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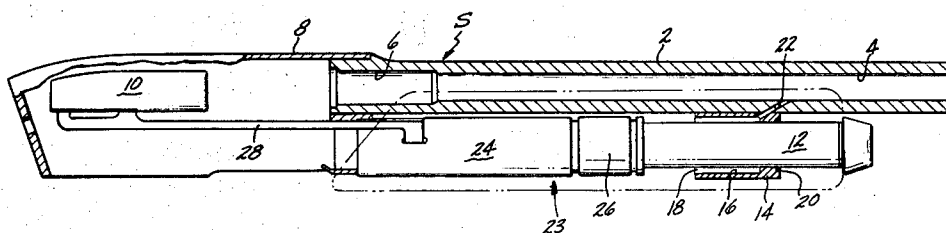
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[54] **GAS PISTON FOR SHOTGUN**
7 Claims, 7 Drawing Figs.

[52] U.S. Cl. 89/191
 [51] Int. Cl. F41d 5/10
 [50] Field of Search 89/191,
 192, 193

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ABSTRACT: A gas piston for use with a shotgun having a gas cylinder disposed externally on a tubular magazine, the piston being slidably mounted on the magazine. The piston includes a piston sleeve loosely mounted on the magazine and a piston head flexibly connected to the piston sleeve. The piston head may be longitudinally split for radial flexure, and a split ring may be interposed between the piston head and the piston sleeve for opposite radial flexure.



