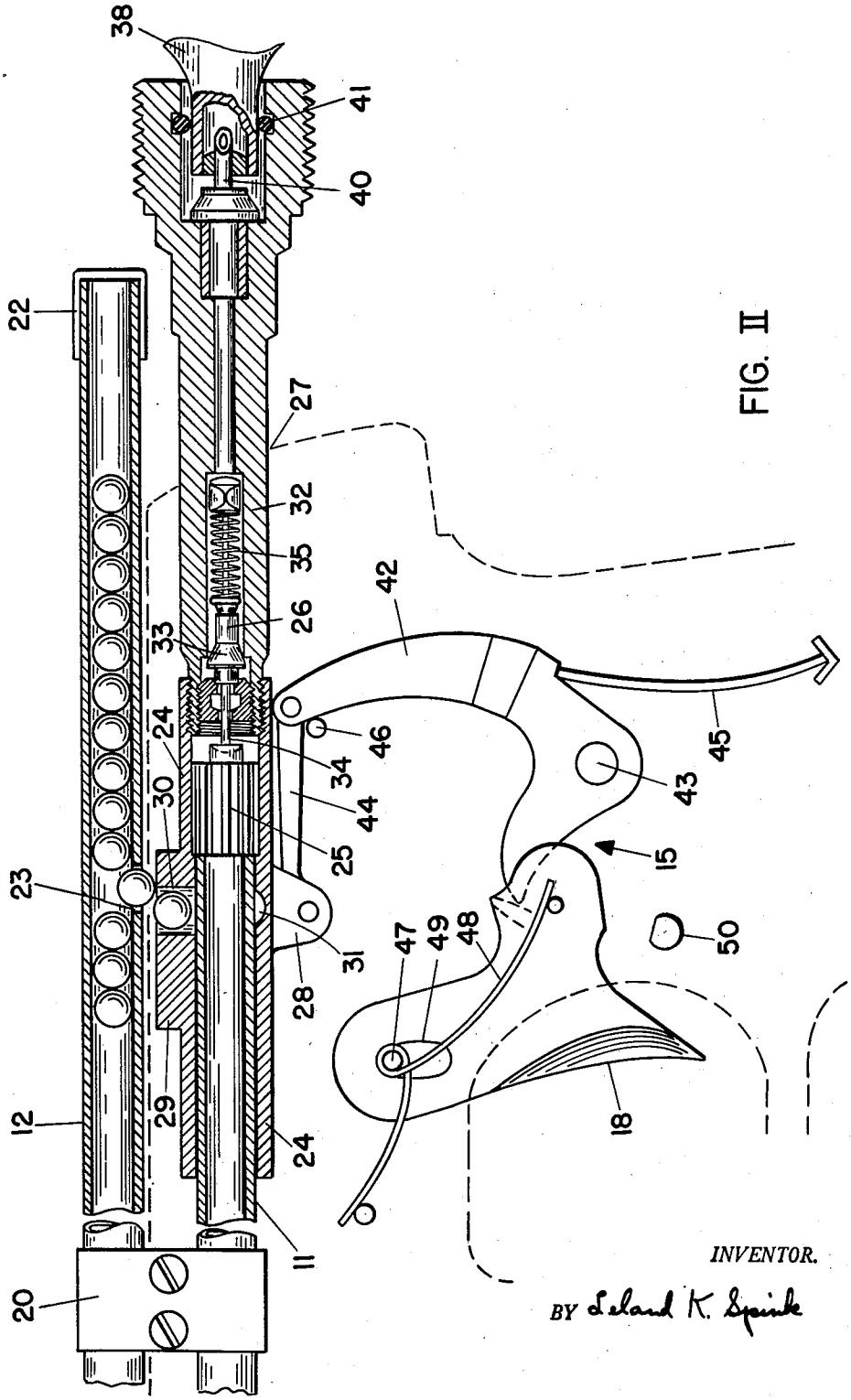


FIG. II

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PNEUMATIC GUN

Filed July 22, 1949 3 Sheets-Sheet 3

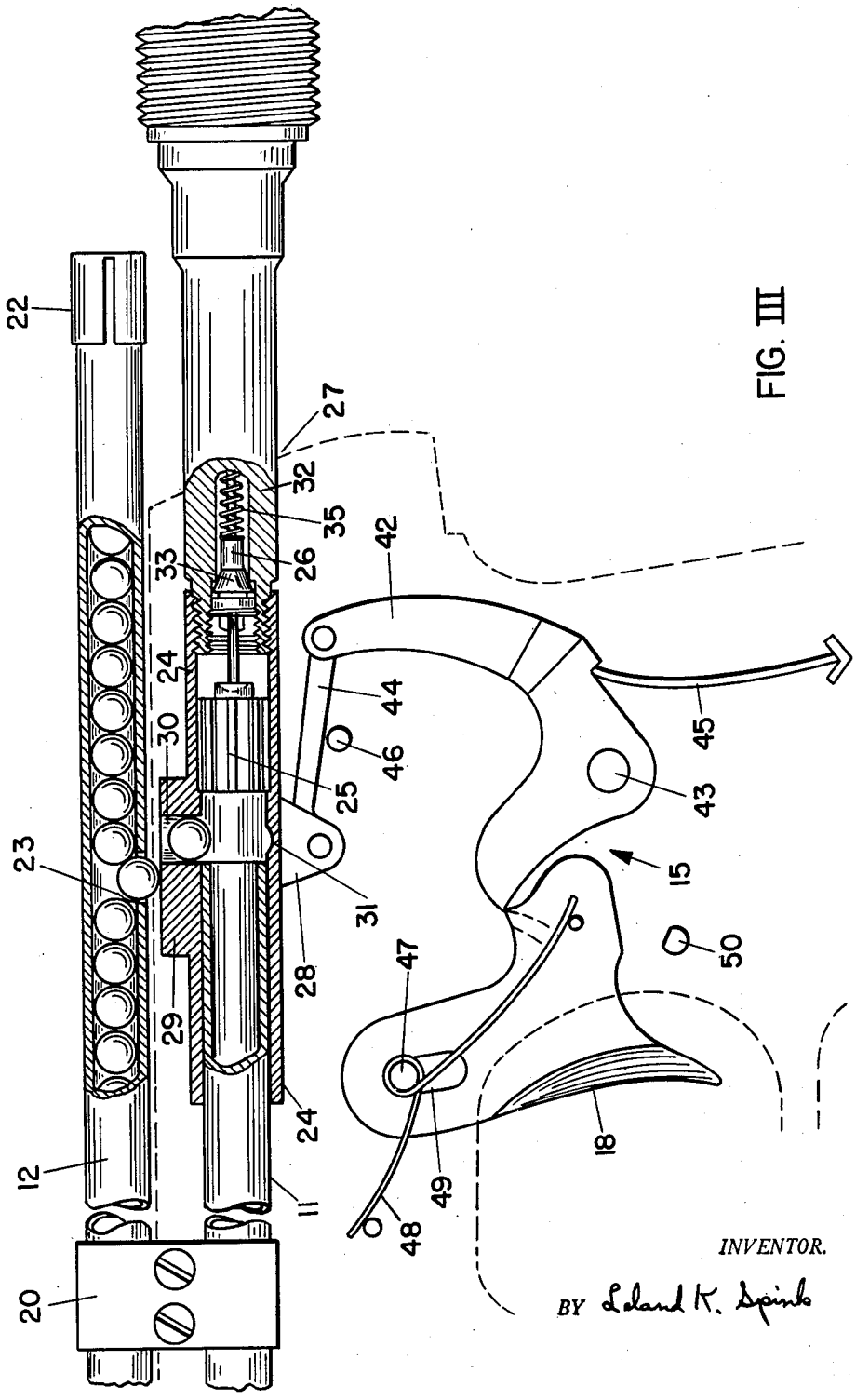


FIG. III

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Patented June 2, 1953

2,640,476

UNITED STATES PATENT OFFICE

2,640,476

PNEUMATIC GUN

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Application July 22, 1949, Serial No. 106,210

4 Claims. (Cl. 124—11)

1

This invention relates to guns, and has particular reference to pneumatically powered guns.

It is an object of this invention to provide a new and improved pneumatic gun.

Other objects and advantages will be apparent from the following specification and claims, taken in the light of the accompanying drawings. The specific structures shown and described are presented by way of illustration, and it is submitted that reasonable variations in structure are possible without departing from the scope of the invention as shown, described, and claimed herein.

