

Sept. 5, 1961

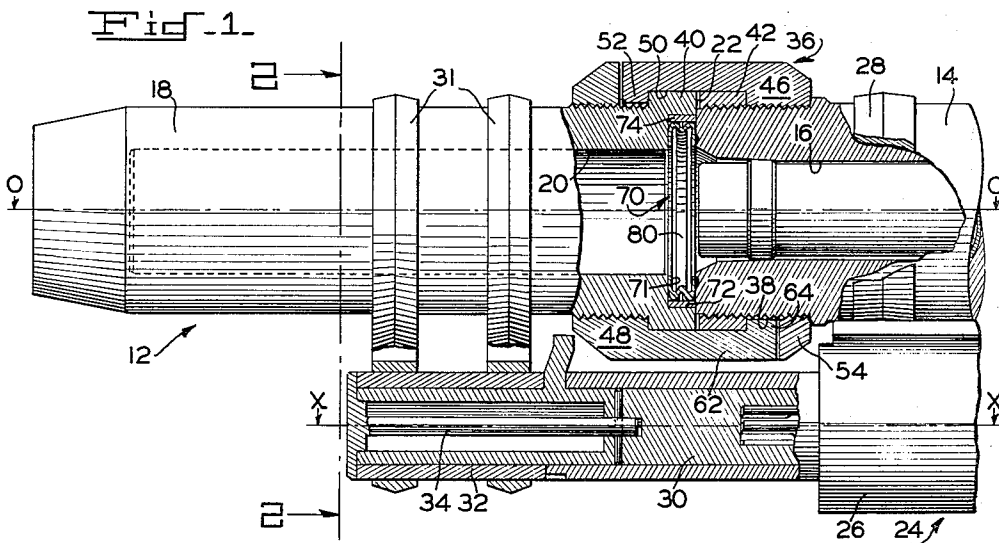
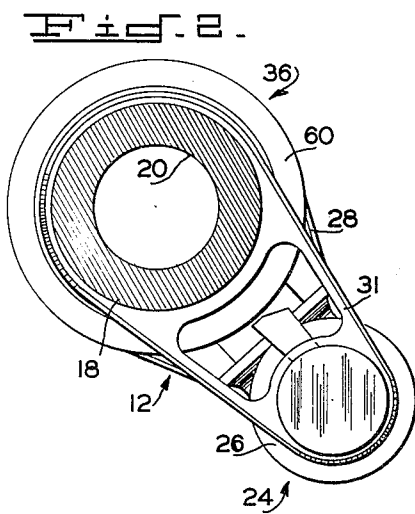
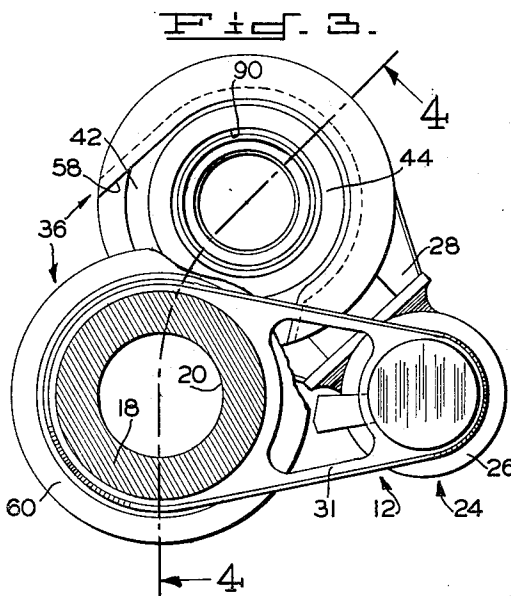
R. J. THIERRY

**2,998,755**

TRAVERSELY SWINGING GUN BREECH WITH OBTURATING SEAL

Filed Feb. 1, 1960

2 Sheets-Sheet 1





1

2,998,755

## TRAVERSELY SWINGING GUN BREECH WITH OBTURATING SEAL

Robert J. Thierry, Averill Park, N.Y., assignor to the  
United States of America as represented by the Secretary of the Army

Filed Feb. 1, 1960, Ser. No. 6,076

6 Claims. (Cl. 89-26)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to guns having a chamber which is pivotally separated from the tube and which is mounted for such pivotal movement around an axis which is parallel to the axis of the tube, and the invention pertains more particularly to means for coupling the chamber and tube when aligned in battery position and for sealing the joint therebetween.

