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PNEUMATIC GUN MECHANISM

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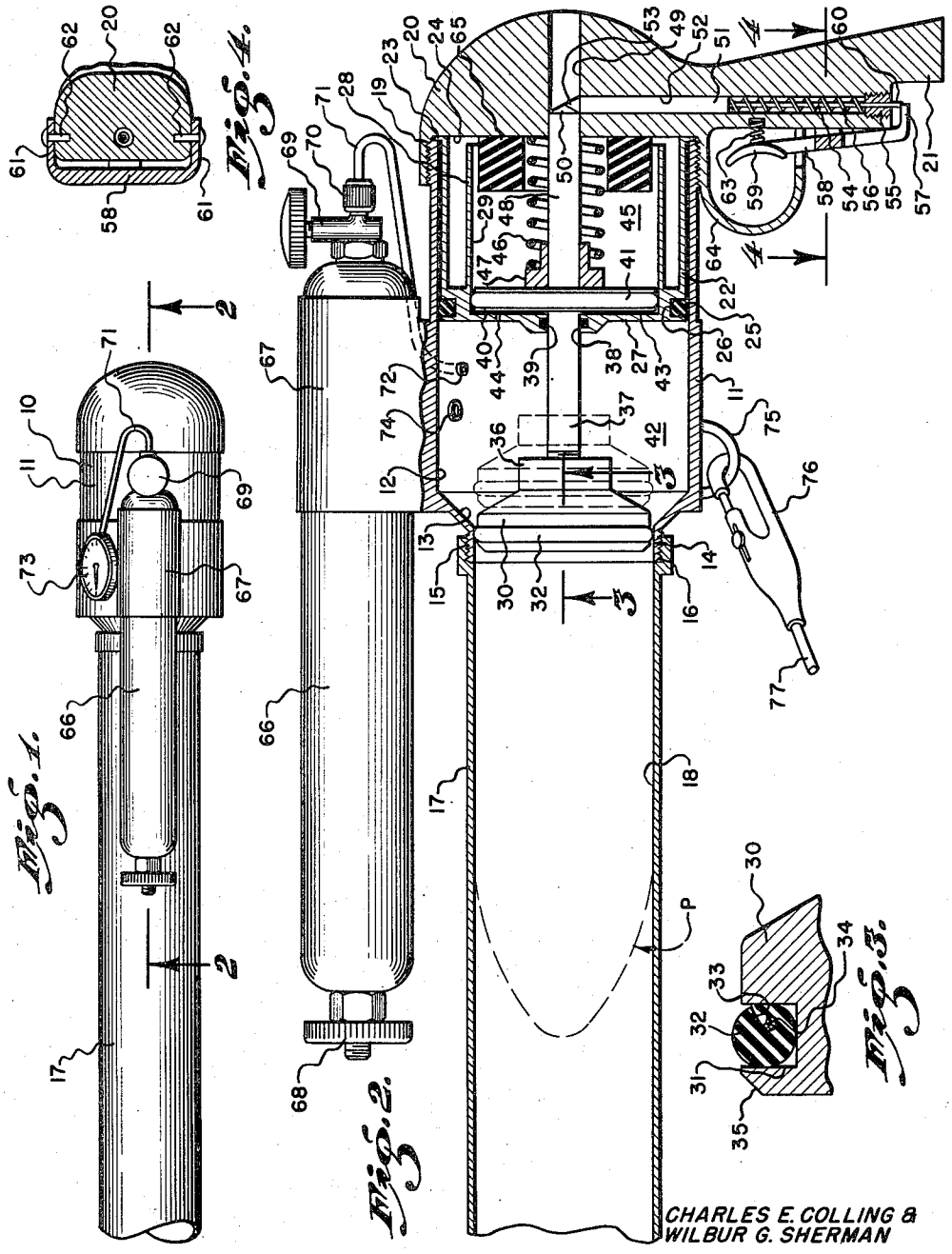


Fig. 4.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 5.

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PNEUMATIC GUN MECHANISM

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1 Claim. (Cl. 124—11)

The present invention relates generally to a pneumatic gun and relates more specifically to a pneumatic gun having a pressure differential operated pneumatic charge releasing mechanism for use in the propulsion of a suitable missile or projectile therefrom.