In the drawings:

Figure I is an illustration, in vertical, longitudinal, and central section, of a pneumatic gun as an embodiment of this invention;

Figure II is an enlargement of the firing chamber area of the structure of Figure I, with the position of the parts representing the condition immediately after firing; and

Figure III is a showing of the same structure as shown in Figure II, showing the parts in loading position.

Reference is made herein and in the claims to a gun, to pneumatic power, to a missile, and to a barrel. These words have broad meanings when used in relation to this invention. The word "gun" is intended to include pistols and rifles whether they are toys or professional weapons, or any type of pneumatically operable object throwing or projecting device. "Pneumatic power" is intended to mean power from compressed air or other compressed gases, or from liquified vapors such as carbon dioxide, freon, propane, or butane. "Missile" is intended to mean any object which may be thrown or projected from a "gun" as defined above. "Barrel" is intended to mean, primarily, a tube through which a "missile" is projected, being of whatever cross-section is convenient, but it is also intended to include any guide chamber, slot, or track along which a "missile" or an impeller therefor, is projected.

While the structure shown is operable by compressed air, there are disadvantages to its use, for example, in the difficulty of repeatedly providing the same power for each of a series of shots, since to use part of a compressed air supply is to use a part of the pressure and reduce the pressure in the supply. With the liquid vapor type of power supply, for example, carbon dioxide, the vapor pressure over the liquid in a closed chamber remains the same for a given temperature, as long as any liquid remains unvaporized in the chamber.

2

Accordingly, removing enough of the carbon dioxide vapor to fire a missile does not reduce the pressure in the power supply until the supply is almost completely exhausted. For example, using BB shot as missiles and a carbon dioxide capsule power supply, about 160 shots may be fired with 157 or 158 of them all at substantially the same power impulse level, and the last two or three shots only, provided with appreciably reduced power after the last of the liquid in the capsule is vaporized.

As an illustrative embodiment of this invention, the drawings and description set forth a pistol, with a liquified carbon dioxide power supply capsule. Carbon dioxide is particularly effective as a power medium. It is commercially available in inexpensive small sealed capsules, and many small bursts of considerable power can be obtained from each capsule. The carbon dioxide is under compression and in liquid form with a vapor head, in the capsule. When a portion of it is released to expel a missile from the gun, this portion expands with great speed and considerable force.

Freezing of the triggering valve has been avoided in this structure by a design which is economical in the use of the gas. A standard capsule contains only between nine and ten grams of carbon dioxide. Tests show that one capsule will provide power for approximately 150 full powered shots. Therefore, the amount of carbon dioxide used for each shot is only 0.00014 pound, and its refrigerating capacity is negligible.

Economy of operation is accomplished by the high expansion ratio made possible by the compact design of the firing assembly, and a minimum volume behind each missile as it is fired. This economy of operation makes practical the use of standard, small capacity, light weight capsules.

With this small consumption of energizing gas per unit shot, a very considerable force is imparted to the missile by efficient use of the energy of expansion. With a consumption rate of approximately ten grams, or one capsule of gas, per 158 shots, the missile is expelled with a force sufficient to lodge in a soft pine board at approximately forty feet. The force per shot may easily be reduced by changing the valve unit to reduce the valve aperture, but for any given valve unit structure, the force of expulsion remains uniform for each shot as long as any liquid remains in the supply capsule. At decreased power, the

number of shots per capsule increases proportionately.

The supply pressure, when the liquid is in the capsule, varies only with temperature. When the liquid is used up, there remains, for the last few shots, only a vapor which decreases in pressure with each shot. This constancy of propulsion force results in a high degree of accuracy with the missile, because the trajectory remains constant.

The gun will operate when pointed either up or down as well as horizontally. A self damming action of one missile prevents all of the missiles from moving to one portion of the missile supply unit. An operator may fire downward as long as any missiles remain in one portion of the missile supply chamber, and upward as long as any missiles remain in another portion of the missile supply chamber, simply by repeatedly pulling the trigger.

The illustrative embodiment of this invention, as shown in the drawings, comprises a gun housing 10, a barrel 11, a missile supply tube 12, a valve assembly 13, a power supply unit 14, and a trigger mechanism 15.

