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S. M. SPEAKE ET AL  
DEVICE FOR PURGING GUNS

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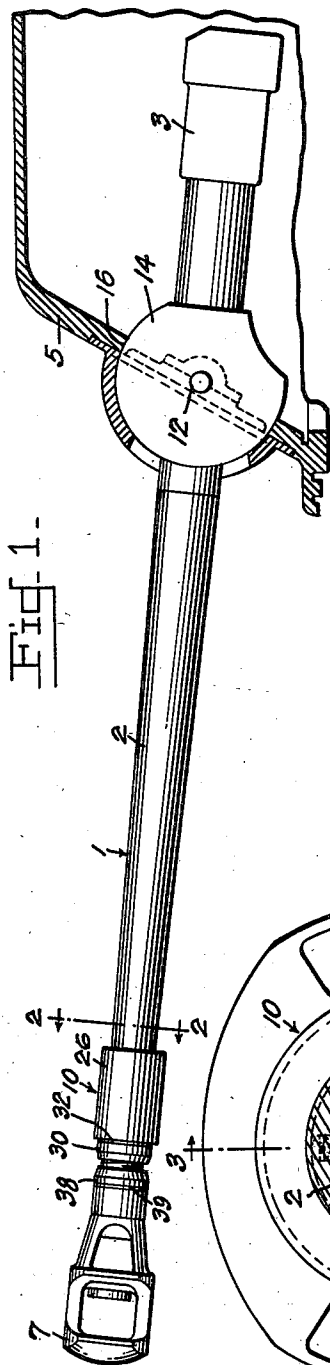


Fig. 2-

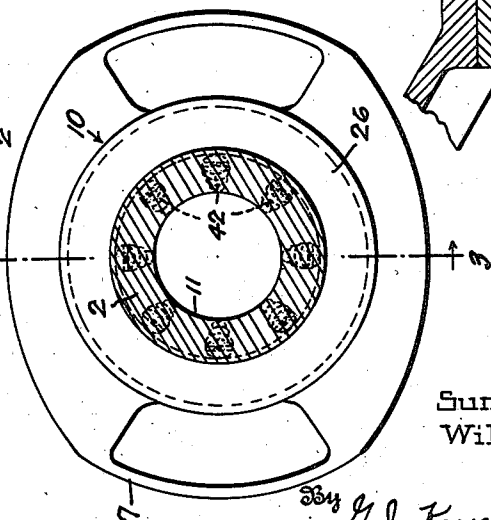
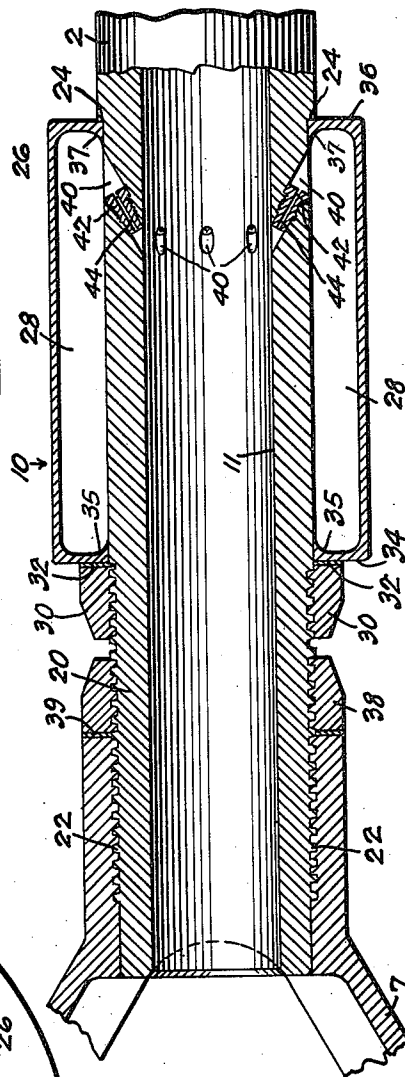


Fig. 3-



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## DEVICE FOR PURGING GUNS

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15 Claims. (Cl. 89—1)

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

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

This invention relates to a device for purging a gun of powder gases or gases of combustion due to ignition of the combustible or explosive charge when firing the gun. More particularly, this invention relates to an annulus type scavenging device for automatically purging a gun, together with cartridge cases therein prior to their ejection from the breech of the gun, when firing the latter, of a major portion or substantially all of such gases.

