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By mesne assignments to
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[54] **AIR OPERATED PROJECTILE FIRING**
APPARATUS
3 Claims, 2 Drawing Figs.

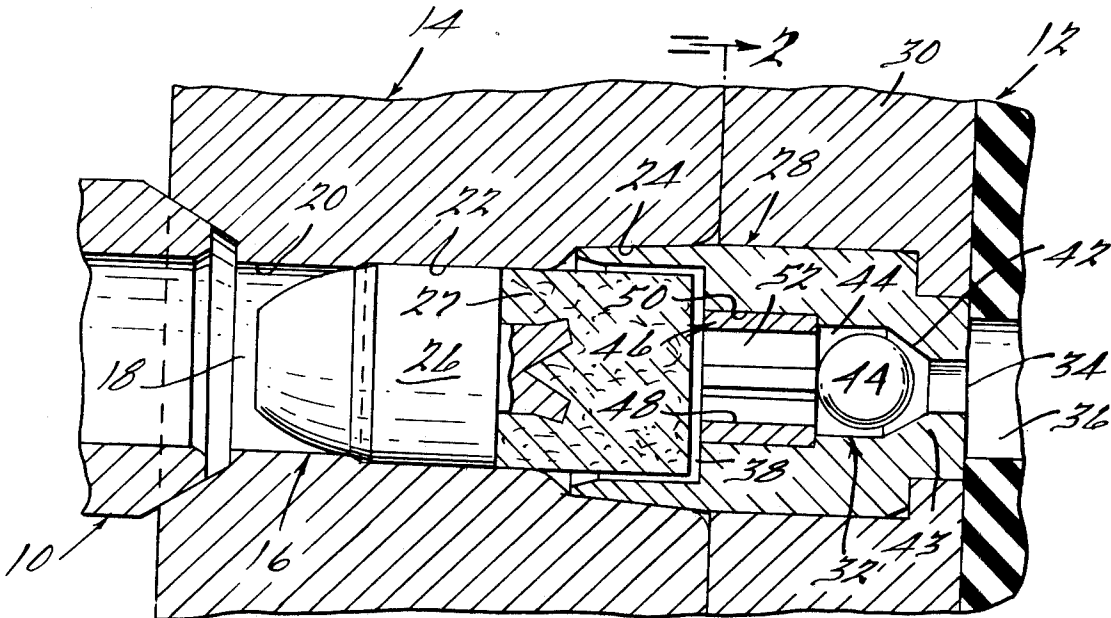
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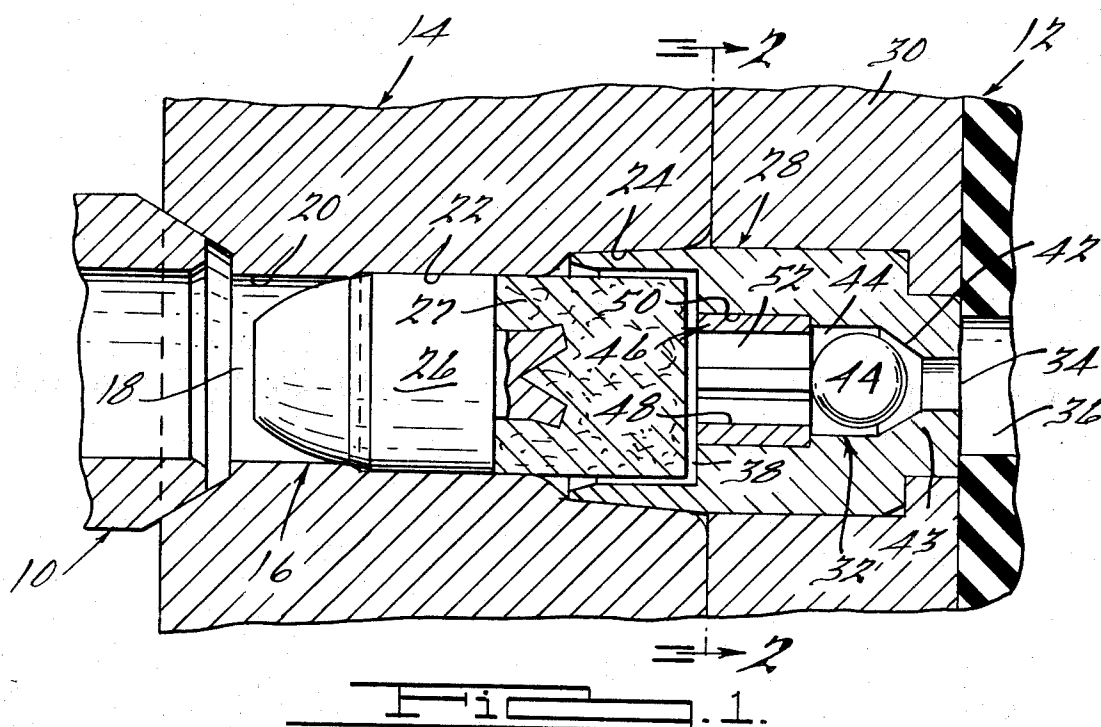
