May 24, 1932. G. DE LUCE ET AL 1,860,276

FIREARM

Filed July 8, 1930 2 Sheets-Sheet 1

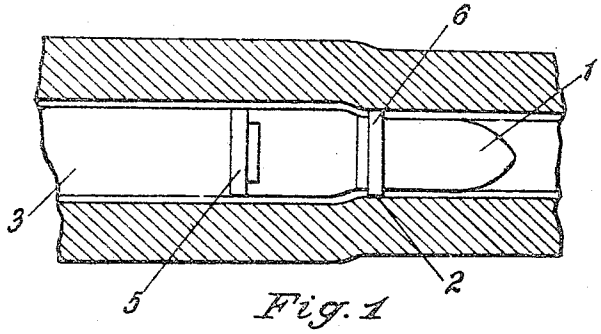


Fig. 1

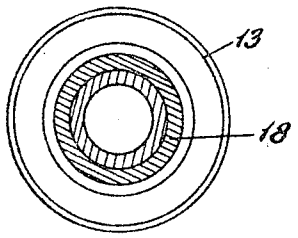


Fig. 3

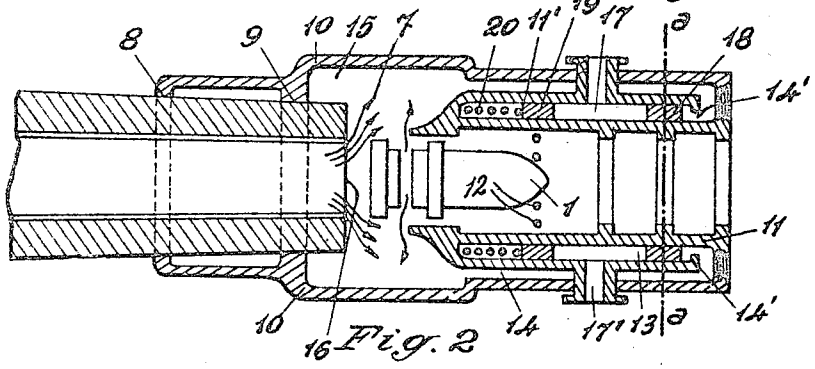


Fig. 2

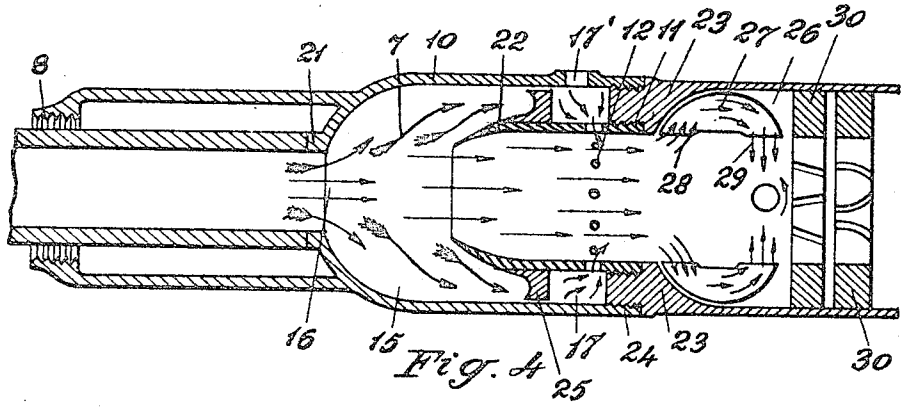


Fig. 4

Fig. 5

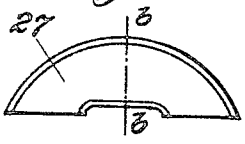
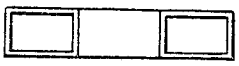


Fig. 6

Fig. 8

Fig. 7



G. de Luce
F. Guerra
INVENTORS

By: Marks & Clerk
Attys.