In large caliber guns, in which the propellant and projectile are handloaded separately thereinto, and where the gun is mounted so that space for such handloading from the rear is limited, it has been found advisable to have the chamber separate from the tube by swinging outwardly from the side therefrom so that the propellant can be loaded rearwardly into the chamber and the projectile inserted forwardly into the tube.

The available chamber opening and locking designs for such guns with pivotal, side opening chambers, however, are excessively complicated and so it is one object of this invention to provide an actuating device for such chamber and means for coupling the chamber and tube when in battery position which are simple and rugged in construction.

In such guns with a pivotal chamber it is, of course, necessary to obturate the joint between the tube and chamber. This requires a seal which must be carried either by the tube or chamber and which must make sealing connection therebetween each firing cycle. Therefore, it is necessary to provide a seal which can be used frequently and for a large number of cycles and which is extendable relative to the axis of the gun so as to maintain sealing connection with the chamber and tube during dilation of the joint therebetween by the discharge forces.

In such firearms, too, the initial closure force which can be applied to the seal mechanically is limited because of the absence of axial movement between the tube and chamber. Consequently, the seal must be one which is energized by the pressure of the gases produced by the discharge of the propellant in the chamber.

The available self-energizing seals for high pressure vessels are modifications of the Bridgman, delta, lens, wave and O types. These seals, however, use the unsupported area principle and, therefore, are not adaptable to firearm use because the unsupported area causes plastic deformation of the seal to produce a gradual and progressive yielding which increases the dimensions of the seal to the extent that the chamber is prevented from closing after only a few rounds.

In such guns, too, the seal has to be mounted in the face of either the tube or chamber and is biased for resilient contact with the face of the opposite member for initial sealing contact. Therefore, when the chamber is swung to and from the battery position, one of the sealing surfaces wipes along the face of the opposite member to cause deformation and wearing of such sealing portion.

It is, therefore, another object of this invention to provide for such pivotal chamber guns a ring seal which is fully supported in back of the sealing surfaces to prevent

2

plastic deformation thereof so that the ring seal is usable for many rounds.

It is still another object of this invention to provide a ring seal which is received by an annular seat in the front face of the chamber and includes a portion which is biased into resilient contact with the rear face of the tube for initial sealing contact with the chamber and tube.

It is a further object of this invention to provide a ring seal which is substantially M-shaped in cross-section and of a bellows-like structure so as to be expandable to maintain sealing contact with the tube and chamber during dilation of the joint therebetween.

It is another and further object of this invention to provide on the portion of the ring seal that contacts the rear face of the tube during movement of the chamber to and from battery position an integral cam follower which maintains the sealing surface on such portion out of contact with the rear face of the tube when the ring seal is moved thereacross.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawings in which:

FIG. 1 is a side view of the gun partially cross-sectioned to show the relation of the seal and coupling when the chamber is in battery position;

FIG. 2 is a section taken along line 2-2 of FIG. 1;

FIG. 3 is a view similar to FIG. 2 but showing the chamber in the open position; and

FIG. 4 is an enlarged view taken along line 4-4 of FIG. 3.