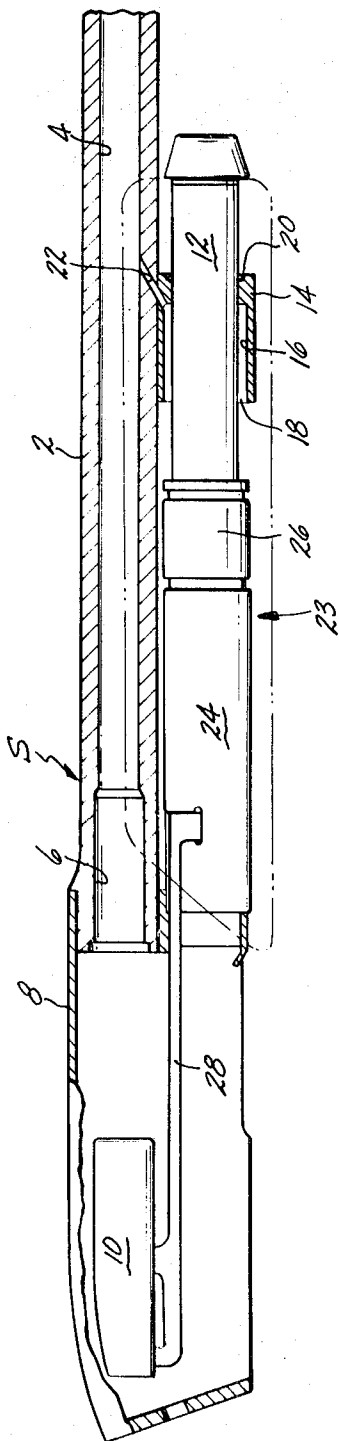


FIG-1

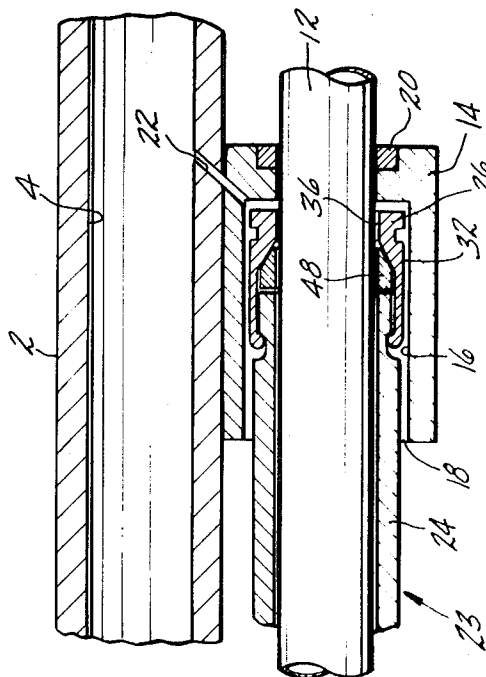


FIG-3

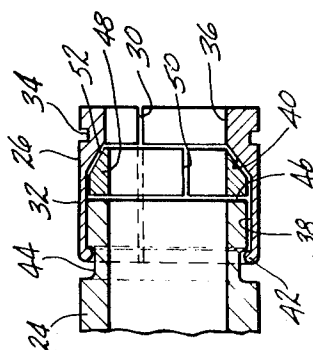
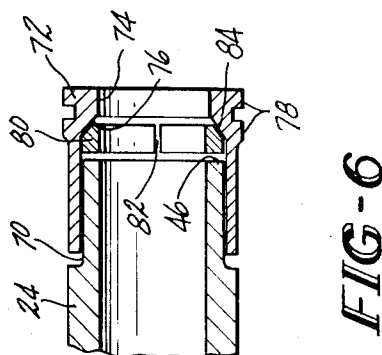
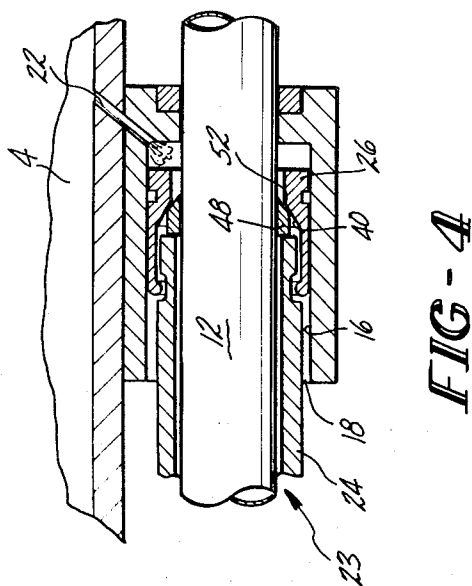
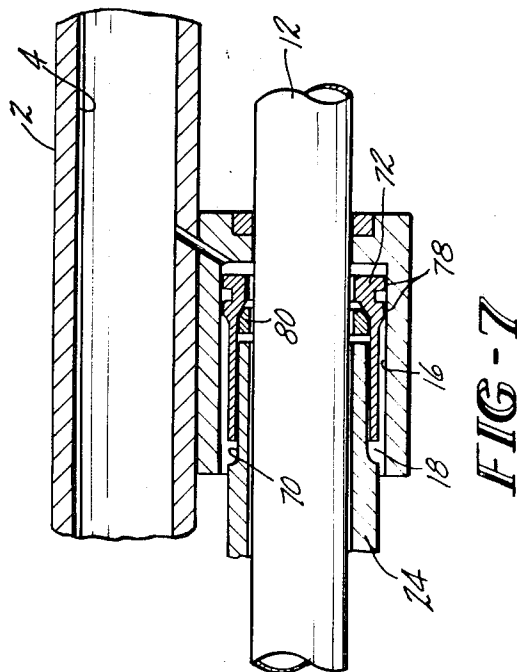
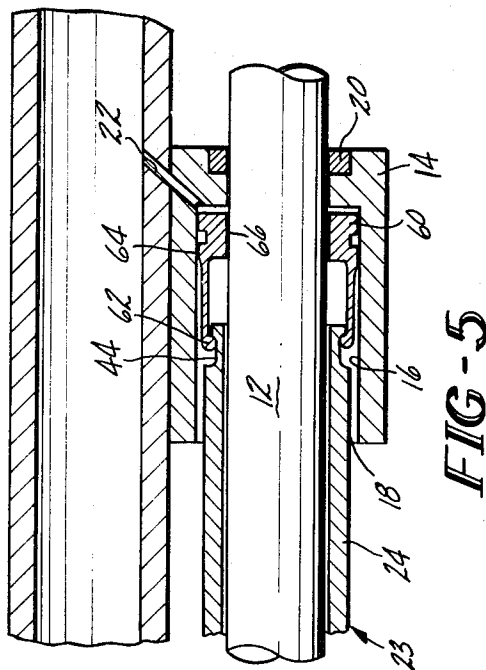


FIG-2

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GAS PISTON FOR SHOTGUN

This invention relates to a gas piston for use with a shotgun, or the like, having a tubular magazine, which gas piston is mounted on the exterior of the magazine. The piston is operable to reciprocate the bolt of the gun after the latter is fired, the piston itself reciprocating on the magazine during operation. The piston of this invention includes a piston sleeve portion which is mounted on the magazine and freely slidable thereon. A piston head is loosely connected to the sleeve, the head being pivotally and longitudinally movable with respect to the sleeve.