May 24, 1932. G. DE LUCE ET AL 1,860,276

FIREARM

Filed July 8, 1930 2 Sheets-Sheet 2

Fig. 9 Fig. 10

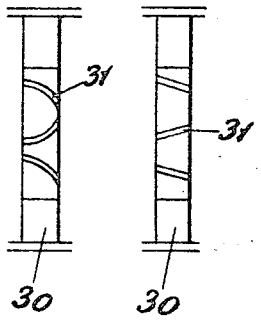


Fig. 11

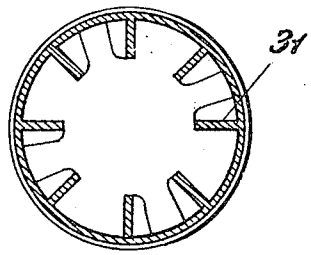


Fig. 12

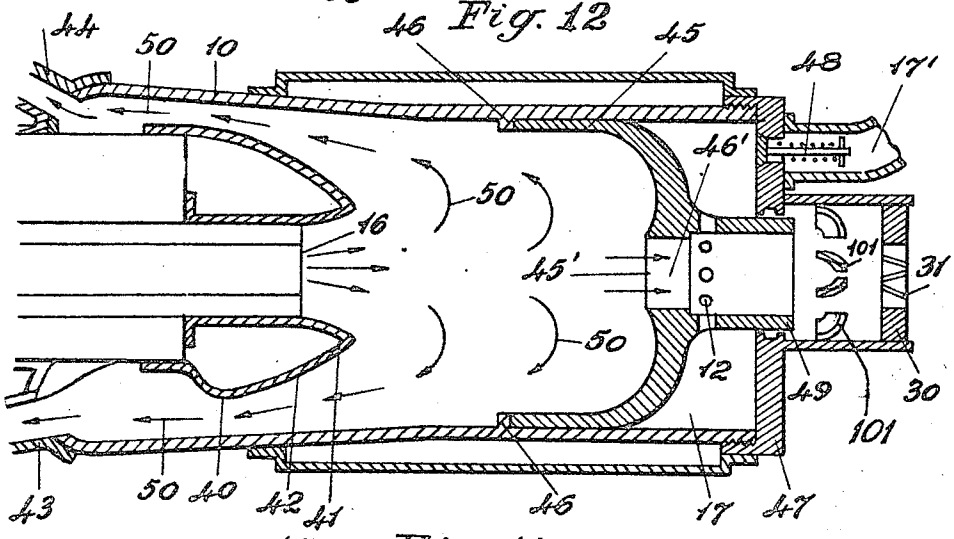


Fig. 14

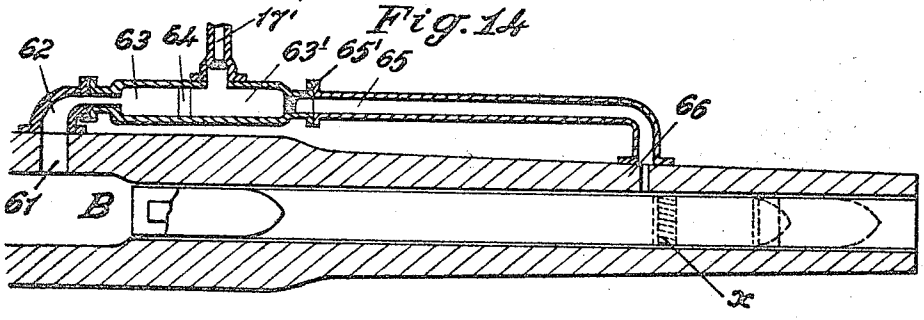


Fig. 13

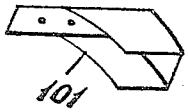


Fig. 15

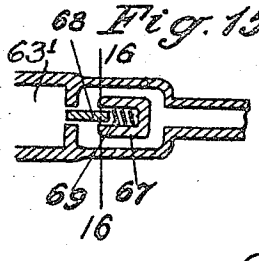
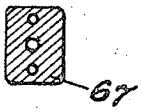


Fig. 16



C. de Luce
F. Guerra
INVENTORS
By: Marks & Clark
Attys.

Patented May 24, 1932 1,860,276

UNITED STATES PATENT OFFICE

GUGLIELMO DE LUCE AND FERRUCCIO GUERRA, OF NAPLES, ITALY, ASSIGNORS TO SOCIETA ITALIANA MIGLIORAMENTO ARMI, OF NAPLES, ITALY

FIREARM

Application filed July 8, 1930, Serial No. 466,569, and in Italy July 10, 1929.