Heretofore, many attempts have been made to devise valve mechanisms and operating means therefor for use in pneumatic guns that are designed for throwing suitable missiles therefrom. Many of these prior devices have had a major disadvantage in that various supplemental structures were used in order to force a valve to an open position to admit a pneumatic charge to the bore of a barrel. Such valves often had to be opened against the force of the pneumatic charge, thus consuming a considerable amount of energy that might otherwise be used for propulsion of a projectile. Additionally, prior arrangements of pneumatic guns have frequently required that a pneumatic charge be conducted through several ninety degree turns before reaching a point rearwardly of a projectile. Each of such turns reduces the effective force of the charge in the propulsion of the projectile.

Accordingly, it is one object of the present invention to provide a pneumatic gun operating mechanism that is simple in construction, compact in design, efficient in operation and adapted to propel a suitable missile or the like therefrom.

It is another object of the present invention to provide a pneumatic gun operating mechanism wherein pneumatic pressure differentials are utilized to effect opening of a suitable valve mechanism for transmitting a pneumatic charge to a barrel bore to propel a missile or projectile therefrom.

It is a further object of the invention to provide a pneumatic gun having a novel sear operating and releasing mechanism.

It is still a further object of the present invention to provide a pneumatic gun wherein a pneumatic charge may be delivered directly to a barrel bore thereof in a manner and from a position that is axially disposed relative to said bore.

It is another object of the present invention to provide a pneumatic gun having novel means for immediately and pneumatically recharging said gun in preparation for release of a new charge and propulsion of a next following projectile.

Other and further important objects of the present invention will become apparent in the disclosures of the following specifications, appended claim and accompanying drawing wherein:

Fig. 1 is a top plan view of the pneumatic gun of the present invention;

Fig. 2 is an enlarged fragmentary sectional view of the operating mechanism of the present pneumatic gun as taken substantially as indicated by line 2—2, Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view of the sealing means for a breech valve as taken substantially as indicated by line 3—3, Fig. 2; and

Fig. 4 is a sectional view through a portion of a trigger

mechanism as taken substantially as indicated by line 4—4, Fig. 2.

Referring to the drawing by reference characters wherein like characters indicate like parts, the pneumatic gun of the present invention is shown as indicated generally at 10. As shown, the gun 10 includes a substantially cylindrical breech casing 11, that is provided with an axial extending bore 12. The bore 12 has a tapered reduced diameter portion 13 on which an axial extending portion 14 is disposed. The portion 14 is provided with external threads 15 that mate with similar threads on the inner end 16 of a barrel 17. The barrel 17 has a suitable bore 18 therethrough, a projectile or missile, indicated generally at P, being adapted for reception in the inner end of the bore 18.

The rearward end of the breech casing 11 is provided with suitable external threads 19 that are adapted to receive a rear closure member 20 from which a handle 21 depends. A cylindrical sleeve member 22 is disposed in the rearward end of the bore 12, an outwardly extending flange 23, formed on the rearward end of the sleeve 22, being adapted for reception intermediate the rearward end of the breech casing 11, and a rear wall or abutment 24 of the closure member 20. The sleeve 22 is sealed with respect to the bore 12 as by a suitable O-ring 25 which is adapted for reception in an annular groove 26 formed on the periphery of the sleeve 22 adjacent the inner end thereof. This inner end of the sleeve 22 is closed as by a partition 27 which extends transversely of the bore 12. The sleeve 22 is further provided with an internal axially extending secondary sleeve 28, the interior diameter of which defines an axially extending recess 29, one end of which is closed by the partition 27. The space defined between the sleeves 22 and 28 may be filled with solid material or removed, as shown, to lighten the gun structure.