It is known in the prior art to provide a semiautomatic shotgun having a tubular magazine with a gas system operative to reciprocate the bolt assembly after the gun is fired, which gas system includes a gas piston mounted on the exterior of the magazine. Such an arrangement is advantageous since it allows the interior of the magazine to be entirely utilized for reception of shells to be fired. Such "external" gas systems include an annular bracket which is mounted on the barrel of the gun and which surrounds a portion of the magazine to define therewith an annular gas cylinder or chamber. The front end of the gas chamber is sealed, and the rear end is open. A gas piston is slidably mounted on the magazine and is movable into and out of the gas chamber. A port interconnects the barrel bore and the gas chamber, the port serving for the passage of pressurized gases from the barrel bore to the gas chamber, which gases drive the gas piston over the magazine. The piston is operative to drive the bolt assembly through its reciprocation cycle during which cycle the spent shell is extracted and ejected and a fresh shell is fed into the firing chamber. In order to operate efficiently the piston must form a gastight seal with the walls of the gas chamber.

The requirement that the piston form a gastight seal with the walls of the gas chamber causes problems relating to the reciprocation of the piston over the magazine. It is, of course, preferable that the piston reciprocate over the magazine as smoothly as possible so as not to interfere with the reciprocation cycle of the bolt assembly. It is also essential that the piston be free of binding or jamming problems which could occur between the piston and the magazine. The magazine is generally not a precision machined part, thus the exterior of the magazine may be out of round, or may contain depressions and/or prominences which interfere with the travel of the piston over the magazine. The above "flaws" in the exterior surface of the magazine can cause the gas piston to bind up on the magazine thus jamming reciprocation of the bolt assembly. One way to insure that the piston will reciprocate smoothly over the magazine would be to precision grind the exterior surface of the magazine. This is, however, an expensive operation and would undesirably increase the cost of the shotgun to the buyer.

A second problem which occurs even on a smoothly ground magazine is the deposition from the combustion gases of material onto the walls of the gas chamber. These deposits are free to build up in the external gas systems of the prior art. Ultimately the deposits can cause the piston to jam in the gas chamber or can close off the bleed port and render the system inoperative.

The gas system of this invention operates without binding or jamming problems by providing a generally two piece gas piston. The gas piston includes a piston sleeve which is mounted on the magazine to freely slide thereover. The inside diameter of the piston sleeve is sufficiently larger than the outside diameter of the magazine to insure that the sleeve will freely slide over the magazine to insure that the sleeve will freely slide over the magazine regardless of standard imperfections on the outside surface of the latter. The piston also includes a piston head which is loosely connected to the piston sleeve, the connection permitting the sleeve and head to travel together over the magazine tube, while at the same time permitting relative lateral and longitudinal movement to occur between the sleeve and head as they travel over the magazine.

The piston head includes inner and outer lands which form a gastight seal with the walls of the gas chamber, the lands having a longitudinal dimension of the entire piston. Thus only the lands on the piston head form a gastight seal with the walls of the gas chamber, and in particular, only the inner lands forms a gastight seal with the magazine tube. Since the lands are of a minor longitudinal dimension, and since the piston head is free to move laterally and longitudinally with respect to the piston sleeve as the piston moves over the magazine, the piston head is free to follow any depressions and/or prominences on the external surface of the magazine without influencing the movement of the piston sleeve. Thus the piston will not become canted and jam on the magazine.

The piston head may be compound in construction, and may include an outer portion connected to the piston sleeve and having a radially outwardly extending land. The outer portion is split so that it can be radially outwardly flexed. The compound piston head also includes an inner split ring which is sandwiched between the outer portion and the piston sleeve and which can be radially inwardly flexed to form the inner land. The outer portion and the ring are normally loosely slidable over the magazine and within the gas chamber, and are flexed outwardly and inwardly respectively into gas sealing engagement with the gas chamber walls when the high-pressure gases are bled into the gas chamber. In the case of the compound piston head, the outer portion and the ring also serve to scrape deposits off of the gas chamber walls during the rearward position of the reciprocation of the piston.