In the operation of a turret mounted gun, for example a 75 mm. gun or larger mounted in the turret or fighting compartment of a combat vehicle, it is important that the concentration of after-firing fumes in the turret or fighting compartment, due to escape therein from the gun breech of such gases, be eliminated or reduced as much as possible to prevent injury to crew members. Heretofore, the concentration of such fumes in the turret or fighting compartment due to such escape has been such as to be contaminating and toxic, thereby presenting a ventilation problem; and in addition, instances of after-burning or "flashbacks" have occurred on opening of the breech of the gun which have painfully injured crew members. The general problem of ventilation of turret or fighting compartment for the purpose of reducing or eliminating such concentration of after-firing fumes is greatly simplified if such gases are prevented from entering the turret or compartment by purging the gun and cartridge cases prior to their ejection from the breech of such gases by evacuation of the latter through the muzzle of the gun. Purging the gun in this manner will also eliminate the cause of "flashbacks."

Previously proposed devices for purging guns of such gases by evacuation of the latter through the muzzle have required complicated auxiliary equipment, such as compressors or storage containers, to provide an external source of air or other purging fluid under pressure, pipes, or numerous moving parts such as delay acting valves, often involving intricate timing and valving requirements. Disadvantages of such purging devices are apparent, particularly with guns mounted in the turrets of combat vehicles where provision of compressors or pressure storage containers for air or other external purging fluid is disadvantageous or even impractical, and where the use of such device involving moving parts subject to wear necessitates undesirable and often difficult periodic maintenance.

It is accordingly an object of this invention to provide an improved automatic device for purging a gun of gases to prevent or substantially reduce escape of these gases from the breech of the gun when firing the latter, which device eliminates the above stated disadvantages of previously proposed devices.

It is a further object of this invention to provide an improved automatic self-contained gun purging device which

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embodies no moving parts and requires no external purging fluid for its operation.

Other objects and advantages in providing an improved gun purging device of this invention, including simplicity of construction and installation, and economy, effectiveness, efficiency, and simplicity of operation, will be apparent from a description thereof as it proceeds.

An illustrative embodiment of the invention is disclosed by way of example in the following description, and in the accompanying drawings in which:

Figure 1 is a side elevation of a gun with the device of this invention.

Figure 2 is a section taken on a plane indicated by the line 2—2 of Figure 1.

Figure 3 is an enlarged sectional view taken on a plane indicated by the line 3—3 of Figure 2.

Referring now to the structure generally shown in Figure 1, numeral 1 indicates a gun, such as a 90 mm. gun, including a barrel or tube 2 and suitable breech and firing mechanism generally indicated by numeral 3. Numeral 5 designates the forward wall of a turret, such as on a combat vehicle (not shown). Gun 1 is mounted for vertical pivotal movement on its trunnion members 12 within the turret, so that such vertical pivotal movement may be accomplished by means of any suitable gun elevating mechanism (not shown) within the turret. A rotor member 14 is carried by gun 1 at opening 16 in turret wall 5 to provide protective closure for the opening 16 at any desired degree of elevation of gun 1. Gun 1 is desirably equipped at its muzzle end with a suitable muzzle brake 7, in accordance with usual practice with a gun of this type.

The foregoing description with respect to Figure 1 thus far is of general structure well known in the art. Gun 1 is shown equipped with the device of this invention generally indicated by numeral 10, near the muzzle end of the gun but behind muzzle brake 7, and reference is now made particularly to Figure 3 for the detailed description following.

Provided externally on a portion 20 of gun tube 2 near the muzzle end of the latter are screw threads 22, portion 20 extending rearwardly from the muzzle end and being of smaller external diameter than the remaining portion of tube 2, portion 20 terminating rearwardly, at the forward end of the latter, in an annular shoulder 24. A hollow cylinder member or annulus 26 fits over and around a part of gun tube portion 20, thus forming an annular chamber 28. A locking nut 30 on threads 22 with a washer 32 at end 34 of annulus 26 holds the latter at its other end 36 in tight engagement with shoulder 24. Ends 34 and 36 of annulus 26 are provided with respective radially inner tapered portions 35 and 37 in contact with the external surface of gun tube portion 20, these tapered end portions 35 and 37 extending longitudinally of the axis of gun tube 2 and thereby providing extended areas of snug-fitting contact between respective end portions 35 and 37 and gun tube portion 20, to decrease any possibility of gas leakage from chamber 28 between respective ends 34 and 36 and gun tube portion 20. Screw threads 22 accommodate internally threaded rearward end portion of muzzle brake 7 at the muzzle end of gun tube 2. At the rearward end of muzzle brake 7, a locking nut 38 on threads 22, and washer 39, similar to respective locking nut 30 and washer 32, holds muzzle brake 7 in position.