This invention relates to gun firing and has for its object to provide means by which the flame and flash that accompany the projectile on its flying past the gun muzzle can be totally suppressed.

It is a well known fact that the moment a gun is fired, a very vivid flame is produced at its muzzle soon after that the shell has abandoned the barrel and perhaps also an instant before. The flame now referred to is due to the fact that neither the whole energy of the gases produced by the explosion of the charge is utilized on the projectile, nor are all the calories developed by the combustion of the charge absorbed during the flight of the projectile within the barrel.

This flame is very objectionable, specially at night, as it allows the enemy to discover where the gun is located, and correct his aim for the destruction of the gun, however well the latter may be concealed.

There is, besides, another objectionable fact which takes place specially with long barreled guns, for instance marine guns, this being the smoke that is produced even when using the so called smokeless powder, a fact that has not been reasonably explained so far, but that appears due to the relatively long time the projectile remains in the barrel, which allows a portion of the powder charge not to be fully burned and to reach the muzzle of the gun in a smoky condition but not hot enough to burn either on coming into contact with atmospheric air.

It is then the object of this invention to so diminish the temperature of the not utilized gases by very finely dividing and pulverizing and mixing them with a cooling means, that such unexhausted gases will become extinct and invisible.

This effect, that has been proved by real experience, is attained by primarily placing inside the barrel, between the top of the charge and the bottom of the shell, a certain quantity of a cooling substance, either fluid or finely divided solid matter and arranging besides at the muzzle end of the gun a device that automatically injects a supplementary portion of the finely divided cooling means into the still burning gases before their flight into the air behind the shell.

The accompanying drawings show a number of modifications of the above said arrangement, and particularly:

Figure 1 is an axial sectional view of the portion of a gun where the shell and charge are placed when loading the gun:

Figure 2 is an axial sectional view of the muzzle arrangement according to one form of the invention, of which Figure 3 is a cross section on the line *a—a*;

Figure 4 is a view similar to Figure 2 of a rather modified form of the muzzle arrangement;

Figures 5, 6, 7 and 8 being a sectional axial view, a cross sectional view, a front and perspective view respectively of one of the flame diverging means adopted with this arrangement and Figures 9, 10, 11 are radial and cross sectional views respectively of one or more internally baffle plated rings as are fixed inside and on the outer end of the muzzle member, in order to still deviate the remnants of the gases, and cooperate to check the recoil of the gun, and the noise of the shot.

Figure 12 is in an axial sectional view of a further modified form of the muzzle arrangement, in which a portion of the gases are deflected rearwardly;

Figure 13 being a perspective view of another gas deflecting means, in connection with this invention.

Figure 14 is an axial view of a still further modified form of the device according to this invention specially adapted for small bore guns and machine guns.

Fig. 15 is an enlarged fragmentary sectional view corresponding to a portion of Fig. 14 but showing one of the valves in detail.

Fig. 16 is a transverse section on the line 16—16 of Fig. 15.

As stated above, this invention aims primarily to cause that portion of the calories produced by the ignition of the powder charge, which are not utilized for the propulsion of the shell or projectile to be absorbed and destroyed. Accordingly a first

part of the action aimed by this invention is effected inside the gun barrel and more particularly between the front end of the charge and the bottom of the shell as is well shown in Figure 1, in which 1 indicates the shell in its position before firing, between the bottom 2 of which and the end of the charge 3 a space or room 4 is left in which a closed bag of any convenient flexible material is placed as a cushion and containing a cooling material, separating the charge from the shell by means of two discs of adapted material as 5 and 6, or any other convenient means.