Shown in the figures is a gun 12 having a tube 14 with a bore 16 for receiving a projectile. A chamber 18 is separable from tube 14 and includes a well 20 for receiving propellant to energize the projectile. Well 20 extends rearwardly into chamber 18 from a front face 22 thereof. Chamber 18 is swung outwardly away from tube 14 for opening the rear end of bore 16 and the mouth of well 20 to permit the loading of gun 12 by a motor 24. Motor 24 may be energized by electric, hydraulic or recoil-powered means, whichever is the most practical, and includes a housing 26 which is connected by a bracket 28 to tube 14. Motor 24, as shown in FIG. 1, includes a rotor 30 which is disposed so that the longitudinal axis thereof, noted at  $x-x$ , is parallel to axis  $O-O$  of tube 14 and which is rotated when the motor is energized. Chamber 18 is connected by a bracket 31 to a hub 32 which is coaxially mounted on rotor 30 for rotary movement respective thereto so that the chamber is pivotally supported by such rotor. Hub 32 is connected to rotor 30 by a torsion bar 34, whereby chamber 18 is pivotable by motor 24 between an open loading position and a closed battery position and is resiliently held in either one of the two positions by continued limited rotation of the motor, after the chamber is stopped therein, so as to energize torsion bar 34. A latching device (not shown) may be provided to releasably lock chamber 18 in either position if found desirable.

A coupling device 36 connects chamber 18 to tube 14 when the chamber is in battery position to prevent free axial movement therebetween and to support the joint where the chamber and tube contact to minimize the dilation of the joint by discharge forces. Coupling device 36, as best shown in FIG. 4, includes a peripheral flange 40 which extends around the front end of chamber 18 and a collar 42 which is provided with internal threads for engaging a threaded portion 38 which extends forwardly along tube 14 from a rear face 44 thereof. Flange 40 and collar 42 are releasably locked together by a coupler 46 anchored to tube 14 and a secondary-coupler 48 anchored to chamber 18. Coupler 46 is tubular in con-

3

figuration and is provided with an annular channel 50 around the inside thereof. Channel 50 forms a rearward lip 52 and a forward mounting portion 54 which is provided with internal threads which engage threaded portion 38. In installation, coupler 46 would be mounted on tube 14 first and then collar 42 installed afterwards with the collar and mounting portion 54 being in contact when finally assembled and the collar located adjacent rear face 44.

The diameter of channel 50 is similar to the outside diameter of flange 40 so that the flange is receivable therein and the width of the channel is such that lip 52 is spaced sufficiently rearward of rear face 44 of tube 14 to form therebetween a clearance 56 which matingly receives flange 40 when chamber 18 is in battery position. Channel 50 and lip 52 are interrupted by an opening 58 (FIG. 3) through coupler 46 to permit the passage of chamber 18 therethrough to battery position.

Secondary-coupler 48 includes a circular mounting section 60 which threadingly engages chamber 18 and which is mounted thereon to contact the rear end of flange 40. A segmental portion 62 extends forwardly from mounting section 60 and such segmental portion has a configuration similar to opening 58 so as to be receivable therein to complete the tubular configuration of coupler 46. Segmental portion 62 is arcuately recessed to complete channel 50 and such recess forms a lip 64 which is receivable by a mating recess 66 formed in the rear of mounting portion 54 so that such lip is in contact with the front surface of collar 42 when chamber 18 is in battery position. Another recess 67 is formed in mounting section 60 of secondary-coupler 48 to matingly receive lip 52 and permit contact thereof with the rear end of flange 40. Whereby, when chamber 18 is in battery position, flange 40, collar 42 and the lips 52 and 64 are interlocked to prevent free axial displacement between tube 14 and chamber 18 and the joint therebetween is supported completely therearound.