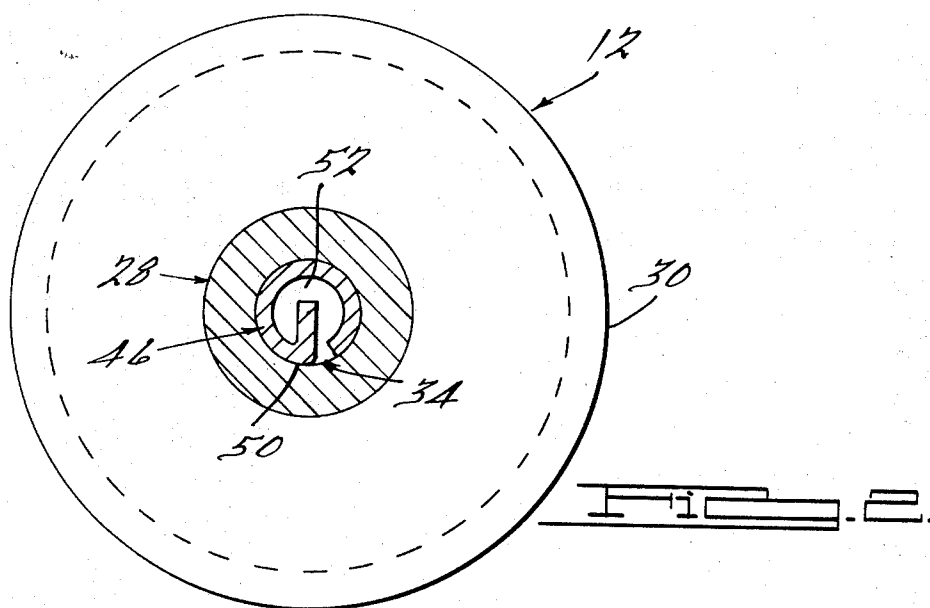
[50] **Field of Search**..... **89/7;**
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ABSTRACT: There is herein disclosed an air ignition system firearm wherein a ball valve is freely floatingly mounted in a valve chamber in a separate one-piece valve plug mounted on the front of an axially movable air compression device.