It is, therefore, an object of this invention to provide an external gas system for a firearm, which gas system includes a gas piston that reciprocates on a tubular magazine without attendant jamming or binding occurring between the piston and the magazine.

It is a further object of this invention to provide a gas system of the character described, wherein the gas piston includes a piston sleeve loosely mounted on the magazine, and a piston head loosely connected to the piston sleeve, the piston head having lands for sealing engagement with a gas chamber surrounding a portion of the magazine.

It is yet another object of this invention to provide a gas system of the character described wherein undesirable deposits are scraped from the gas chamber walls during operation of the gas piston.

These and other objects and advantages of this invention will become more readily apparent from the following detailed description and accompanying drawings in which:

FIG. 1 is a side view, partially in section, of a portion of a shotgun utilizing a preferred embodiment of the gas system of this invention, the system being shown with the bolt assembly in its retired position;

FIG. 2 is a side sectional view of the piston head, the split ring, and a portion of the piston sleeve showing the manner in which the piston head is connected to the piston sleeve;

FIG. 3 is an enlarged side sectional view of a portion of the shotgun of FIG. 1 showing the gas piston disposed in the gas chamber as it appears before the gun is fired, and particularly showing the manner in which the piston is loosely slidable both on the magazine tube and within the gas chamber;

FIG. 4 is a side sectional view similar to FIG. 3, but showing the piston head as it flexes outwardly and inwardly into gas sealing engagement with the walls of the gas chamber when high-pressure combustion gases are bled from the barrel bore into the gas chamber;

FIG. 5 is a side sectional view similar to FIGS. 3 and 4, but showing an alternative embodiment of the piston head;

FIG. 6 is a side sectional view of still a third embodiment of the piston of this invention, wherein the piston head is not split, but the ring sandwiched between the piston head and the sleeve is split for radial flexure; and

FIG. 7 is a side sectional view of the gas chamber showing the piston of FIG. 6 disposed in the gas chamber as it appears prior to the introduction of high-pressure gases into the chamber.

Referring now to FIG. 1, a semiautomatic shotgun S is partially shown. The shotgun includes a barrel 2 having a bore 4 and a firing chamber 6. The barrel 2 is connected to a receiver 8 in which is reciprocally mounted a bolt assembly 10 (shown schematically). The bolt assembly 10 is shown in its retired position. A tubular magazine 12 is connected to the receiver 8 and is disposed below and parallel to the barrel 2. An annular bracket 14 is mounted on the barrel 2, the bracket 14 having an inner wall 16 which surrounds a portion of the magazine 12 to define therewith an annular gas chamber 18. An annular seal 20 is mounted on the front end of the bracket 14 around the magazine 12 to form a gastight front wall for the gas chamber 18. It is noted that the rear end of the gas chamber 18 is open. A port or conduit 22 interconnects the barrel bore 4 with the gas chamber 18 to provide a passage through which high pressure combustion gases are bled from the bore 4 into the gas chamber 18.

A piston 23 comprising an annular piston sleeve 24 is slidably mounted on the magazine 12 so that the piston is freely and easily slidable over the magazine. An annular piston head 26 is loosely connected to the forward end of the sleeve 24, the head 26 being both pivotally and longitudinally movable with respect to the sleeve 24. A pair of elongate slide arms 28 (only one of which is shown) are connected to the sleeve 24 and to the bolt assembly 10.

Referring now to FIG. 2, details of the piston head 26 and the manner in which it is connected to the piston sleeve 24 are shown. The piston head 26 is generally annular in configuration and is longitudinally split at 30 to permit the head 26 to be radially flexed. The outside surface 32 of the head 26 is preferably grooved as at 34, and the inside surface of the head 26 includes a first smaller diameter portion 36 and a second larger diameter portion 38. An intermediate frustoconical portion 40 forms an oblique surface which interconnects the portions 36 and 38. The rear end of the head 26 includes an inwardly turned bead 52 which is disposed in an elongated slot 44 in the piston sleeve 24. The bead 42 and slot 44 are formed in such a manner that the head 26 can be both pivoted and slid longitudinally somewhat with respect to the sleeve 24, but will not become disconnected from the sleeve 24. The forward end of the sleeve 24 extends slightly into the larger internal diameter portion 38 of the head 26 and terminates in the face 46. A ring 48 which is longitudinally split at 50 is disposed between the sleeve terminal 46 and the oblique surface 40 on the head. The ring 48 includes an oblique face 52 which is complementary to and disposed against the oblique face 40 on the head.