The housing 10 is formed in a conventional pistol shape, with a handle 16, a barrel section 17, a trigger 18, and a trigger guard 19. This gun is distinguished in appearance from an ordinary, flat, bullet firing pistol by the supply tube 12 extending along the top of the barrel section 17 in parallel with the barrel 11, and by the valve assembly 13 and power supply unit 14 extending rearward from the back of the gun. If desired, the tube 12 and the power supply unit 14 may be enclosed except at the ends, in the gun body, and the barrel and the supply tube mounted within a single housing.

The barrel 11 is a metal tube secured to the housing 10 by a screw held clamp 20. The missile supply tube 12, in this instance holding BB shot, is secured on top of the housing 10, and extends more than the full length of the gun, being capable of containing a considerable supply of missiles at one time. The tube diameter is such as to hold a single line of missiles in free rolling fit relation therewith. One end of the supply tube 12 has a closing cap 22 thereon and by turning the gun upside down, the damming effect in the supply tube is temporarily eliminated and all of the new missile loads may be put in from the capped end. A missile feeding opening 23 is located in the bottom of the tube 12, near the valve unit 13, but a substantial distance from either end of the tube 12 so that a good supply of missiles may be contained both forward and rearward of the feeding opening 23.

The valve assembly 13 is a particularly important part of this structure. It is mounted in telescopically sliding relation with the fixed assembly comprising the barrel 11 and missile supply tube 12, and comprises a sleeve 24, a floating depressor cap 25, and a valve unit 26. The sleeve 24 encloses the inner end of the barrel 11 in sliding fit relation therewith and this fitting relation provides, for the most part, the support for the entire valve assembly 13 and the power supply unit 14 as well, except for the additional bearing relation between the valve assembly and the housing 10 as the assembly passes rearwardly therethrough, as at 27. The sleeve 24 has a depending lug 28 to which the trigger mechanism is secured, so that the operation of the trigger mechanism slides the whole unit of the valve assembly 13 and the power supply unit 14, forward and back on the barrel 11. The sleeve 24 also has an upstanding block 29 fixed to the top thereof, with a missile supply opening 30 therethrough, and through the sleeve 24 also.

Inside the sleeve 24, on the bottom, there is a small recess 31 in which a missile rests before it is fired through the barrel. This, plus the shoulder formed by the inner end of the barrel, prevents the missile from rolling out of the barrel if it is tipped downwardly.

When the mechanism of the gun is placed as in Figure I, there is no missile in the barrel, or, more accurately, in the sleeve adjacent the inner end of the barrel. One missile lies in the opening 30 in the block 29, being prevented from entering the sleeve 24 because the barrel blocks the lower end of the opening 30 in that position. Another missile lies partially in the supply tube opening 23, being blocked by the missile in the block opening 30, and in turn blocking the other missiles in the supply tube so that those in the front of the tube may not roll to the back and vice versa. This action makes it possible to maintain a supply of missiles either in the front or rear of the supply tube for repeated firing, upward or downward, respectively. In such firing, because the next missile in line is resting against the blocking missile, it does not have the inertia necessary to roll past the opening 23, and consequently, it simply drops in the opening 23 when the blocking missile is released to pass on into the sleeve 24. Since, in normal handling and firing of the gun, it is tilted somewhat, there is, for all practical purposes, a missile invariably ready to drop into the opening 23 as long as the supply lasts.

The action of alignment and disalignment of the openings 23, 30, and the inner end of the barrel 11, in feeding missiles from the supply tube into the sleeve 24 ready to be fired through the barrel, is as follows: first, it will be seen from the drawings that the inner end of the barrel 11 is to the rear of the supply tube opening 23. As the trigger is pulled, the sleeve 24 is made to slide back on the barrel until the block opening 30 passes the end of the barrel and the missile heretofore held in the opening by the outside, solid top of the barrel, is dropped into the sleeve and into substantial alignment with the barrel, ready to be fired therethrough. Meanwhile, the missile that was resting partially in the supply tube opening 23 is maintained in that position by the top of the sleeve block 29. Then the trigger mechanism slides the sleeve 24 forward until the block opening 30 is in alignment with the tube opening 23, permitting the missile in the opening 23 to drop into the opening 30, and the next in line missile to drop partailly into the opening 23, reestablishing the arrangement shown in Figue I, the missile inside the sleeve having been fired through the barrel meanwhile. Figure III illustrates the loading position of the mechanism with the sleeve 24 in its back position, and Figure II illustrates the position of the parts of the mechanism with the sleeve 24 in its forward position, just after a missile has been fired with the trigger pulled but not released and the condition of the mechanism duplicates the shown condition of Figure I.