AIR OPERATED PROJECTILE FIRING APPARATUS

This is a continuation of application Ser. No. 469,987, filed July 7, 1965, now abandoned.

This invention relates to air operated projectile firing apparatus of the type adapted to utilize ammunition having a projectile portion and an associated propellant portion capable of being ignited by surface contact with high temperature air.

This invention is related to and adapted to be utilized with apparatus of the type disclosed in copending application Ser. No. 473,556 filed July 7, 1965, for Air Operated Projectile Firing Apparatus.

The objects and advantages of the invention have been attained by utilization of the inventive principles disclosed hereinafter by reference to the accompanying drawing in which:

FIG. 1 is a side elevational view, in section, of a projectile firing device having a new and improved valve assembly; and

FIG. 2 is an end view of the valve assembly.

In general, the invention is in the provision of a new and improved valve assembly in apparatus for firing projectiles which is characterized by the provision of a valve chamber adapted to floatingly receive a valve member between a firing chamber in which a propellant is ignitable by surface contact with high temperature air and air compression means for obtaining the high temperature air, a valve member floatingly mounted in the valve chamber for movement between an open position permitting flow of high temperature air from the air compression means to the firing chamber and a closed position preventing flow of high temperature high pressure gases from the firing chamber to the air compression means after ignition of the propellant and forming a rigid reaction wall therebetween, and retaining means floatingly retaining said valve in said valve chamber.

Referring now to the drawing, barrel means 10 and a compression means 12 are connected, in a firing position, by breech means 14. Ammunition holding means 16 comprising a central bore 18 having stepped portions 20, 22, 24 supports the ammunition 26 which has a propellant portion 27 ignitable by surface contact with high temperature air to drive the projectile through the barrel. An obturating plug 28 of integral one-piece construction is mounted in a compression cylinder head 30 and supports the valve assembly 32 in a central bore 34 which provides a passage having a longitudinally extending central axis connecting air compression chamber 36 to firing chamber 38. The first part of the passage adjacent the compression chamber has a perimeter of reduced diameter relative to the remainder of the passage.

The valve assembly 32 comprises valve means 40, in the form of a ball valve, and valve seat means 42 in the form of a conical surface along a second part of the passage next adjacent the reduced diameter part and formed by an outwardly diverging surface. The valve seat is formed in a rigid reaction wall 43 and faces away from the air compression chamber toward the firing chamber. A valve chamber 44 is formed in a third part of the passage next adjacent the valve seat by an enlarged cylindrical bore at the end of the valve seat. The valve chamber is larger than the ball valve so as to floatingly support the valve. Retaining means 46 are provided at the end of the valve chamber 44. In the illustrative embodiment, the retaining means comprises a one-piece coil spring element 48 compressible fixedly mounted in an enlarged retainer seat 50 formed in a fourth part of the passage next adjacent the valve chamber and extending along the wall of the passage from the valve chamber to the firing chamber and mounted to floatingly retain the valve between the end of the retainer and the valve seat. It may be observed that the coil spring element 48, in the illustrative embodiment, comprises a length of resilient spring sheet material wound into coil form, compressed, inserted into the valve chamber, and held therein by spring-like expansion forces. The width of the polygonal sheet material is substantially equal to the length of the retainer seat. Passage means 52 are thus provided through the retainer

means to connect the firing chamber to the compression chamber. A transverse surface of the retainer extends across the passage and blocks the valve chamber to keep the ball valve therewithin.

In operation, the ball valve is normally maintained in an open position permitting flow of high temperature air from the compression chamber to the firing chamber formed in the illustrative embodiment by a fifth part of the passage and of enlarged size so as to receive the propellant and permit the retainer and the valve to be inserted and removed through the firing chamber end of the passage. When the pressure in the firing chamber, including passage means 52 and valve chamber 44, exceeds the pressure in the compression chamber, the ball valve is moved onto the conical seat to close the firing chamber relative to the compression chamber and to provide a rigid reaction wall across the flow passage.

While the illustrative embodiment of the inventive principles hereinbefore disclosed has particular advantages, it will be recognized that certain details of construction may be modified and varied without departing from the fair meaning and intended scope of the claims.

We claim:

1. In an air ignition system firearm such as a rifle or pistol having a firing chamber for ignition of a propellant by surface contact with high temperature air and a compression chamber for obtaining air at a temperature at which the propellant is ignitable, air passage means connecting said firing chamber to said compression chamber, a valve seat formed in said air passage means, an enlarged valve chamber formed in said air passage means adjacent said valve seat, a ball valve smaller than said valve chamber floatingly supported in said valve chamber, and valve retainer means mounted in said air passage means adjacent said valve chamber and floatingly retaining said valve in said valve chamber, said valve being freely movable in said valve chamber solely in response to pressure differentials existing between said firing chamber and said compression chamber and being movable by gas pressure in said firing chamber onto said valve seat to close said air passage means when the pressure in said firing chamber exceeds the pressure in said compression chamber, said valve retainer means comprising a one-piece coiled polygonal sheet of resilient material mounted in a cylindrical portion of said air passage means.

