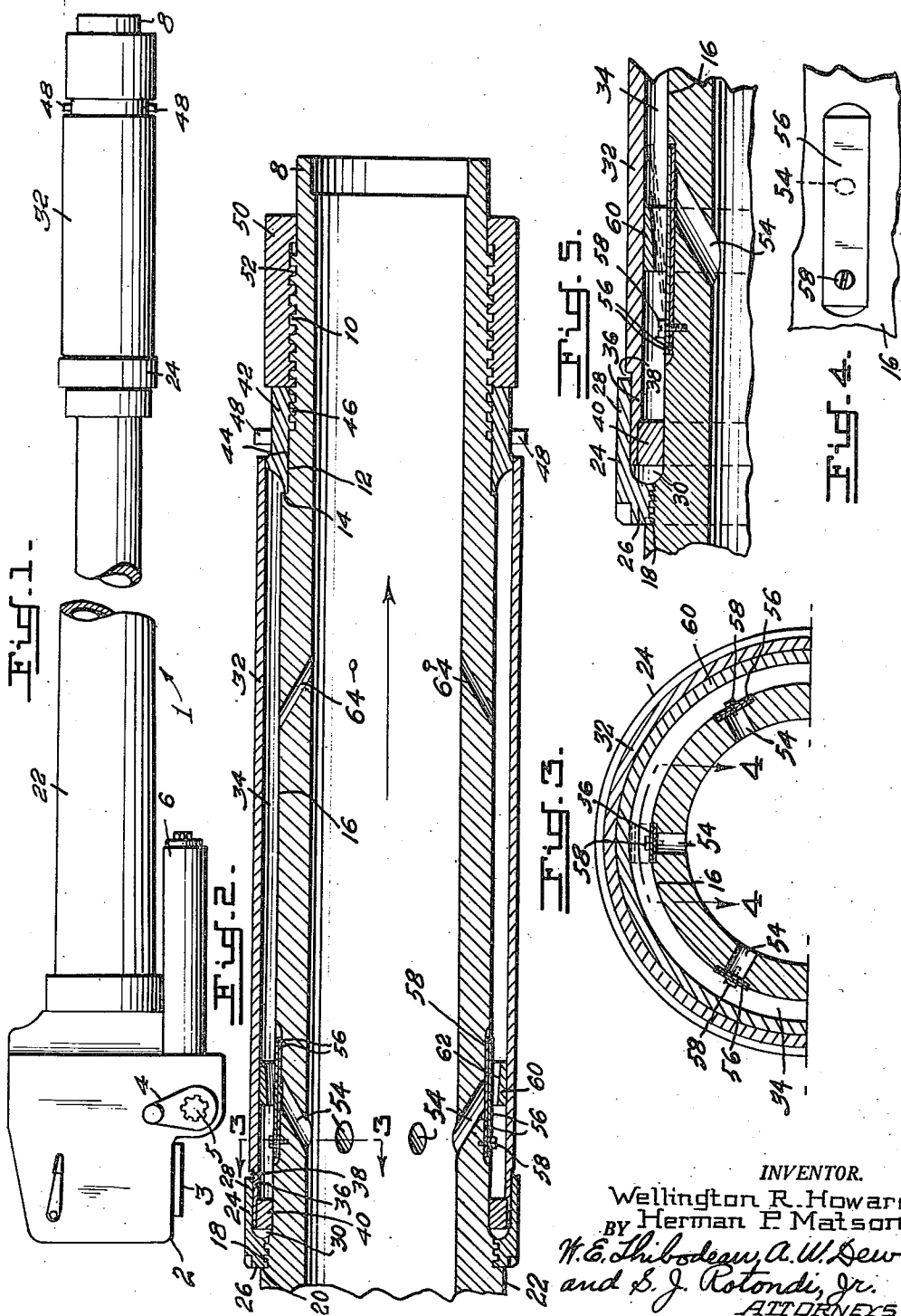


Oct. 1, 1957

W. R. HOWARD ET AL
BORE EVACUATOR FOR GUN BARRELS

2,807,986

Filed July 3, 1953



INVENTOR.
Wellington R. Howard
BY Herman F. Matson.
W. E. Thibodeau, A. W. Dew
and S. J. Rotondi, Jr.
ATTORNEYS.