FIG. 3 shows the forward end of the piston disposed within the gas chamber, the piston being ready for reciprocation when a shell is fired from the gun. It is noted that the piston head 26, piston sleeve 24, and the ring 48 are formed in such a manner that the piston 23 is easily slidable over the magazine 12 and within the gas chamber 18. Specifically the inside surface of the sleeve 24 and the ring 48, and the smaller inside diameter 36 on the head 26 are all slightly spaced apart from the magazine 12 and not in gas sealing engagement therewith. Also the outside surface of the sleeve 24, and the outside surface 32 of the head 26 are slightly spaced apart from the inner surface 16 of the bracket 14, and are not in gas sealing engagement therewith. The condition shown in FIG. 3 is a normal condition for the ring 48 and head 26 which exists as long as the piston is not exposed to the force of high-pressure gases being bled into the gas chamber 18 from the barrel bore 4. It is thus readily apparent that the piston 23 as shown in FIG. 3 will slide over the magazine 12 quite easily and will not become jammed or bound by standard imperfections found on the exterior of the magazine.

FIG. 4 shows the piston head 26 and ring 48 as they appear when high-pressure gases are bled from the barrel bore 4 into the gas chamber 18. When the charge of high-pressure gases is bled from the barrel bore 4 through the port 22 into the gas chamber 18, the increased pressure forces the piston head 26 toward the left, or rearward, as shown in FIG. 4. The loose connection between the piston head 26 and the piston sleeve

24 permits the head 26 to slide rearwardly with respect to the sleeve 24, thus moving the oblique face 40 on the head 26 against the oblique face 52 on the ring 48. The ring 48 is trapped between the sleeve 24 and the head 26, and since the ring 48 and head 26 are both longitudinally split, the moving contact between the oblique faces 40 and 52 causes the head 26 to flex radially outwardly into gas sealing contact with the outer wall 16 of the gas chamber 18, and the ring 48 to flex radially inwardly into gas sealing contact with the exterior of the magazine 12. Thus, as shown by FIG. 4, the gas chamber 18 immediately becomes sealed by the head 26 and ring 48 when the high-pressure gases are introduced into the chamber 18 through the port 22. The pressurized gas in the chamber 18 then serves to drive the piston 23 rearwardly. Once the piston head 26 leaves the gas chamber 18, the head 26 and ring 48 are freed from the force exerted on them by the high-pressure gases, and the head and ring reassume their normal configurations on the magazine 12, thereby again becoming freely slidable thereover. Sufficient momentum having been imparted to the piston 23, the slide arms 28, and the bolt assembly 10 by driving the head 26 from the gas chamber 18, the piston 23, the slide arms 28, and the bolt assembly 10 continue to move rearwardly through their reciprocation cycle, and are returned through the last half of the cycle by a conventional spring (not shown) to the positions shown in FIG. 3.

It is thus readily apparent that the embodiment shown in FIGS. 1—4 is capable of providing a seal between the piston and gas chamber when a pressurized charge of gas is introduced into the chamber so as to drive the system through the first half of its reciprocation cycle, while at the same time, the seal between the piston and magazine is eliminated after the piston leaves the gas chamber so that the piston can slide freely over the magazine without jamming or binding occurring.

It is also apparent that the head 26 and the ring 48 will scrape the walls of the gas chamber 18 as the piston leaves the gas chamber, thus deposits will be removed from the gas chamber walls. The scraping will not, however, occur when the piston reenters the gas chamber 18, thus deposits will not be scraped forward in the gas chamber 18 to be built up therein. It is apparent that if deposits were scraped forwardly through the gas chamber, the buildup would ultimately close off the bleed port 22.