2. In an air ignition system firearm such as a rifle or pistol for firing a round of ammunition having a projectile and a propellant ignitable by surface contact with high temperature air:

ammunition holding means in the firearm for holding a round of ammunition in a firing position;

firing chamber forming means in the firearm adapted to be associated with said round of ammunition in the firing position and to form a firing chamber about the propellant;

an air compression chamber in the firearm for obtaining high temperature air for ignition of the propellant;

a passage in the firearm having a longitudinally extending central axis connecting said air compression chamber to said firing chamber;

a first part of said passage adjacent said compression chamber having a perimeter of reduced size relative to the remainder of said passage;

a second part of said passage next adjacent said first part being of outwardly diverging generally conical shape and forming a valve seat facing the firing chamber;

a third part of said passage next adjacent said valve seat having a perimeter of enlarged size relative to said first part and to said valve seat and forming a valve chamber;

a valve having a perimeter of reduced size relative to said third part and of enlarged size relative to said first part and being:

freely floatingly received in said valve chamber and freely movable away from said valve seat to open said passage and permit flow of high temperature air from the com-

pression chamber to the firing chamber, and freely movable onto said valve seat to close said passage after delivery of high temperature air to the firing chamber to prevent flow of propellant gases from the firing chamber to the compression chamber, said movement being caused solely by pressure differential between the firing chamber and the compression chamber;

a fourth part of said passage next adjacent said valve chamber having a perimeter of enlarged size relative to said valve to permit insertion of said valve through said fourth part of said passage and providing valve retainer holding means between said valve chamber and said firing chamber, and a valve retainer member mounted in said fourth part of said passage on said valve retainer holding means along the wall of said fourth part of the passage and defining therewith an opening connecting said valve chamber to said firing chamber, said retainer member having a transverse surface extending across said passage and blocking the adjacent end of said valve chamber to freely floatingly retain said valve in said valve chamber, said retainer member comprises a one-piece coiled polygonal sheet of resilient material having a width substantially equal to the length of the fourth part of the passage.

3. In an air ignition system firearm, such as a rifle or pistol, having an air compression cylinder means in which air is compressed to a temperature sufficient to ignite ammunition propellant by surface contact therewith, a barrel means through which an ammunition projectile is propelled after ignition of ammunition propellant associated therewith, and valve means between the cylinder means and the barrel means to prevent rearward flow of propellant gases, the improvement comprising:

- a separate one-piece valve plug mounted on said cylinder means;
- a portion of said valve plug extending beyond said cylinder means toward said barrel means;

a firing chamber provided at the barrel end of said valve plug;

valve retainer holding means provided in said valve plug next adjacent said firing chamber;

a retainer mounted in said valve retainer holding means, a valve chamber provided in said separate valve plug next adjacent said valve retainer holding means;

a free floating valve mounted in said valve chamber and having a size smaller than said valve retainer holding means and said valve chamber so as to be insertable therethrough;

a valve seat of smaller size than said valve in said separate valve plug next adjacent said valve chamber and facing said barrel means;

an air passage in said separate valve plug connecting said cylinder means to said firing chamber means through said valve seat;

a first valve plug chamber in said air cylinder means next adjacent and opening toward said barrel means, a second valve plug chamber in said air cylinder means next adjacent and being smaller in size than said first valve plug chamber;

a transverse abutment surface connecting said first valve plug chamber and said second valve plug chamber and facing said barrel means;

a first peripheral plug surface corresponding in size and shape to said first valve plug chamber; and

a second peripheral plug surface corresponding in size and shape to said second valve plug chamber, a transverse abutment surface on said valve plug corresponding in size and shape to said transverse abutment surface connecting the valve plug chambers, and said separate valve plug being supportingly mounted in the valve plug chambers with the transverse abutment surfaces in engagement and holding said valve plug against axially directed forces generated by propellant gases in said firing chamber.

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