Chamber 18 is counterbored from front face 22 to form a seat 68 at the mouth of well 20 for receiving a ring seal 70 which obturates the joint between the chamber and tube 14. Seat 68 includes an annular end wall 71 and a circular outer wall 72. Ring seal 70 is retained in seat 68 by pressing a retainer ring 74 between the ring seal and outer wall 72. Ring seal 70 in cross-section is essentially M-shaped in configuration with the inside opening to the inside of chamber 18 so as to be subjectable to the pressure of discharge gases therein. Ring seal 70 includes a rear section 76 having contact with end wall 71, a base 78 which contacts retainer ring 74 and which is crimped inwardly to form a U-shaped projection 80 for a bellowslike structure, and a front section 82 which is contactable with rear face 44 of tube 14. The leading edges of rear section 76 and front section 82 are pressed slightly apart so that ring seal 70 makes sealing contact with end wall 72 at a sealing surface 83 which extends around the rear section 76 adjacent the edge thereof and with rear face 44 of tube 14 at a sealing surface 84 which extends around front section 82 adjacent the edge thereof.

Sealing surface 84 is positioned, normally, forwardly of front face 22 so that when chamber 18 is rotated to battery position and front section 82 is slidably engaged by rear face 44, ring seal 70 is compressed and thereby preloaded to assure initial obturation. It is obvious that sealing surface 84 would be severely mutilated if permitted to contact rear face 44 when chamber 18 is swung to and from battery position. Therefore, front section 82 is provided with an integral cam follower 86 which projects outwardly beyond sealing surface 82 between the sealing surface and base 78 and extends around such front section. Whereby, when chamber 18 is rotated to and from battery position, the contact between cam follower 86 and rear face 44 holds sealing surface 84 out of contact therewith. Rear face 44 is provided with a radius

4

at the outside periphery thereof to form a cam surface 88 for easing cam follower 86 onto the rear face when chamber 18 is initially moved from open position. When chamber 18 is in battery position, cam follower 86 is received by an annular groove 90 formed in rear face 44 to permit contact between sealing surface 84 and the rear face.

From the foregoing it is clearly apparent that there is provided herein a self-energizing seal wherein the sealing surfaces 83 and 84 are fully backed by end wall 72 and rear face 44, respectively, so that ring seal 70 is not plastically deformed by the pressure of the discharge gases and that, through the bellowslike configuration of the ring seal, sealing contact is maintained with tube 14 and chamber 18 during the dilation of the joint therebetween resulting from discharge forces. It is also clearly apparent that the efficiency of ring seal 70 is prolonged considerably by sealing surface 84 being held away from contact with rear face 44 during movement thereof.

It is also evident that the means for actuating chamber 18 between the loading and battery positions and for coupling it with tube 14 are simple and rugged in construction.

While the preferred embodiment shows the invention applied to a gun with a separable chamber, it is evident that the invention may also be effectively applied to guns, such as mortars, wherein the tube is pivotally dividable into two coextensive sections so that the front section may be pivoted to the side to permit the loading of he mortar shells from the front end of the resulting shortened length of the tube.

Although a particular embodiment of the invention has been described in detail herein, it is evident that many variations may be devised within the spirit and scope thereof and the following claims are intended to include such variations.

I claim:

1. In a gun having a tube member, a chamber member mounted to said tube member for pivotal displacement between an open loading position and a closed battery position, an axially flexible ring seal carried by said chamber member for forming a gas-tight seal between said tube and chamber member when said chamber member is in the battery position, a sealing surface disposed on said ring seal for sealing contact with said tube member when said chamber member is in the battery position, cooperating cam means disposed on said ring seal and said tube member for compressing said ring seal to displace said sealing surface clear of contact with said tube member during pivotal displacement of said chamber member to and from the closed position, and means to permit forward expansion of said ring seal when said chamber member is in the battery position and thereby obtain sealing contact between said sealing surface and said tube member.