With this arrangement it will soon be understood that the moment the gun is fired, as the cooling matter is very little or not at all compressible, the effect of the charge on the shell will in no way be changed or diminished, the shell starting therefore with its proper speed, as if the cooling means did not exist at all. But the instant the projectile leaves the gun muzzle, as in the position shown in Fig. 2, said cooling means, which, owing to the very high pressure it will have undergone from the gases of the explosion, will be extremely finely divided and vaporized due also to the very high temperature developed. At the same time said cooling means will intimately mingle with the gases, partly following the shell, partly expanding sideways in the direction shown by arrows 7 into the expansion chamber 15, the admixture of such cooling means with the gases already causing the latter to be greatly cooled down.

This action of temperature lowering has proved however not always sufficient to totally check the flame hereinbefore referred to, so that it has been proved necessary to adopt a means for still keeping the gas vapour under protection of a cover and to still further admit a portion of the cooling substance to mingle with the gases and deviate their course before allowing them to expand into the air.

This object has been attained by a prolongation added to the gun muzzle, and so construct this added member as to force the gases to deviate from the course of the shell and to cause another quantity of cooling material to be sent into the mass of said gases, just behind the projectile.

One first form of such device as adopted according to the present invention is represented in an axial sectional view in Fig. 2. According to this form, the device comprises a cylindrical hollow member 10 having its axis coincident with the gun axis, and constituted as a sleeve through which the shell can freely pass during its flight. This sleeve 10 is fixed on the outside of the gun, near its muzzle, in any convenient manner, as for instance by screwing as at 8 and 9.

Conveniently fixed into the outer sleeve is another concentrically arranged sleeve 11 of a sufficiently smaller outside diameter as to leave between the two sleeves and by means of a conveniently fixed tubular diaphragm 11′, two circular tubular chambers 13, 14 which communicate with one another at their forward ends as at 14′. The sleeve 11 has one or more circularly arranged series of perforations 12, and the diaphragm 11′ has one or more flanged openings 17′ which permit communication of chamber 14 with any convenient container of the cooling means not represented, from which by any convenient means whatever as by compression said cooling means may be fed. Freely mounted on the inner sleeve 11 are two piston-like metal rings 18, 19, which may slide tightly in the chamber 14, forming between them a circular chamber 17 which is filled up with the cooling means as fed through the holes 17′, the ring 19 being controlled by a coil spring 20 bearing against the bottom of chamber 14, as shown in the drawings. In such a way, said ring 19 in its normal position as shown covers the perforations 12, so that the cooling matter contained in chamber 17 cannot flow into the inner sleeve 11.

In operation, that is, on the gun being fired, the moment the shell flies past the muzzle, the gases which have expanded as said above following the direction of arrows 7, will pass along chamber 14, and through its end 14′ will enter into chamber 13, and act on the pistonlike ring 19. The latter will therefore be moved backward and compressing the cooling matter in chamber 17, will cause the pistonlike ring 18 to move back, and uncover the perforations 12, when the cooling means will therefore be ejected with force into sleeve 11, just behind the shell, and so cooperate to diminish the temperature of the passing gases and by this means to extinguish the flame.

On this action being completed, the spring 20 will push ring 18 forward again, hence the perforations 12 will be covered again, and the cooling matter, while replenishing again chamber 17, will send ring 19 forward to its resting position as shown in Figure 2, ready for another operation.

In accordance with the matters specified herein above, if the sizes of the various parts or members of the device and their masses as well as the quantity and quality of cooling material contained in chambers 4 and 17 are well appropriate, the cooling means will thoroughly be pulverized and vaporized as well as intimately mixed with the gases which will have followed the shell in its flight and even afterward with the other portion of gases which has concurred to set the system of piston-like rings in operation. In this way, the energy of these gases will fully be absorbed and no sufficient quantity of them will still remain to produce the undesirable flame.