The valve unit 26 is essentially a tube, 32, threadedly mounted on the sleeve 24, in substantial alignment with the barrel 11. The forward end of the tube contains a valve seat 33, and a valve stem 34, for seating on said valve seat, extends axially of the tube with a helical spring 35 holding the stem against the seat. This valve

unit is like an ordinary bicycle tire valve, with the free projecting end of the stem on the front end of the valve unit and extending into the sleeve **24** and the spring end of the stem contained within the tube **32**.

The separation, in the sleeve **24** between the barrel and the valve tube **32** may be called the firing chamber and its size varies as the valve assembly **13** is moved back and forth in the course of firing the gun. This size is a matter for calculation in relation to the amount of power desired for each individual shot. The larger the chamber, the more gas per unit shot. Allowance is made, in this separation, for the floating depressor cap **25**. This cap is in the form of a short cylinder with openings therethrough, or a grooved periphery, either being for the passage of the carbon dioxide into the barrel. The cap is in axial sliding fit relation with the sleeve **24**, and has a central depression in its rear face, for engaging the free end of the valve stem. If desired, the power per shot may be controlled by using a different depressor cap with a different amount of rear face surface, or by using a cap with a central boss extending rearwardly about the free end of the valve stem to constrict the valve opening.

The firing chamber is fully enclosed except for the gas inlet from the valve and the gas outlet through or around the depressor cap. No opening is necessary for triggering because of the telescoping relation between the barrel and the valve unit. Every bit of gas in the firing chamber is thus made to concentrate on firing the missile, and very efficient and economical use of the gas is the result. The pistol may be fired repeatedly with the same power for each shot, as long as any liquid remains in the power supply capsule.

The carbon dioxide capsule **36** and the holder **37** therefor comprise the power supply unit **14**. The capsule is the commercially available soft metal unit about two inches long with a ¾ inch outside diameter, containing liquified carbon dioxide sealed therein. One end of this unit has a reduced diameter point **38** which is used as the outlet for the gas when an opening is made therein. The holder **37** is in the form of a partial sleeve and an end portion for receiving the power capsule in loose, curve conforming relation. The other end of the holder **37** comprises a neck **39**, threaded for mounting on the rear end of the valve housing. The rear portion of the valve housing has a pointed, hollow pin **40** fixed therein for breaking the seal of the power capsule as it is being mounted on the valve housing, and a rubber collar or O-ring **41** for encircling the neck of the capsule as a seal. It should be noted that the power capsule is removable without distributing the valve unit.

The triggering mechanism includes a lever **42**, pivoted on the gun housing at **43**, and connected to the valve unit lug **28** by an arm **44** in pivotal connection with both the lug and the lever. A leaf spring **45** urges the lever **42** counterclockwise and consequently tends to move the valve unit forward on the barrel in the valve opening direction. A stop pin **46** is used to limit the motion of the lever **42** in this direction at a point that permits just enough movement to make valve opening contact between the valve stem, depressor cap and the end of the barrel. The trigger **18** is pivoted at **47** and has a positioning spring **48** of the usual sort, to snap it back to its original position against a stop **50** after being pulled.