2. In a gun having a tube member, a motor provided with a rotor and a housing mounted on the tube member, a chamber member supported by said rotor for pivotal displacement thereby between an open loading position and a closed battery position, a torsion bar operationally disposed between said rotor and said chamber member so as to be energizable by said motor for resiliently holding said chamber member in the battery position after said chamber member is displaced by said motor thereto, a coupling device for joining said chamber member to said tube member when in the battery position, an axially flexible ring seal carried by said chamber member for forming a gas-tight seal between said chamber and tube member when said chamber member is in the battery position, a sealing surface disposed on said ring seal for sealing contact with said tube member when said chamber member is in the battery position, cooperating cam means disposed on said ring seal and said tube member for compressing said

5

ring seal to hold said sealing surface clear of contact with said tube member during pivotal displacement of said chamber member to and from the battery position, and means for permitting forward expansion of said ring seal when said chamber member is in the battery position to obtain sealing contact between said sealing surface and said tube member.

3. The gun as defined in claim 2 wherein said tube member is provided with a rear face and an outside periphery, said cam means includes a cam follower disposed around said ring seal adjacent said sealing surface and so as to extend forwardly thereof and a cam surface in said tube member leading rearwardly from the periphery thereof to said rear face, said cam surface being disposed for contact by said cam follower during displacement of said chamber member to the closed position for compressing said ring seal and delivering said cam follower into sliding contact with said rear face, and said means to permit release of said ring seal comprising an annular groove disposed in said rear face for matingly receiving said cam follower when said chamber member is in the battery position.

4. The gun as defined in claim 2 wherein said ring seal is of bellowslike structure and said chamber member is provided with a seat formed for receiving said ring seal so that the inside thereof is open to gas pressure in said chamber member and so that the front end of said ring seal extends forwardly from said chamber member to make resilient contact with said tube member when said chamber member is in the battery position.

5. The gun as defined in claim 2 wherein said chamber member is provided with a propellant receiving well which extends rearwardly thereinto and which is counterbored at the entrance to form for said ring seal a seat having an annular end wall and an outer wall, and wherein said ring seal is of expandable bellowslike structure energizable by the pressure of gases in said chamber member, said ring seal including a rear section which has sealing contact with said end wall and is supported thereby when said ring seal is energized, a front section which is contactable with the rear end of said tube member and is supported thereby when said ring seal is energized and which is disposed to be pressed rearwardly by the rear end of said tube member when passing

6

thereover to preload said ring seal for initial obturation when said chamber member is in battery position, a base which integrally joins said front and rear sections so that said ring seal is open to the gases in said chamber member, and an integral U-portion crimped inwardly around said base for accommodating said ring seal to relative axial movement between said tube member and chamber member without plastic deformation.

6. The gun as defined in claim 2 wherein said coupling device includes a peripheral flange at the front end of said chamber member, a collar threadably mounted on said tube at the rear end thereof, a tubular primary coupler having a mounting portion for anchoring said coupler to said tube, a lip disposed rearwardly of the rear end of said tube member for contact with the rear end of said collar when said chamber member is in battery position and a channel disposed between said mounting portion and lip to matingly receive said flange, an opening in said primary coupler interrupting said channel and lip to permit passage of said chamber member to battery position, a secondary coupler anchored to said chamber member by means of an encircling mounting section having contact with the rear end of said flange, a segmental portion extending integrally forward from said mounting section, said segmental portion having the same configuration as said opening to complete the outside tubular configuration of said primary coupler and said channel and lip therein, a recess formed in said mounting section to permit contact of said lip with the rear end of said flange when said chamber member is in battery position, and a lip disposed on the inside of the front end of said segmental portion so as to be receivable by a recess in said mounting portion of said primary coupler for contact with the front end of said collar.

#### References Cited in the file of this patent

#### UNITED STATES PATENTS

|           |                     |               |
|-----------|---------------------|---------------|
| 1,072,319 | Dawson et al. _____ | Sept. 2, 1913 |
| 1,394,490 | Giles _____         | Oct. 18, 1921 |
| 2,468,134 | Swipp _____         | Apr. 26, 1949 |
| 2,790,353 | Bird _____          | Apr. 30, 1957 |