1

2,807,986

BORE EVACUATOR FOR GUN BARRELS

Wellington R. Howard, Falls Church, Va., and Herman P. Matson, Washington, D. C., assignors to the United States of America as represented by the Secretary of the Army

Application July 3, 1953, Serial No. 366,081

6 Claims. (Cl. 89—1)

(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 to us of any royalty thereon.

The present invention relates to a device for purging noxious gases from the bore of a gun barrel.

More particularly the invention relates to a device for evacuating noxious gases from the muzzle end of the barrel of an artillery piece.

The utilization of artillery weapons on tanks and other self-propelled combat vehicles having closed cabs and turrets for the accommodation of the gun crew has given rise to the serious problems of asphyxiation caused by the escape and blow back of noxious gases through the breech and into the enclosed space occupied by the crew. In the larger semi-automatic type weapons, great volumes of noxious gases are formed by the explosion of the propelling charge. Although some of the gases escape by way of the muzzle after the projectile has left the bore of the weapon, a goodly portion of the gases remain in the bore as the gun recoils in its mount. Upon counterrecoil a cam arrangement usually actuates an operating crank to open the breech block. At the same time, extractor mechanism mounted on the breech block ejects the cartridge through the open breech and into the enclosed space. The act of ejection also "drags" with it a large portion of the noxious gases remaining in the bore thereby resulting in great discomfort and serious danger to the gun crew.

Various devices such as, for example, one in which a stream of compressed air is directed into the breech end of the weapon at the precise moment that the breech is opened have been tried and found ineffective. These devices are known to be complex, unwieldy and extremely cumbersome. Additionally, they usually depend for action upon a complex system of valves and require a source of air under pressure, a source of power and are generally unsatisfactory for field use.

It is accordingly a primary object of this invention to provide a device for evacuating the bore of a weapon which is simple, effective, and free of the defects prevalent in prior art devices.

It is also an object of this invention to provide structure for evacuating the bore of a weapon which can be readily mounted on existing gun barrels, and which is instrumental to prevent the escape of noxious gases from the breech end and into the gun turret.

It is also another object of this invention to provide a chamber mounted adjacent the external surface of the barrel of a weapon close to the muzzle end thereof, for trapping a portion of the noxious gases under pressure until the breech block slides open, whereupon the expulsion of the trapped gases to atmosphere by way of the muzzle, drags along the noxious gases remaining in the gun bore.

It is still another object of this invention to purge the noxious gases from the bore of a gun barrel by way of

2

the muzzle end thereof, by inducing a flow of gases axially forwardly in the bore by aspiration.

It is also a further object of this invention to provide a chamber concentric about the gun barrel and adjacent the muzzle thereof, constructed and arranged to trap a portion of the noxious gases under pressure, and to release the trapped gases into the barrel and out of the muzzle as the breech block is opened, whereby an aspirating effect is created to suck clean air into the breech end to mix with and to sweep the noxious gases out of the muzzle end of the gun barrel.

With these and other objects in view as will hereinafter become apparent as the following specification develops, reference is made to the accompanying drawing forming a part of the specification and wherein:

Figure 1 is a view in longitudinal elevation of a gun barrel modified to incorporate the device of the instant invention, and with the breech ring and block schematically illustrated.

Figure 2 is an enlarged partial longitudinal section of the gun barrel illustrating the manner in which the novel device is mounted thereon.

Figure 3 is a transverse section taken on lines 3—3 of Figure 2.

Figure 4 is a view taken on line 4—4 of Figure 3 and illustrating a preferred leaf spring-type one-way check or flap valve to control the admission of gases to the trap chamber and

Figure 5 is an enlarged sectional view of the valve of Figure 4 in closed and open (dotted lines) position, and including a stop ring to check the valve travel and prevent undue distortion.

Referring again to the drawing wherein the same reference characters have been used to identify like or similar parts throughout the several views, reference character 1 designates a gun barrel, fitted with a breech ring 2 in which is vertically slidable a breech block 3. Reference character 4 represents a breech block crank operating mechanism mounted on a splined shaft 5, and 6 a tubular spring housing to house a breech closing spring (not shown). Since the breech block operating mechanism is not pertinent to an understanding of the invention, and is of the standard and well known variety common, for example, in the 76 MM-M1 gun, it has not been illustrated in detail. The operation of the portion of the gun described above is briefly as follows.

The breech is opened when the breech block is manually or automatically lowered by an operating handle or crank secured to splined shaft 5 at the left side of the gun. Means are provided to lock the breechblock in this position, and as the cartridge is forced into the gun chamber the breechblock is unlocked and is automatically raised and moved to closed or battery position. When the gun is fired the barrel recoils and upon counter recoil the operating crank 4 is engaged by means provided on the mount, to rotate splined shaft 5, to in turn lower the breech block 3. The lowering of the breech block actuates extractor mechanism in the well known manner to eject the cartridges from the open breech, thereby permitting noxious gases to escape by way of the breech into the enclosed turret as previously described.

The device to prevent the escape of noxious gases by way of the open breech may be applied to any existing barrel in the following manner. The forward end of the barrel 1 is milled or turned down to provide an exterior stepped surface of diameter generally smaller than the largest outer diameter of the barrel. The stepped surface comprises a forwardmost smooth cylindrical portion 8 of smallest diameter extending for a short distance rearwardly of the muzzle end of the barrel and merging into a threaded portion 10 of a length equal approximately to its diameter. Rearwardly of threaded portion 10

3

the barrel is formed as a cylinder 12 of again slightly larger diameter, extending rearwardly for a short distance and ending in a shoulder 14, from which there extends rearwardly for almost the entire remainder of the stepped exterior surface, a smooth cylindrical portion 16 of slightly enlarged diameter, ending in a threaded portion 18 of small axial extent and terminating in a shoulder 20 defining the forward extent of the unmilled portion 22 of the barrel.

In assembling the members forming the gas trap chamber upon the barrel, an internally threaded ring or head 24 screw-threadedly mates with threads 18 on the barrel to tightly abut shoulder 20. Ring 24 is formed as a heavy rear portion 26 coextensive with the threaded portion and of a diameter larger than that of the barrel, and integral therewith is a forwardly extending portion 28 of the same outer diameter as the rear portion but of larger inner diameter to provide an annular space 30 there between and the outer surface of cylindrical portion 16. A sleeve 32 slightly longer than the longitudinal extent of cylindrical surface 16, is concentrically disposed about surface 16 to form therewith an annular extension 34 of space 30. The outer surface of sleeve 32 is reduced in diameter adjacent its rearward end for a limited extent as at 36, and is adapted to slidably, though tightly engage the inner surface of ring portion 28, there being a small gap 38 formed between opposed vertical surfaces of portion 28 and sleeve portion 36 to permit limited longitudinal expansion of sleeve 32 when heated by noxious gases confined therein as later to be described. A gas sealing ring 40 press fitted within and adjacent the rear end of sleeve 32 and tightly engaging the barrel surface prevents the gases from leaking past the slip joint formed by reduced sleeve portion 36 and ring portion 28.

The forward end of space 34 is sealed by a ring 42 having an inner bore 44 of enlarged diameter adapted to snugly engage cylindrical portion 12, and a threaded portion 46 adapted to screw threadedly mate with a rear portion of threads 10. The outer surface of ring 42 snugly engages the inner surface of sleeve 32 adjacent its forward end, and may be secured thereto as by welding to insure a gas tight seal. Pins 48 are received in recesses formed in the outer surface of ring 42, and extend radially outwardly to be engaged by a spanner wrench for tightening purposes in the well known manner. A lock nut 50 having threads 52 to mate with the remaining portion of threads 10 abuts the forward end of ring 42 and is tightly screwed into place to securely fasten the parts together. Means (not shown) may also be provided to lock together nut 52 and ring 42 against lateral displacement when the gun is fired.

In order to permit the noxious gases to travel from the barrel to annular space 34, the barrel is provided with equally-angularly spaced forwardly and outwardly inclined (relative to the gun bore) inlet gas passages or slots 54 of substantial diameter. Appropriate one-way check valves are provided to permit the gases to gain access only to space 34. In the illustration disclosed, these valves are seen as laminated leaf type spring members 56 (2 layers shown) lying flatly in recesses 58 formed in the inner wall of space 34 and extending slightly forwardly and rearwardly of each slot 54. The spring members are securely fastened to the outer barrel surface in approximate radial alignment with the rear end of slots 54 as by screws or studs 58, so that the valve members when acted upon by the gases under pressure from the bore are inclined upwardly and forwardly. A ring stop member 60 snugly engaging the inner wall of sleeve 32 has an inner face 62 inclined to correspond with inclination of the valve members 56 in open position to prevent their bending and distortion. Although other type check valves may be suitable, such as for example spring pressed ball type valves, this latter type is prone to excessive carbonization because of the point contact presented. The present type valve as illustrated is preferred since each blast of noxious gases

4

directed against the lower face of the leaf spring tends to "wash" away any carbon deposits left by the previous blast. The gases are permitted to leave space 34 by means of a plurality of equally angular spaced outlet gas conduits or ports 64 extending through the wall of the barrel adjacent the forward end of space 34. Ports 64, as shown, are inclined inwardly and forwardly relative to space 34 to direct streams of noxious gases back into the gun bore and toward the muzzle end of the barrel.

The operation of the device is readily apparent. When any weapon is fired the pressure of the expanding gases are at a maximum adjacent the breech end, dropping off gradually as the muzzle end is approached. Soon after the projectile leaves the muzzle end of the gun, the pressure in the gun bore, of course, drops rapidly. It has been found more effective to place the evacuating device as close to the muzzle as possible, the distance rearwardly of the gas intake ports depending on whether a low or high pressure gun is involved, the size of the bore and the nature of the propellant used. Additionally the size of gas intake and outlet ports, and the volume of the gas trap chamber may also vary depending on the variables previously mentioned. As a general rule the gas intake ports are made substantially larger than the outlet ports. In the illustration shown the gas intake ports have been placed approximately 25 inches rearwardly of the muzzle, and the outlet ports are approximately one third the size of the inlet ports. Additionally the obliquity of the gas ports is such as to follow the natural flow of the gases, although it is clearly within the purview of the invention to incline the ports in any desired direction. As the projectile travels up the barrel bore and passes the intake orifices 54, the pressure of the expanding gases force leaf spring valves 56 to turn counterclockwise until the stop members 60 are encountered, thereby permitting a portion of the noxious gases to be trapped in annular space 34. As the projectile approaches the muzzle, the gun is in recoil, and upon counterrecoil the breech block is slid downwardly automatically, as previously described, thereby opening the breech end to permit clean air to gain access to the barrel bore. At this time the projectile has already left the gun bore and the pressure in the bore has dropped below that existing in the gas trap chamber 34, whereupon the gases exit from ports 64 as jets which travel rapidly toward and out of the muzzle. The suction adjacent the muzzle caused by the aspirating action of the fast moving jets, draws the clean air through the entire length of the bore, mixing with and dragging the noxious gases out of the muzzle end and to atmosphere.

An alternative structure to that illustrated in Figures 1-5 contemplates an arrangement whereby the need to drill the forward set of oblique slots in the gun barrel is eliminated. In this alternative arrangement, the structure forming the slip joint for sealing the rear end of the trap chamber, and the inlet holes and valving are the same. However the forward end of tube 32 is sealed off by a ring having its outer surface engaging the inner surface of tube 32 and its inner surface engaging a rearward portion of the threaded forward end of the gun barrel. The sealing ring is provided with a plurality of equally angularly spaced longitudinal slots parallel to the axis of the gun barrel, and is held in place by a lock nut engaging the remaining portion of the threaded forward end of the gun barrel. The lock nut is provided with an annular recess in its rearward face, and a plurality of slots arranged to conform to the spacing and number of the slots in the sealing ring. The forward end of the slots in the lock nut are inclined inwardly so that gas jets emerging therefrom sweep forwardly and across the muzzle opening of the gun to induce by aspiration a forward axial flow within the gun bore. The annular recess in the lock nut is provided for ready assembly of parts without the need for close aligning of corresponding slots. Suitable means such as an O-ring may be used to insure a gas-tight seal

between contiguous opposed faces of the lock nut and sealing ring.