In the operation of this device, the gun is fired by snapping the valve assembly forwardly against the barrel in a telescoping sliding movement Pulling of the trigger **18** first pulls the valve assembly back away from the barrel, and this movement loads spring **45**. In continuing to pull the trigger, it slips past the lever **42** to release the valve assembly, the assembly then being impelled toward the barrel by the loaded spring **45**. Two forces then exist in the moving valve assembly, one being the spring force and the other being the inertia of the valve assembly. Both forces continue up to a point where the depressor cap **25** is in, or close to, engagement with the barrel **11**, and the valve stem **34** is in, or close to, engagement with the depressor cap **25**. At this point the spring force is removed as the lever **42** on which the spring is acting directly, is stopped in its movement by a pin **46**. However, the linkage between the lever **42** and the valve assembly is purposely made slightly loose. That is, the connecting arm **44** has slightly loose pivot connections at its ends. Therefore, even though the direct force of spring **45** is removed, the valve assembly continues its forward movement a small distance, under the force of its inertia, and is free to do so because of the linkage looseness. This continuing movement positively engages the depressor cap **25** with the barrel, and the valve stem with the depressor cap to snap the valve open momentarily, admitting a burst of carbon dioxide to the firing chamber. This burst acts forwardly, past the depressor cap by way of the peripheral grooves therein, and against the missile, to impel it through the barrel. This burst also, simultaneously, acts against the rear of the depressor cap and the front of the valve stem housing in a tendency to separate these members. Since the depressor cap is prevented from moving forward by its engagement with the barrel, and the valve assembly inertia is spent, this force acts rearwardly to start to move the valve assembly back, away from the barrel. The valve stem spring, which tends to close the valve, acts in aid of this rearward movement of the valve assembly. This rearward movement is short, being arrested by the spring **45** at the point where, in the forward movement of the valve assembly, the impelling force of spring **45** was removed. This rearward movement takes advantage of the linkage looseness so that the lever **42** is not moved back at all, and yet sufficient separation is provided between the depressor cap and the valve to allow the valve stem to move forwardly and close the valve. The amount of movement of the valve stem necessary to open or close the valve enough for the purpose of this gun, is small, and the linkage looseness need not be great to accommodate the movement.

In the at rest condition of the device, therefore, the stop pin **46** keeps the spring **45** from pressing the valve stem against the combination of the depressor cap and the fixed barrel. Thus the valve remains closed until the gun is again triggered.

Having described my invention, I claim:

1. A pneumatic gun comprising a barrel, a valve assembly mounted on the outside of the inner end of said barrel for telescoping movement with respect thereto, and a pneumatic power supply unit mounted on said valve assembly, said valve assembly including a valve opening member

movable within said valve assembly for engagement with the inner end of said barrel, and a valve, including a valve stem for opening said valve upon engagement of said stem with said valve opening member as it engages the inner end of said barrel, a spring for thrusting said valve assembly telescopingly along said barrel to open said valve by engaging the inner end of said barrel with said valve opening member and engaging said valve opening member with said valve stem, and a trigger mechanism for simultaneously loading said spring and moving said valve assembly in the direction away from said barrel, and thereafter releasing said spring for thrust against said valve assembly in the direction toward said barrel.

2. In a pneumatic gun structure, a barrel unit and a valve unit mounted for relative movement with respect to each other, a spring arranged to bias one of said units toward the other, and a trigger mechanism for producing said relative movement as a means of operating said valve, said movement comprising an initial movement against the bias of said spring and in the direction of separation of said units as the trigger is pulled and a final movement in the opposite direction under the impetus of the built up bias of said spring, released by said triggering mechanism.

3. A pneumatic gun comprising a barrel and a valve unit mounted for relative telescopic movement with respect to each other, a valve in said valve unit, a valve depressor member between said barrel and said valve in movable relation with respect to both said barrel and said valve unit, and a trigger mechanism for producing said relative telescopic movement as a means of operating said valve.

4. A pneumatic pistol comprising a housing, a missle discharge barrel fixed in said housing, a sleeve mounted over the inner end of said barrel in sliding fit relation therewith, a valve depressor cap in sliding fit relation within said sleeve for engagement with the end of said barrel, a valve fixed in the end of said sleeve beyond said depressor cap, a valve stem in said valve and extending into said sleeve for engagement with said depressor cap, a missile supply chamber above said barrel and sleeve, a missle supply opening in said chamber, a boss on the top of said sleeve, a missile supply opening through said boss to the interior of said sleeve whereby one position of said sleeve on said barrel aligns said missile supply openings and another position of said sleeve disaligns said missile supply openings while locating said boss missile supply opening rearwardly beyond the inner end of said barrel, a lug on the bottom of said sleeve, a trigger mechanism connected to said lug, an impeller spring bearing on said trigger mechanism, whereby initial triggering movement pulls said sleeve backward on the barrel against the action of said impeller spring and final triggering movement releases said spring to impell said sleeve forward on said barrel to engage said valve stem with said depressor cap and said depressor cap with the inner end of said barrel to open said valve momentarily, and a pneumatic power supply unit connected to said valve.

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