Referring now to FIG. 5, a second embodiment of the gas system is shown. The piston 23 includes a sleeve 24 loosely mounted on the magazine tube 12, the sleeve 24 having an elongated slot 44 on the forward portion thereof. A piston head 60 is disposed forward of the sleeve 24 and is loosely connected to the latter by means of an inwardly turned bead 62 which extends into the sleeve slot 44. The slot 44 and bead 62 form a loose connection which permits the head 60 to pivot and slide longitudinally to a predetermined degree with respect to the sleeve 24. The piston head 60 includes a radially outwardly extending shoulder 64 at its forward end which is disposed in gas sealing engagement with the outer wall 16 of the gas chamber 18. The piston head 60 also includes a radially inwardly extending shoulder 66 at its forward end which is disposed in gas sealing engagement with the magazine 12 during the entire reciprocation cycle of the system. The relatively short longitudinal dimension of the shoulder 66, and the flexibility of the connection between the sleeve slot 44 and the head bead 62 permits the head 60 to closely follow the outer contour of the magazine 12 without causing the sleeve 24 to jam on the magazine.

Referring now to FIGS. 6 and 7, yet a third embodiment of the piston of this invention is shown. The piston includes a sleeve 24 having an undercut 70 at the forward end thereof. An annular piston head 72 is slidably fitted over the undercut 70. The interior surface of the piston head 72 includes a first smaller diameter surface 74 and an adjacent oblique surface 76. The exterior of the piston head 72 includes a land 78 which forms a seal with the outer wall 16 of the gas chamber 18, as shown in FIG. 7. It is noted that the piston head 72 is not

split, but rather is a solid, annular body. A ring member 80 which is longitudinally split at 82 is sandwiched between the forward terminal face 46 of the sleeve 24 and the oblique surface 76 on the piston head 72. The ring 80 includes an oblique face 84 which is adjacent and complementary to the oblique piston head surface 76. As shown in FIG. 7, when the piston head 72 is disposed within the gas chamber 18, the head lands 78 form a gastight seal with the outer wall 16 of the gas chamber 18, but the interior surface 74 of the piston head 72 is spaced apart from and in nonsealing arrangement with the inner wall of gas chamber 18, e.g. with the exterior surface of the magazine tube 12. The ring 80 and the sleeve 24 are also in nonsealing arrangement with the magazine tube 12. When high-pressure gases are bled from the barrel bore into the gas chamber 18, the piston head 72 is initially driven back over the undercut 70 on the sleeve 24 driving the oblique surfaces 76 and 84 on the head 72 and ring 80 respectively against each other. The ring 80 is thus driven against the forward terminal 46 of the sleeve 24 and caused to flex radially inwardly into sealing engagement with the exterior of the magazine tube 12. The piston thus seals with both surfaces in the gas chamber 18, and the piston is then driven to the rear to reciprocate the bolt.

It is readily apparent that the system of this invention provides for smooth, nonjamming reciprocation of the bolt assembly of a semiautomatic firearm, while at the same time permitting the mounting of the gas piston of the system on the exterior of a tubular magazine. The smooth operation of the system is, furthermore, assured without requiring expensive and time consuming precision machining of the exterior surface of the magazine.

What I claim is:

1. In a firearm having a bolt assembly, a barrel, and a tubular magazine adjacent to the barrel, a mechanism for driving the bolt assembly through a reciprocation cycle, said mechanism comprising:

- a. bracket means surrounding a portion of said magazine to define therewith an annular gas chamber;
- b. means sealing a forward end of said gas chamber;
- c. conduit means interconnecting said gas chamber with a bore in said barrel;
- d. sleeve means loosely mounted on said magazine and freely movable thereover, said sleeve means being rearward of said gas chamber;
- e. annular means slidably mounted on said magazine forward of said sleeve means for movement into and out of said gas chamber, said annular means contacting said sleeve means, and said annular means normally being disposed in nongas sealing relationship with walls of said gas chamber;
- f. slide arm means interconnecting said sleeve means and said bolt assembly to drive the latter through its reciprocation cycle when said sleeve means is driven rearwardly over said magazine; and
- g. said annular means being operative to flex radially outwardly and radially inwardly into gas sealing engagement with said gas chamber walls upon introduction of high-pressure gases into said gas chamber to drive said annular means and said sleeve means rearwardly over said magazine, and said annular means being operative to flex back to its original radial dimension after exiting said gas chamber, and means operable to permit said annular means to maintain contact with said sleeve means during the entirety of said reciprocation cycle.

2. The mechanism of claim 1, wherein said annular means comprises a longitudinally split piston head loosely connected to said sleeve means, and a longitudinally split ring sandwiched between said head and said sleeve means.