An annular breech valve member 30 is normally disposed in the inner end of the bore 18 and adapted normally to seal off this inner end. This breech valve member 30 is provided with an annular groove 31, Fig. 3, about the inner end thereof, in which an O-ring 32 is adapted to be disposed. The O-ring 32 has a normally extending, axially relatively short groove 33, in the portion thereof adjacent the bore 12, in which several turns of a wire or cord are positioned. For a purpose to be hereinafter more fully described, the cord 34 serves to maintain the O-ring 32 in the groove 31 and deforms the O-ring 32 until the groove 33 assumes the position shown in Fig. 3. Also, for a purpose to be hereinafter more fully described, the end of the breech valve 30 adjacent the inner end of the bore 18 is beveled as at 35. The other end of the breech valve 30 is reduced in diameter and terminates in an axially extending boss 36 that is threadably engaged on an axially extending shaft 37.

As shown primarily in Fig. 2, the shaft 37 extends rearwardly and through an axial opening 38 in the partition 27, a sealing member 39 being disposed in the partition 27 and adapted to surround and engage the shaft 37. An actuating piston 40 is disposed on the end of the shaft 37 that extends through the opening 38, this piston having a peripheral sealing member 41 that is adapted to make sliding contact with the recess 29 formed within the sleeve 28. It is to be noted that the diameter of the piston 40, together with the sealing member 41, is slightly larger than the diameter of the breech valve 30 and the O-ring 32, to effect opening of the breech valve in a manner to be hereinafter more fully described.

The pneumatic gun of the present invention is thus provided with a charge pressure chamber 42 that is defined within the bore 12 intermediate the partition 27 and the breech valve 30. An actuating pressure chamber 43 is formed intermediate one side of the piston 40 and the

partition 27, there being an orifice 44 through the partition 27 to provide a restricted communication between the charge pressure chamber 42 and the actuating pressure chamber 43. A back-up or cushion chamber 45 is formed intermediate another side of the piston 40 and the rear wall 24 of the closure member 20, a compression spring 46 being disposed in this cushion chamber 45 and acting intermediate the rear wall 24 of the closure member 20 and a fitting 47 adjacent the piston 40, this spring serving to bias the piston 40 leftwardly, as seen in Fig. 2 and, through the shaft 37, bias the breech valve 30 toward the closed position as also shown in Fig. 2. The piston 40 provides a movable wall between the actuating pressure chamber 43 and the cushion chamber 45. For purposes of description, the chambers 43 and 45 are combined and termed a secondary chamber with chamber 42 being referred to as a primary chamber.

An extension 48 of the shaft 37 extends from the piston 40 through the fitting 47 and is slidably positioned in an axial bore 49 formed in the closure member 20. The rearward end of this extension is normally spaced from the end of the bore 49, and is provided with a conical end portion 50 that may have an angular relationship of sixty degrees, for example, relative to the axis of the extension 48. A sear 51 is positioned in a cylindrical opening 52, in the closure member 20 and handle 21, this opening 52 being disposed normal to the axis of the extension 48 and bore 44. The upper end of the sear 51 is provided with a conical end portion 53 that is adapted to extend into the bore 49 and mate with the conical end 50 formed on the extension 48. For this purpose, it may be seen that the conical end 53 may have an angular relationship of thirty degrees relative to the axis of the sear 51.

The sear 51 has a reduced diameter rod portion 54 that extends through the lower end of the cylindrical opening 52 and is journalled in a bushing 55 which is in turn threadably disposed in the lower end of the cylindrical opening 52. A compression spring 56 extends intermediate the inner end of the bushing 55 and the sear 51, normally to bias the sear 51 and the end 53 thereof into engagement with the end 50 of the extension 48. A catch member 57, that is positioned approximately normal to an operating arm 58 of a trigger 59, is adapted to engage a protruding portion 60 of the rod 54 thereby to maintain the rod 54 in its upward position with the sear 51 in position for engagement of the end 53 thereof with the end 50 of the extension 48.

The arm 58 of the trigger 59 is provided with wing portions 61, Fig. 4, that extend rearwardly on each side of the handle 21 and are pivoted on pins 62 which extend into the handle 21. A compression spring 63, Fig. 2, is disposed intermediate the handle 21 and the trigger 59, normally to bias the trigger 59 and the arm 58, together with the catch 57 to the position shown in Fig. 2. A trigger guard 64 is also disposed about the trigger 59 in the usual manner and for the usual purpose.