Connecting annular chamber 28 with bore 11 of gun tube 2 are eight holes 40 drilled symmetrically around the circumference of portion 20 of gun tube 2, near shoulder 24 and forward of end portion 37. Holes 40 are inclined inwardly at an acute angle of about 30° from the axis of bore 11, the direction of inclination of holes 40 being such that their inner ends at bore 11 are forward such

that they extend muzzleward or toward the muzzle of gun 1 relative to their outer ends at chamber 28. Holes 40 are tapped to receive therein exteriorly threaded removable nozzle jet inserts 42 having therein internal nozzle passages 44.

The principle of operation of the device of this invention will now be described. After a round has been fired and the projectile has moved up the gun bore to a point beyond the holes connecting the annular chamber with the bore, powder gases and gases of combustion flow through the nozzle passages or jets in the holes and into the annular chamber, thereby pressurizing the latter. The gases, under pressure, are stored in the chamber until the pressure in the gun bore drops below that in the chamber, after which the gases in the chamber pass back through the jets into the gun bore in the form of converging blasts from the jets. These converging blasts move muzzleward in the gun bore, creating a "stack action" or suction throughout the length of the gun bore, thus causing the residual gases in the gun bore to be ejected from the gun muzzle in an exhausting action. This exhausting action continues for a considerable period of time after the projectile leaves the gun bore, and if the breech mechanism of the gun is opened during this time, a definite scavenging action takes place.

It is obvious that the dimensions of the device of this invention are subject to variation in a wide range, dependent upon size, type, and characteristics of the particular gun. Thus, by way of example but not limited thereto, with a 90 mm. gun, the annular chamber may have a capacity of 0.1-0.3 cubic feet, while the nozzle passages or jets may vary in number from the eight shown in the example and may have at their narrowest point an internal throat diameter of  $\frac{1}{16}$ - $\frac{5}{32}$  inch. It is also obvious that the location of the device on the gun near the muzzle end thereof is similarly subject to variation; for example, instead of the cylindrical member or annulus being spaced from a muzzle brake when the latter is employed as shown, the annulus or cylindrical member obviously may abut, be keyed to, or be formed integral with a muzzle brake.

Although a specific embodiment of the invention has been illustrated and described, it will be understood that various alterations in the details of construction may be made without departing from the scope of the invention as indicated in the following claims.

We claim:

1. A device of the character described comprising, in combination, a gun tube having a muzzle and a bore, a closed hollow member surrounding a portion of said tube and spaced from the latter to provide an outer chamber thereon, said chamber being in fluid communication with said bore only, and a plurality of passages being disposed in a common vertical plane at a point entirely between the end walls of said outer chamber and having outer and inner ends connecting said chamber and said bore to provide said fluid communication, said passages being inclined to the horizontal axis of said bore in a direction of inclination such that said inner ends are toward said muzzle end relative to said outer ends.

2. A device of the character described comprising, in combination, a gun tube having a muzzle end and a bore, a closed hollow cylindrical member surrounding a portion of said tube near said muzzle end thereof and spaced from said tube to provide an outer annular chamber thereon, and a plurality of passages in said tube at a point entirely between the end walls of said cylindrical member and connecting said chamber and said bore, whereby said chamber is in fluid communication with said bore only, said passages having outer chamber ends and inner relatively muzzleward bore ends such that said passages are inclined at an angle to the longitudinal axis of said bore.

3. A device as set forth in claim 2, wherein said angle to the longitudinal axis of said bore is about 30 degrees.

4. In a gun of the type having breech mechanism and a tube with a bore equipped at the muzzle end thereof with a muzzle brake, an improved device for automatically purging said bore of gases when firing said gun, said device comprising a closed hollow cylindrical member surrounding a portion of said tube adjacent said muzzle brake and spaced from said tube to provide an outer annular chamber thereon, means for rigidly holding said cylindrical member on said tube adjacent said muzzle brake, and a plurality of nozzle passages disposed in a common vertical plane at a point entirely between the end walls of said cylindrical member and connecting said chamber and said bore whereby said chamber is in fluid communication with said bore only, said passages being inclined to the longitudinal axis of said bore in a direction inwardly toward said muzzle end from said chamber to said bore.