3. The mechanism of claim 2, wherein said head includes an oblique face, and said ring includes an oblique face, said oblique faces being complementary and in face-to-face relationship, and said oblique faces providing sliding surfaces operative to promote radial flexure of said head and said ring when said head is forced against said ring.

4. In a firearm having a bolt assembly, a barrel, and a tubular magazine adjacent to the barrel, a mechanism for driving the bolt assembly through a reciprocation cycle, said mechanism comprising:

- a. bracket means surrounding a portion of said magazine to define therewith an annular gas chamber;
- b. means sealing a forward end of said gas chamber;
- c. conduit means interconnecting said gas chamber with a bore in said barrel;
- d. sleeve means loosely mounted on said magazine and freely movable thereover, said sleeve means being rearward of said gas chamber;
- e. piston head means slidably mounted on said magazine forward of said sleeve means for movement into and out of said gas chamber, said piston head means contacting said sleeve means, and said head means being longitudinally split from end to end for radial flexure into gas sealing engagement with a wall of said gas chamber;
- f. ring means slidably mounted on said magazine and contacting said piston head means, said ring means being longitudinally split for radial flexure into gas sealing engagement with another wall of said gas chamber;
- g. slide arm means interconnecting said sleeve means and bolt assembly to drive said bolt assembly rearward when said sleeve means is driven rearwardly; and
- h. said piston head means and said ring means being operative to flex radially into gas sealing engagement with opposite walls of said gas chamber when pressurized gases are bled into said gas chamber to cause said piston head means, said ring means and said sleeve means to be driven rearwardly, and said piston head means and said ring means being operative to flex back to their original radial dimensions after exiting said gas chamber so as to be freely slidable over said magazine to maintain contact with said sleeve means during the entirety of said reciprocation cycle.

5. The mechanism of claim 4, further comprising complementary oblique faces formed on said head means and said ring means said oblique faces providing sliding surfaces operative to promote radial flexure of said head means and said ring means when said head means is forced against said ring means.

6. In a firearm having a bolt assembly, a barrel, and a tubular magazine adjacent to the barrel, a mechanism for driving the bolt assembly through a reciprocation cycle, said mechanism comprising:

- a. bracket means surrounding a portion of said magazine to define therewith an annular gas chamber;
- b. means sealing a forward end of said gas chamber;
- c. conduit means interconnecting said gas chamber with a bore in said barrel;
- d. sleeve means loosely mounted on said magazine and freely movable thereover, said sleeve means being rearward of said gas chamber;
- e. piston head means slidably mounted on said magazine forward of and contacting said sleeve means for movement into and out of said gas chamber;
- f. ring means slidably mounted on said magazine and contacting said piston head means, at least one of said piston head means and said ring means being longitudinally split from end to end for radial flexure into gas sealing engagement with said tubular magazine, and the other of said ring means and said piston head means being operable to form a gastight seal with a wall of said bracket means;
- g. elongate means connected to said sleeve means, said elongate means being operative to drive said bolt assembly rearward during a rearward stroke of said sleeve means; and
- h. said longitudinally split one of said piston head means and said ring means being operable to flex radially inwardly into gas sealing engagement with said magazine when pressurized gases are introduced into said gas chamber to drive said piston head means, said ring means and said sleeve means rearwardly, and said longitudinally split one of said piston head means and said ring means further

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being operative to flex back to its original radial dimension after exiting from said gas chamber so as to be freely slidable over said magazine to maintain contact between said piston head means and said sleeve means during the entirety of said rearward stroke of said sleeve means.

7. The mechanism of claim 6, wherein said head means in-

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cludes an oblique face, and said ring means includes an oblique face, said oblique faces being complementary and in face-to-face relationship and said oblique faces providing sliding surfaces operative to promote radial flexure of said ring means when said head means is forced against said ring means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,601,002 Dated August 24, 1971

Inventor(s) Stefan Kenneth Janson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 2, line 3, after "dimension" please insert --which
is substantially less than the longitudinal dimension--;

In Column 1, line 68, after "magazine" please delete --to
ensure that the sleeve will--;

In Column 1, line 69, before "regardless" please delete
--freely slide over the magazine--.

Signed and sealed this 4th day of April 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents