Dec. 8, 1964 J. W. TREAT ETAL 3,159,938

GAS SEAL FOR ROTATABLE CARTRIDGE DRUM

Filed July 27, 1962 2 Sheets-Sheet 1

Fig. 1.

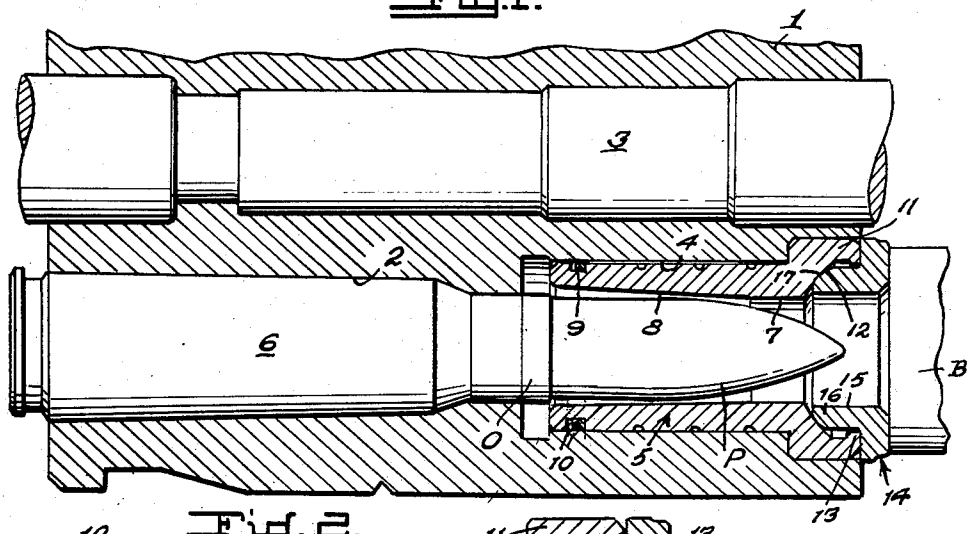

Fig. 2.

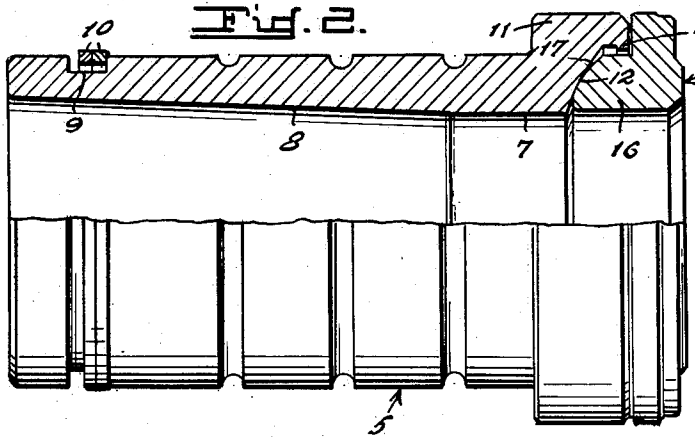

Fig. 4.

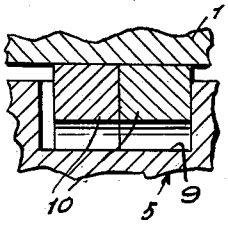

Fig. 3.

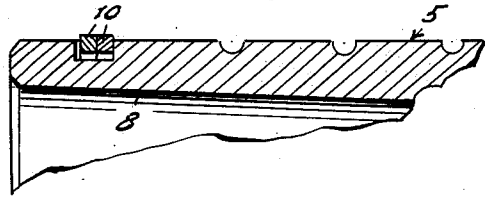

Fig. 5.

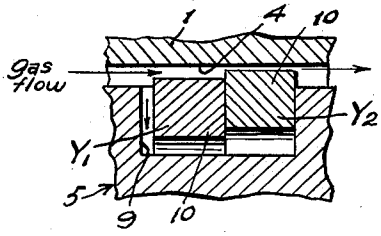

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Fig. 6.

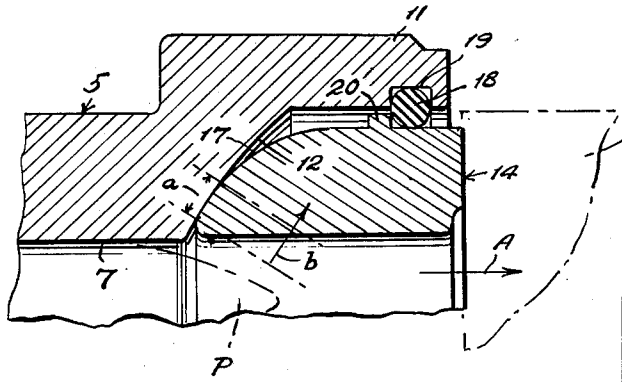


Fig. 8.

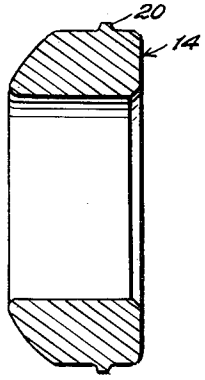


Fig. 7.

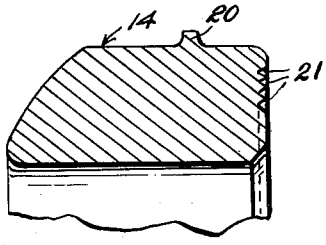


Fig. 9.

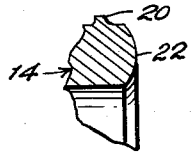
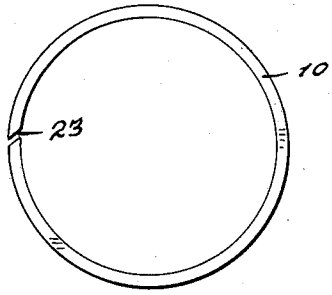


Fig. 10.



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GAS SEAL FOR ROTATABLE CARTRIDGE DRUM

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7 Claims. (Cl. 42—59)

This invention relates to a gas seal and more particularity to an obturating seal for use in revolver type guns in which cartridges are chambered in circumferentially spaced bores in a revolving drum for feeding into a gun barrel or barrels.

It is usual in the revolver type gun to have an obturating seal slidably mounted in each bore. Each seal moves forward upon firing of a cartridge therein to seal between the end of the bore and the breech end of the barrel.

It is also usual to have a sealing aid between the sealing face of the obturating seal and the breech face of the barrel of the gun. These aids consist of many forms such as grooves, rings, etc.

Additional features desirable in the design of obturating seals are to:

(*a*) Reduce heat transfer into the drum;

(*b*) Reduce impact between the seal and the end of the barrel, and

(*c*) Increase barrel life.

The present invention is designed to accomplish the aforesaid features by providing a ring which floats in a recess in the drum face. The ring is forced against the barrel face by gases, which are ported into a chamber at the rear of the seal.

It is a primary object of this invention to reduce the heat transfer into the revolving drum of a revolver type gun by reducing the leakage of gas between the face of the seal and the end of the barrel and between the outside diameter of the seal and the inside diameter of the drum counterbore, by breaking up carbon and metallic deposits on the face of the barrel against which the seal seats, and by reducing the length of travel of high velocity gases leaking between the face of the barrel and the face of the seal which seats against it.

It is another object of this invention to reduce the impact force between the seal and the end of the barrel by the spring effect of an obturating ring, by the effect of the long taper of the inside diameter of the seal and by the drag of a primary seal located between the outside diameter of the seal and drum counterbore.

A further object of the invention is to provide increased barrel life by the self alignment feature of the spherical segment which provides full sealing surfaces between the body of the seal and end of the barrel, thereby decreasing leakage and the erosion which results therefrom and by decreased impact of the seal and barrel which eliminates surface cracks on the end of the barrel.

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:

FIGURE 1 is a fragmental sectional view taken through a cartridge drum of a revolver type gun and showing the seal of the invention;

FIGURE 2 is an axial section, partly in elevation, of an obturating seal in assembled relation;

FIGURE 3 is a partial section showing the primary sealing means,

FIGURE 4 is a detail section on an enlarged scale of the primary sealing means and its relation with the inside diameter of the obturating seal;

FIGURE 5 is a similar view showing the primary sealing means upon initial pressurization;

FIGURE 6 is a detail section of the sealing ring having an O-ring seal;

FIGURE 7 is a detail section of a modified form of sealing ring having a grooved face;

FIGURE 8 is a view in section showing a sealing ring in its entirety and having a smooth face;

FIGURE 9 is a partial section showing a sealing ring having a rounded face, and;

FIGURE 10 is a side view of one of the primary sealing members.

Referring to the drawings, reference character 1 (FIGURE 1) represents a portion of a cartridge drum of a revolving type gun and shows one bore 2 for chambering a cartridge therein.

Drum 1 is mounted on an axial shaft 3. Bore 2 is counterbored as at 4 to receive a cylindrical seal member indicated generally by 5. Seal 5 is slidably mounted in counterbore 4.

A cartridge 6 is shown in bore 2 in FIGURE 1.

Seal 5 is cylindrical and has a central bore 7 therethrough. Bore 7 is provided with a long rearward tapered inside diameter as at 8.

Seal 5 is provided at its peripheral surface near the rear with an annular groove 9 for receiving a primary sealing means which comprises a pair of split rings 10. Rings 10 are square in cross section as best seen in FIGURES 4 and 5 for a purpose to be apparent later.

Seal 5, as illustrated, is provided with an enlarged head portion 11 which is counterbored to form an annular recess having a concave rearward wall. An inwardly extending annular flange 13 provides means for retaining a gasket.

An obturating ring indicated generally by 14 floats in recess 12.

Ring 14 is provided with an axial bore 15 and a rearward reduced portion 16.

Reduced portion 16 is convex on its rearward face as at 17 to mate with the concave rearward wall of recess 12. This wall and face 17 both form segments of a circle for a smooth sliding fit.

FIGURE 6 depicts a modified form of obturating ring. In this form the obturating ring is shown used with an O-ring seal 18.

In order to secure the O-ring, an annular channel 19 is provided in the inner peripheral surface of the seal 5.

An annular flange 20 is provided on the outer peripheral surface of the obturating ring 14 for retaining obturating ring 14 in the recess 12.

FIGURES 1–6 and 8 show obturating sealing ring 14 having a flat forward face.

In FIGURE 7, there is shown a ring having a grooved face. Circular grooves 21 are provided in the forward face of the ring 14 for cleaning carbon from the breech face of barrel B.

Another modified face for an obturating ring is shown in FIGURE 9, in which the face is rounded as at 22.

The action of the seal 5 is as follows, and is best demonstrated by FIGURES 1 and 6 in which the principal features are shown.

Arrow A indicates the direction of the gun's muzzle, B being the breech end of the gun barrel and the nose of projectile P is in its position for firing.

The seal is assembled into the drum with the concave recess 12 in the direction of barrel B and its rear end in the direction of the base of cartridge 6 (see FIGURE 1). Lineal relationships are such to the rest of the cartridge that the projectile P protrudes into the seal 5 with the obturating band O position to the left side of the seal 5. As drum 1 indexes into battery position, the seal 5 is cammed to the left by the space relationships pro-

vided in the overall gun design. When cartridge 6 is fired, the projectile is forced out of its case and starts its movement through the inside diameter of the seal. The long introductory taper 8 of seal 5 is so dimensioned that the interference fit between the obturating ring 14 and the inside diameter of seal 5 does not occur until projectile P is well into taper 8.

Prior to reaching this point, chamber pressure is high enough to produce a longitudinal pressure drop across the seal 5 which forces the seal 5 to the right, bringing the obturating ring 14 into contact with the end of barrel B. While this action is occurring, gas flows under primary seals 10, resulting in a sealing action by forcing seals 10 outwardly against the counterbore 4 of drum 1 (see FIGURE 4) and against other sealing surfaces to form an effective gas barrier. The misalignment existing between the centerline of the seal 5 and the centerline of band B, plus other conditions due to the lack of squareness of sealing surfaces with this centerline are overcome by the action of the obturating ring's rounded surface 17 and the concave recess 12 of seal 5 which automatically aligns itself to overcome these misalignment features. Misalignment referred to is that due to manufacturing tolerances, differential expansions due to temperature differentials in parts, and springing of gun structure due to setback loads acting thereon.

Impact, which would normally be experienced with a right circular cylinder acting as a seal, and which is normally present due to the kinetic energy in this seal built up during its travel to overcome clearance between it and the barrel B, is reduced by the dragging action of primary seals 10, the spring action of obturating ring 14 which acts in the same manner as a Belleville washer, and the reduced internal drag between the obturating ring 14 on projectile P and the inside diameter 7, 8 on projectile P.

In addition, the tapered bore 8 of seal 5 introduces this drag at a time when it can offer frictional damping characteristics.

As the annular grooves 21 in the face of obturating ring come in contact with the end of barrel B, any carbon or metallic deposits are broken up, thereby allowing a more satisfactory sealing action to occur.

During gas pressurization in the sealed area, leakage is reduced to a minimum by the action of the primary seals 10, and by the action of the annular grooves 21 in the face of obturating ring 14. This reduces heat input by decreasing both the quantity of gas and the length of travel of high velocity gases. As the empty cartridge case 6 is indexed out of battery position the annular grooves 21 provide a wiping action which serves to clean the end of the barrel.

The action of the obturating ring 14 with relation to the seal recess 12 may be further demonstrated in FIGURE 6 where *a* represents the initial contact area (when parts are new) and *b* represents the direction contact increases as the members deflect under a load and as parts wear.

The purpose of rings 10, which are similar to split piston rings (see FIGURE 10) is to provide the primary means of confining the gas that escapes around the outside diameter of seal 5. Where clearances are large they are particularly effective because it requires a very high pressure to cause the ring 14 to obturate.

FIGURES 4 and 5 illustrate the action of the primary seals 10.

It will be seen from these figures that the rings 10 are square in cross section to provide sharp edges to aid in removing accumulated carbon which would collect between the outside diameter of the rings and the counterbore 4 of drum 1 and interfere with efficient obturation.

The rings 10 act against three surfaces in performing their sealing action as follows: (See FIGURE 5). (1) The axial pressure drop forces ring indicated by Y_1 against ring indicated by Y_2 and as the splits 23 (see FIGURE 10) are installed 180° apart, direct axial leakage through the rings 10 is prevented. (2) Ring Y_2 is forced against the edge of groove 9 preventing leakage in a radial direction past ring Y_2 except through a split 23 in the ring. (3) The radial outward pressure drop forces both rings Y_1 and Y_2 against the bore of drum 1, causing the rings to fit tightly against the inside diameter of drum 1. (See FIGURE 4.)

This action occurs after the void between the rings 10 and the length of the diameter of the groove is pressurized.

The initial pressurization, though transient in nature, is shown in FIG. 5. As combustion gas reaches rings 10, it forces both rings 10 inward as the void between the rings is not initially pressurized.

Also, the pressure drop across ring Y_1 will be greater than that across Y_2. These drops may or may not be great enough to prevent rings 10 from recovering enough to act in the manner shown in FIG. 4. Also leakage past the split 23 in ring Y_2 may be great enough to cause some distortion at split 23 in that ring.

The rings 10 are slightly oversize. Their cross section is such to prevent permanent deformation when they are installed in grooves 9.

Long taper 8 permits proper alignment of the obturating band O (see FIG. 1) as it enters the inner diameter of seal 5. This taper has an effect upon the impact force of the obturating ring 14 face as it is driven against the end of barrel B. This impact is due to acceleration of the seal 5 mass through its clearance by (1) the axial pressure drop, (2) the drag force produced by the swaging action of the obturating band O passing through the bore 8, 7, (3) the axial clearance between the face of obturating ring 14 and barrel B, and (4) the point of application of the swaging force. The use of a long introductory taper reduces the impact force by allowing gas pressure to force seal 5 and obturating ring 14 against barrel B prior to the time of swaging action, and also to reduce peak pressure produced between the face of obturating ring 14 and barrel face of B by reducing the swaging force.

Variations and modifications may be effected without departing from the scope of the novel concept of the present invention as set forth in the appended claims.

What is claimed is:

1. In combination with a rotatable cartridge drum for feeding cartridges into a gun barrel, there being at least one axially spaced bore through said drum for chambering a cartridge, said bore having a forwardly disposed counterbore, a gas seal for preventing leakage of combustion gases between said drum and said barrel comprising, a cylindrical member having an axial bore therethrough, said cylindrical member being slidably mounted in said counterbore in said drum, said axial bore having an annular recess in its forward portion thereof, said recess having a concave rearward wall, seal means between the outside surface of said cylindrical member and the inside surface of said counterbore carried by said cylindrical member, a ringlike obturating member between said couunterbore and said barrel movably mounted in said recess, said ringlike member having a rearward convex surface to engage said concave rearward wall and a forward face to engage said barrel and means sealing between the outside surface of said ringlike obturating member and the inside surface of said recess in said cylindrical member said first mentioned seal means comprising an annular groove disposed in the outer peripheral surface of said cylindrical member and a pair of split circular rings in side-by-side relation in said groove and adapted to expand and engage the inside surface of said counterbore, said split rings being angularly positioned with respect to each other.

2. In a device as set forth in claim 1 wherein said split rings have an outside diameter slightly larger than the outside diameter of said cylindrical member.

3. In a device as set forth in claim 1 wherein said split rings have a square cross section.

4. A device as set forth in claim 1 wherein said concave wall in said recess defines a segment of a circle.

5. A device as set forth in claim 1 wherein the barrel engaging face of said ring like member is provided with a series of concentric circular grooves.

6. A device as set forth in claim 1 wherein the barrel engaging face of said ringlike member is rounded.

7. In combination with a rotatable cartridge drum for feeding cartridges into a barrel, there being at least one axially spaced bore through said drum for chambering a cartridge, said bore having a forwardly disposed counterbore, a gas seal for preventing leakage of combustion gases between said drum and said barrel comprising:

a cylindrical member having an axial bore therethrough,

said cyclindrical member being slidably mounted in said counterbore in said drum,

said axial bore having an annular recess in its forward portion thereof,

said recess having a concave rearward wall and an annular groove forwardly of said rearward wall,

seal means between the outside surface of said cylindrical member and the inside wall of said counterbore carried by said cylindrical member,

a ringlike obturating member movably mounted in said annular recess, said obturating member having a convex surface to engage said concave wall and a forward surface to engage the rear surface of said barrel,

said obturating member having an outwardly extending annular flange on the outer surface thereof adjacent said annular groove, an O-ring disposed in said annular groove outwardly of and adjacent said annular flange.

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