For a purpose to be hereinafter more fully described, the inner wall 24 of the closure member 20 may be provided with a resilient bumper member 65 that may be secured thereto as by gluing or the like and adapted to be engaged by the piston 40 upon axial movement thereof.

A source of compressed gas which may be carbon dioxide, for example, is contained within a suitable supply cylinder 66 which is mounted, as by a bracket 67, to the exterior of the breech casing 11. The cylinder 66 may be provided with a suitable filler valve arrangement 68 at one end thereof, and a discharge control valve 69 at the other end thereof. While the cylinder 66 is shown as disposed above the barrel 17 of the pneumatic gun, it is to be understood that this position is merely by way of example and that the cylinder 66 may either be secured to any other portion of the gun or arranged completely remote therefrom. The valve 69 has a fitting 70 that connects with a tube 71 that extends from the fitting and

communicates with the charge pressure chamber 42 as at 72. The tube 71 is necessarily relatively small in diameter to provide a flow restricting communication between the cylinder 66 and the charge pressure chamber 42. The charge pressure chamber 42 is fitted with a guage 73, Fig. 1, as by a fitting 74, Fig. 2, to enable the operator of the gun to determine the pressure existing in the charge pressure chamber 42.

In operation, when the valve 69 is opened, the gas under pressure from the cylinder 66 is admitted through the tube 71 to the chamber 42 and bleeds through the orifice 44 into the actuating pressure chamber 43. Inasmuch as the effective area of the piston 40 is greater than the effective area of the breech valve 30, there exists a differential in pressure acting upon the piston 40 tending to compress the spring 46. This tendency for compression of the spring 46 is resisted by the sear 51, and upon movement of the trigger 59 to remove the catch 57 from its engagement with the protruding end 60 of the rod 54, the force of this differential pressure will move the piston 40, breech valve 30, rod 37 and extension 48 rearwardly, compressing the spring 46 and moving the sear 51 out of its normal position by action of the conical end 50 against the conical end 53. Upon initial movement of the piston 40 and initial opening of the breech valve 30, pressures acting about the breech valve 30 are substantially equalized, thus causing a greater effective force on the piston 40 to force complete opening of the valve 30. The beveled end 35 of the breech valve 30 permits immediate transmission of the charge within the charge pressure chamber 42 to the inner end of the bore 18 and eliminates any tendency to withdraw the projectile P into the chamber 42 when the breech valve 30 is opened to the position shown by the dotted lines, in Fig. 2.

As the piston 40 together with the breech valve 30 moves to the dotted line position in Fig. 2, air contained in the cushion chamber 45 will be compressed, thus providing a pneumatic cushion for the rearward movement of the breech valve and piston assembly. Additionally, due to the restricted communication between the charge pressure chamber 42 and the actuating pressure chamber 43, as defined by the orifice 44, upon movement of the breech valve and piston assembly, the force of the gas pressure in the chamber 43 is soon expended in the initial opening of the breech valve 30 thereby creating a rarified atmosphere and a semi-vacuum in the chamber 43 to thus provide additional cushioning for movement of the breech valve and piston assembly. It has been found that approximately 800 pounds of gas pressure is satisfactory to adequately propel the projectile from the gun. Should additional pressure be used, the piston 40 may travel rearwardly a greater distance toward the cushion chamber 45 than would be expected under normal circumstances. In such a case, the side of the piston 40 adjacent the cushion chamber 45 would engage the resilient cushion member 65 thus avoiding any metal to metal contact that might otherwise injure the parts of the mechanism.

When the charge has been expended from the chamber 42, the spring 46 tends to return the breech valve 30 and piston 40 assembly toward the position shown in Fig. 2. This action occurs almost simultaneously with the release of the charge from the chamber 42, thus permitting the sear 51 to return to its original position at the rearward end of the extension 48 and allowing the catch 57 to move to its original position, in engagement with the extended end 60 of the rod 54. The gun mechanism is next readied for the following discharge by continued communication between the cylinder 66 and the charge pressure chamber 42 through the tube 71. In view of the restricted communication provided by the tube 71 between the cylinder 66 and the chamber 42, this next charge will build up rather slowly and little pressure will be lost during the opening and closing of the breech valve 30 in view of the short duration during which the breech valve is open. Thus successive shots may be made without the necessity for

manually recharging the chamber 42. In some instances, it may be desirable to admit only the desired pressure to the chamber 42 by opening the valve 69, and then closing this valve when the desired charge pressure is obtained. In such instances, the pressure in the chamber 42 may be read directly through use of the gauge 73 and the valve 69 closed following the establishment of the desired pressure in this charge pressure chamber.