5. A device of the character described comprising, in combination with a gun tube having a muzzle end and a bore, a closed hollow cylindrical member surrounding a portion of said tube near said muzzle end thereof and spaced from said tube to provide an outer annular chamber thereon, a plurality of passages in said tube connecting said chamber and said bore said passages being disposed in a common vertical plane and at a point entirely between the end walls of said cylindrical member, whereby said chamber is in fluid communication with said bore only, said passages having outer chamber ends and inner relatively muzzleward extending bore ends such that said passages are inclined at an angle to the longitudinal axis of said bore, and a nozzle jet insert carried in each of said passages.

6. A device of the character described comprising, in combination with a gun tube having a muzzle end and a bore, a closed hollow cylindrical member surrounding a portion of said tube near said muzzle end thereof and spaced from said tube to provide an outer annular chamber thereon, said cylindrical member having end portions thereof providing extended areas of snug-fitting contact with said tube, means for securing said cylindrical member to said tube, and a plurality of passages in said tube being disposed in a common vertical plane entirely between the end walls of said cylindrical member and connecting said chamber with said bore, whereby said chamber is in fluid communication with said bore only, said passages having outer chamber ends and inner relatively muzzleward extending bore ends such that said passages are inclined inwardly at an acute angle to the longitudinal axis of said bore.

7. A device of the character described comprising, in combination with a gun tube having a muzzle end and a bore, an external chamber surrounding said tube for a portion of the length thereof and in fluid communication only with said bore, and a plurality of passages in said tube being disposed in a common vertical plane entirely between the end walls of said external chamber and providing said fluid communication, said passages being inclined inwardly from said chamber toward said muzzle end at an acute angle to the axis of said bore.

8. In combination with a turret mounted gun having a tube with a muzzle end and a bore, an external chamber surrounding said tube for a portion of the length thereof and in fluid communication only with said bore, and a plurality of passages in said tube providing said fluid communication, said passages extending inwardly toward said muzzle end from said chamber to said bore and being disposed in a common vertical plane entirely between the end walls of said external chamber.

9. In combination with a turret mounted gun having a tube with a muzzle end and a bore, a closure member surrounding a portion of said tube, said member having a part thereof spaced from said tube to provide an outer annular chamber thereon, and a plurality of passages in said tube connecting said chamber with said bore said passages being disposed in a common vertical plane entirely between the end walls of said outer annular cham-

ber, whereby said chamber is in fluid communication only with said bore, said passages extending inwardly in a direction toward said muzzle end from said chamber to said bore.

10. 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 passageways disposed in a common vertical plane entirely between the end walls of said pressure tank chamber and providing communication only between said chamber and the bore of said barrel, said chamber first receiving gases under pressure from the explosion of a cartridge in said barrel by way of said passageways, and then exiting the gases by way of said passageways into said bore and toward said muzzle end upon a drop in pressure in said barrel below the gas pressure in said chamber.

11. 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 passageways formed in the wall of said barrel and providing communication only between said chamber and the bore of said barrel disposed in a common vertical plane entirely between the end walls of said pressure chamber and, said passageways extending inwardly and forwardly toward said muzzle end.

12. The device of claim 11, including a jet forming insert received in each one of said passageways.

13. A device for aspirating noxious gases from the muzzle end of a gun barrel comprising, means concentric about the muzzle end of said barrel and secured thereto to form a pressure tight chamber about said barrel, there being a plurality of circumferential equiangularly spaced passageways disposed in a common vertical plane entirely between the end walls of said pressure tight chamber and extending through the wall of said barrel and

providing communication only between said chamber and the bore of said barrel, said passageways being inwardly and forwardly inclined relative to the bore of said barrel.

14. The device in claim 13, including a jet forming insert received in each of said passageways, each of said inserts having a restricted central bore parallel to its corresponding passageway.

15. A device of the character described comprising, in combination, a gun tube having a muzzle and a bore, a closed hollow member surrounding a portion of said tube and spaced from the latter to provide an outer pressure chamber thereon, said chamber being in fluid communication with said bore only, there being a plurality of passages having outer and inner ends connecting said chamber and said bore respectively, to provide said fluid communication, said passages being equiangularly-spaced elements of a right cone having its axis coincidental with the bore axis of the gun and its apex toward the muzzle and being disposed entirely between the end walls of said closed hollow member.

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