Accordingly, the quantity of cooling material needed will advantageously be divided

between chambers 4 and 17, but it must be understood that actual experience may suggest either to place the whole quantity of cooling matter into the powder chamber or to divide said appropriate quantity partly therein, partly in the muzzle arrangement or even all at the muzzle, none in the powder chamber, etc.

Figure 4 shows a modified form of the muzzle arrangement as shown in Figure 3, with some additional details as shown in Figures 5 to 8 and 9 to 11 respectively.

The outside sleeve or jacket 10 according to this modified form is screwed on to the gun as at 8 with a flanged portion 21 against the muzzle face of the gun where it can be fixed in any convenient manner. The inside sleeve 11 is made with a restricted mouth at its rear portion 27 widening therefrom, said sleeve being supported by an additional sleeve 23, which is screwed both on the jacket and the inside sleeve, by means of an inside and outside screwed prolongation 24.

According to this form of construction a large expansion chamber 15 for the powder gases is formed in the jacket where the gases flow as shown by arrows 7: said chamber 15 being closed forward by a piston-like ring 25 slidably mounted on the sleeve 11, to form the chamber 17 which communicates as in the former construction with the refrigerating means supply container not shown, through a hole 17'. As in the former construction the perforations 12 are supplied to permit of the cooling means being injected into the sleeve as in the former case.

Conveniently fixed in the prolongation 23, where the latter widens as at 26, are a number of shell like tubes 27 having preferably a square cross section and a curved shape as shown in detail in axial and cross sectional views in Figures 5 and 6 and in front and prospective views in Figures 7 and 8 respectively.

Further, in addition to the above arrangement as shown in Figure 4, inside and near the outer opening of member 23 are one or more rings 30, as shown in detail in Figures 9, 10 and 11, in their axial sectional and front views respectively. These rings have inside fixed small baffle blades 31 of any convenient shape, set at an inclined position with respect to the axis of the gun.

In operation, whilst a portion of the gases expand in the chamber 15 as above and the remaining portion follows the projectile as shown by the arrows 7', they are subject to a first cooling action on the part of the cooling means ejected by chamber 17 through the perforations 12; but, on reaching the point where the deviating shells 27 are, said gases enter the shells and are further deviated and deflected as shown by the arrows 28 and 29, so that said gases now mixed and cooled, proceed still forward until they meet and pass the baffle blades 31 where they are further mixed and cooled so that no flame whatever may become apparent.

Besides, as these baffle blades receive the last impulse of the gases, they will cooperate owing to the axial forward action on said inclined blades to diminish the energy of recoil of the gun.

The modified form of construction of the flame reducing in guns as specified with reference to Figure 4, is particularly useful with long barreled guns, in which, as stated above, beside the flame the projectile is accompanied in its flight by a certain amount of smoke, which will be widely suppressed due particularly to the restriction 22 of tube 11 as well as to the intimate mixture of the cooling matter and the inflamed gas which is obtained by the deviation of the gases in a direction normal to the gun axis caused by tubes 27.

With this modified form of flame checking device, the shock of the gases against the baffle plates 31 in the opposite direction of the gun recoil causes the length of this recoil to be diminished and softened.

A further modified form of construction of the device for checking the gas flame in guns which has for its principal object to greatly diminish the volume of the gases that fly after the projectile, and obtain in this way the capital advantage of lessening the quantity of cooling material necessary in such kind of devices, while still obtaining a thorough cooling of the gases, is shown in Figure 12.

According to this modified form of the invention, a portion of the gases immediately after their flying past the gun muzzle, is deflected backward and either dispersed into the atmosphere behind the gun or by means of an artificial physical or chemical cooling process, caused to be thoroughly absorbed and anyhow rendered harmless to men's health.

Referring to Figure 12, according to this modified form of device, conveniently fixed on the muzzle end is a kind of hollow metal cap 40 so shaped, as to facilitate the gas flowing backward through tubes 43, 44 fixed on a convenient prolongation of jacket 10, as shown by the arrows 50.

Freely slidable in the jacket 10, but with a good contact with the jacket wall in order to prevent gas escape, is a cap 45, the backward movement of which is limited in a convenient manner, as by an annular stop 46. The jacket 10 is shut by a front cover 47, having a central hole in which a tubular prolongation 49 of the cap, can slide as in a guideway. In this way the usual chamber 17 is provided between the cap and the jacket cover, into which cooling matter may be sent through a spring controlled valve 48 and feeding tube 17'.

The cap 45 is supplied with perforations

12 as in the preceding cases, through which the cooling means may be ejected when, owing to the forward impulse of the powder gases, the cap is moved forward, said cap being sent back when the pressure inside it is extinguished, by the pressure of the incoming cooling means.

Baffle rings 30, may be provided at the jacket mouth as in the preceding case, and besides some baffling members 101 of pressed metal as shown in Figure 14, may be provided in order to more fully deviate the powder gases before escaping behind the projectile, and also to stand a part of the impulse of said gases, in the opposite direction to the recoil of the gun, which latter will be consequently diminished.

In this modified form of the flame checking device, as soon as the projectile leaves the gun muzzle, owing to the inertia of cap 45 and to the open way traced by the backward turned tubes 43, 44, a part of the powder gases will turn backward in the direction shown by the arrows 50, whilst the other part of said gases will follow the course of the projectile, acting upon the cap as stated above, and causing the cooling material to mix with the powder gases and cool them.

Figure 14 shows a still further modified form of the arrangement according to this invention, particularly adapted for small bore guns, rifles, machine guns and the like.

According to this modification, a hole 61 is drilled in the wall of the gun, in correspondence with the charge chamber B, on which a bent tube 62 is conveniently fixed, which widens in a chamber 63 where a piston 64 may tightly slide, forming and limiting a further chamber 63′ communicating through a tube 17′ with a cooling matter feeding container not shown. To said chamber 63′ is fixed a tube 65 that runs parallel to the gun barrel near the muzzle of which it is fixed as at 66, where another hole communicates again with the barrel.

Now, conveniently fixed at the union between chamber 63′ and tube 65, is a hindering valve as diagrammatically shown in Figure 15 such valve having a rod 68 being guided in a plate 67 and controlled by a spring 69 so that the cooling matter, either mixed to the powder gases or not, cannot pass forward or backward unless acted upon by the pressure of the powder gases, when the valve plunger will be acted upon and moved forward against the action of the spring and permit the passage of the gases and cooling matter which will be injected into the barrel in the proximity of the muzzle, said gases being efficiently cooled down and the flame disappearing.

The cooling matter may be water, for instance, but any other appropriate matter, either fluid or gaseous or even a finely divided solid matter may be used as actual experience may suggest.

It must be understood that the word shell when used above is meant to include any form of projectile.

It must be understood that we do not restrict ourselves to the details and forms of embodiment as described and illustrated; but that we intend to broadly protect the nature and scope of our invention as specified above which are a process and means for suppressing the flame and flash that accompany the projectile in firing guns and the like.

Having now described and ascertained the nature of our invention and in what manner it is to be performed, we declare that what we claim is:

1. In combination, a gun barrel having a bore, a conduit for a cooling medium arranged to deliver the cooling medium to the gases resulting from the firing of the charge, and a gas conduit communicating with the bore and connected with the cooling medium conduit whereby pressure of the fire gases is utilized to mix the cooling medium with the fire gases.

2. In combination, a gun barrel having a bore, a conduit for a cooling medium arranged to deliver the cooling medium to the gases resulting from the firing of the charge, and a gas conduit communicating with the bore and connected with the cooling medium conduit whereby pressure of the fire gases is utilized to mix the cooling medium with the fire gases, and means for supplying a cooling medium to the first mentioned conduit under initial pressure.

3. In combination, a gun barrel having a bore, a hollow member applied to the muzzle of the barrel, tubular members in said hollow member arranged in spaced relation with each other and providing concentric inner and outer internal chambers, means for supplying a cooling medium to the inner chamber, the outer chamber being in communication with the bore of the barrel, and pressure operated means moving in response to the pressure of fire gases to open communication between the inner chamber and the interior of the inner tubular member.

4. In combination, a gun barrel having a bore, a hollow element carried by the end of the barrel, inner and outer spaced tubular members arranged in said element providing inner and outer chambers, the inner tubular member having perforations therein connecting the interior of the inner tubular member and the inner chamber, the outer chamber being in communication with the bore of the barrel, and a valve-like element normally closing said perforations and operated in response to the pressure of fire gases discharged into the hollow element from the gun barrel to cause uncovering of said perforations.

5. In combination, a gun barrel having a

bore, a hollow element carried by the end of the barrel, inner and outer spaced tubular members arranged in said element providing inner and outer chambers, the inner tubular member having perforations therein connecting the interior of the inner tubular member and the inner chamber, the outer chamber being in communication with the bore of the barrel, and a valve-like element normally closing said perforations and operated in response to the pressure of fire gases discharged into the hollow element from the gun barrel to cause uncovering of said perforations, and means for admitting a fluid medium to the inner chamber.

6. In combination, a gun barrel having a bore, a hollow element carried by the end of the barrel, inner and outer spaced tubular members arranged in said element providing inner and outer chambers, the inner tubular member having perforations therein connecting the interior of the inner tubular member and the inner chamber, the outer chamber being in communication with the bore of the barrel, a valve-like element normally closing said perforations and operated in response to the pressure of fire gases discharged into the hollow element from the gun barrel to cause uncovering of said perforations, means for admitting a fluid medium to the inner chamber, and a piston-like member in the inner chamber for separating the cooling medium from the pressure gases.

7. In combination, a gun barrel having a bore, a tubular member arranged in alinement with said bore and having openings therein, a chamber surrounding said tubular member, means for supplying cooling medium to the chamber and a piston-like member arranged in said chamber subjected to the pressure of the fire gases following the discharge of the projector from said bore, whereby to cause the delivery of the cooling medium from the chamber to the interior of the tubular member through the openings in the latter.

8. In combination, a gun barrel having a bore, a tubular member arranged in alinement with said bore and having openings therein, a chamber surrounding said tubular member, means for supplying cooling medium to the chamber and a piston-like member arranged in said chamber subjected to the pressure of the fire gases following the discharge of the projector from said bore, whereby to cause the delivery of the cooling medium from the chamber to the interior of the tubular member through the openings in the latter, and means arranged in said tubular member for diverting the gases passing therethrough to cause the latter to travel in a direction normal to the path of the projector.

9. In combination, a gun barrel having a bore, a hollow element applied to the end of the barrel, a piston-like element dividing the interior of the hollow element into two chambers and having an axial passage therethrough in line with the bore of the barrel for the passage of a projector, said piston-like member having openings therein connecting the passage therethrough with one of the chambers, valve control means for admitting a cooling medium to said chamber, the piston-like member being subjected to the pressure of the fire gases discharged from the bore, whereby the piston-like member is forced outwardly causing a compression of the cooling medium in the first mentioned chamber and the injection of said cooling medium into the passage of the piston-like member through the openings therein.

10. In combination, a gun barrel having a bore, a hollow element applied to the end of the barrel, a piston-like element dividing the interior of the hollow element into two chambers and having an axial passage therethrough in line with the bore of the barrel for the passage of a projector, said piston-like member having openings therein connecting the passage therethrough with one of the chambers, valve control means for admitting a cooling medium to said chamber, the piston-like member being subjected to the pressure of the fire gases discharged from the bore, whereby the piston-like member is forced outwardly causing a compression of the cooling medium in the first mentioned chamber and the injection of said cooling medium into the passage of the piston-like member through the openings therein, the second mentioned chamber having passages therein for the discharge of the fire gases.

In testimony whereof we have signed our names to this specification.

GUGLIELMO DE LUCE.
FERRUCCIO GUERRA.