It can readily be seen that the device illustrated in the drawing, and the above explanation describes structure, which is simple, free of the defects of prior art devices, and effective to purge the noxious gases from the bore of a weapon by expelling the gases by aspirating action from the muzzle end of the barrel. The illustrated device is merely exemplary, and it is apparent that certain changes such as those before mentioned clearly fall within the purview of the novel apparatus. Also within the purview of this invention are aspirator controls which may take the form of variable orifices or cut-off slide valves either pre-set or set to be automatically operated by and in synchronism with the mechanism which operates the breech block.

Other modifications to the structure disclosed are obvious and may be made without departing from the spirit and scope of the invention as set forth in the subjoined claims.

We claim:

1. A device for aspirating noxious gases from the muzzle end of a gun barrel comprising, means forming a pressure tight chamber fixed to the exterior surface of said barrel and adjacent the muzzle end thereof, there being a first inlet passageway from the bore of said barrel into said chamber rearwardly of said muzzle end, there being a second outlet passageway from said chamber to said muzzle end, said second passageway inclined forwardly and inwardly relative to the exterior of said barrel to produce fluid flow in a forward axial direction in said barrel bore, and one way valve means in said first passageway limiting flow of fluid from said bore to said chamber.

2. A device for aspirating noxious gases from the muzzle end of a gun barrel comprising, means forming a pressure-tight chamber fixed to the exterior surface of said barrel and adjacent the muzzle end thereof, there being a plurality of equi-angularly spaced inlet passageways from the bore of said barrel to said chamber rearwardly of said muzzle end, there being a second plurality of equiangularly spaced outlet passageways from said chamber to said bore and intermediate said first passageways and said muzzle end, said second passageways inclined forwardly and inwardly relative to the exterior of said barrel to produce fluid flow in a forward axial direction in said barrel bore, flexible leaf spring valves overlying said plurality of inlet passageways and fixed at one end only to allow fluid to enter said chamber but prevent flow of fluid through said inlet passageways to said bore.

3. The combination with a gun barrel of means concentric about said barrel and adjacent the muzzle thereof forming a pressure tight chamber, there being a first

plurality of apertures from the bore of said barrel to said chamber, there being a second plurality of apertures forwardly of said first plurality leading from said chamber to said barrel contiguous the muzzle thereof, one way valve means controlling the flow of noxious gas through said first plurality of apertures in a bore-to-chamber direction only, said second plurality of apertures inducing a forwardly axial flow in the bore of said barrel, said first plurality of apertures being forwardly and outwardly inclined relative to the bore of said barrel, said second plurality of apertures being rearwardly and outwardly inclined relative to said bore.

4. The combination recited in claim 3, said first plurality of apertures of substantially larger diameter than the diameter of said second plurality of apertures.

5. The combination recited in claim 3, said one way valve means comprising a plurality of flexible laminated leaf springs overlying said first plurality of apertures, said springs secured at one end only to the outer surface of said barrel.

6. A device for aspirating gases from the muzzle end of a gun barrel comprising, a pressure tight chamber secured concentrically about the exterior surface of said barrel and adjacent the muzzle end thereof, there being a plurality of inlet apertures rearwardly and inwardly inclined relative to the exterior of said barrel, a plurality of flexible laminated leaf spring valves overlying said inlet apertures, said valves fixed to said barrel at one end only, there being a plurality of outlet apertures from said chamber adjacent said muzzle and forwardly of said inlet apertures, said outlet apertures forwardly and inwardly inclined with respect to the exterior of said barrel and of substantially less diameter than the diameter of said outlet apertures whereby static pressure at the muzzle end of said bore is reduced to allow flow of fluid from breech to muzzle of said barrel.

References Cited in the file of this patent

UNITED STATES PATENTS

790,664	Smith	May 23, 1905
2,376,321	Albertson	May 22, 1945
2,641,162	Balleisen	June 9, 1953

FOREIGN PATENTS

31,656	Austria	Feb. 10, 1908
264,611	Italy	May 3, 1929
670,817	France	Aug. 24, 1929
585,851	Germany	Oct. 11, 1933
863,025	France	Dec. 23, 1940
531,143	Great Britain	Dec. 30, 1940

OTHER REFERENCES

Pages 43 and 44 of May 1940 issue of "The American Rifleman."