As hereinbefore described, the O-ring 32 surrounding the periphery of the breech valve 30 is maintained in position by means of the wire or cord 34. Thus, any tendency for the charge within the chamber 42 to unseat the O-ring 32 and possibly discharge this O-ring through the bore 18 of the barrel 17 is completely eliminated. It is to be noted that the groove 33 in which the cord 34 is disposed is actually deformed so that the entrance thereof is spaced radially inwardly from the outer periphery of the O-ring 32, thus to eliminate any malfunctioning of the O-ring in its use in connection with the sealing of the inner end of the bore 18.

In order to compensate for the recoil that may normally be expected in connection with a pneumatic gun of the class described, as shown in Fig. 2, it may be desirable to secure a loop 75 to the lower side of the breech casing 11 as by welding or the like. This loop 75 may be engaged by a suitable buckle 76 or the like, that may be attached to one end of a cable 77. The cable 77 may extend to some point on the ground or in association with a fixed structure and is adapted to be attached at this fixed point. Rearward movement of the pneumatic gun mechanism may thereby be taken up by the loop, buckle and cable arrangement rather than by the arms and other bodily portions of the user.

It may also be desirable to utilize other well known forms of recoil compensating devices that may be attached to the barrel 17 or the rearward closure member 20 of the mechanism; however, under normal conditions, such additional mechanism has not been found necessary as the recoil encountered with the present pneumatic gun is sufficiently low as to enable the user to operate the gun without additional compensating devices.

Having thus described the invention and the present embodiment thereof, it is desired to emphasize the fact that many modifications may be resorted to in a manner limited only by a just interpretation of the following claim.

We claim:

A pneumatic gun comprising, in combination: a breech casing; a barrel attached to said casing and having a missile receiving bore therethrough; a charge pressure chamber formed in said casing adjacent an inner end of said barrel; a breech valve seat having a diameter equal to that of said bore and formed between said charge pressure chamber and said bore; a breech valve adapted for cooperation with said valve seat for controlling flow from said charge pressure chamber into said bore; means normally biasing said breech valve toward a closed position; an actuating pressure chamber formed in said casing axially adjacent to said charge pressure chamber; a partition disposed in said casing and separating said chambers, said partition defining a stationary wall for each of said chambers; an orifice formed through said partition and providing a restricted communication between said charge pressure chamber and said actuating pressure chamber; a piston disposed in said actuating pressure chamber, one side of said piston forming a movable wall for one end of said actuating pressure chamber, said piston having an effective area larger than the effective area of said breech valve; a pneumatic cushion chamber formed in said casing on the other side of said piston, said breech valve biasing means being disposed in said cushion chamber intermediate a stationary end of said cushion chamber and said other side of said piston; a bumper disposed on said stationary end of said cushion chamber, said bumper being adapted for engagement by said piston upon movement thereof and having an axial thickness greater than compressive limits of said biasing means for said breech valve; a shaft slidably disposed through said partition and interconnecting said breech valve and said piston; a source of gas under pressure; orifice means for admitting said gas to said charge pressure chamber to establish a charge therein; an extension formed on said shaft and extending from said piston; a conical end formed on said extension; a sear having a matching conical end adapted for cooperation with said extension conical end for maintaining said breech valve in a closed position; spring means normally biasing said sear into contact with said extension; locking means for securing said sear in said contacting position and a trigger for releasing said locking means, whereby to permit said piston to be moved in response to a pressure differential created by the differences in said effective areas thereby to move said shaft and said extension, depress said sear against the force of said spring means, open said breech valve and transmit said charge from said charge pressure chamber to said bore to propel said missile therefrom.

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