

MUZZLE DEVICE FOR COMBINED BLAST OVER PRESSURE AND MUZZLE FLASH REDUCTION

The present invention relates to a method and a device for reducing blast over pressure and muzzle flash when firing barrel weapons and especially the fully-automatic larger calibre weapons like air-defence guns and suchlike.

Development within artillery technology during the last ten to twenty years has been distinguished more by efforts to optimise older gun constructions and the development of new ammunition and new fire control systems than for the development of entirely new guns. This development work has, however, resulted in improved artillery systems with significantly increased ranges but the guns themselves are often very similar to previous gun generations. Despite having a similar appearance to older generations, these new guns are not always directly interchangeable with the older guns because due to the higher firing performance they have a considerably greater effect on the environment in the form of increased blast over pressure, larger muzzle flash and a generally higher level of decibels. Of these factors, it is mainly the higher blast over pressure and even to a certain extent, the greater muzzle flash which can attain values which are entirely unacceptable especially when the guns must share a confined space with other functions as is the case on sea vessels and aircraft. In the latter case, it is possible that an excessive blast over pressure could negatively influence the carrier's flight characteristics, something which must consequently be documented before an older gun can be replaced by a newer gun with higher performance.

As stated in the introduction, the present invention relates to a method and a device for reducing blast over pressure around the muzzle and for limiting the weapon muzzle flash when firing with fully-automatic barrel weapons mainly of larger calibre such as air defence guns.

The purpose of the present invention is thus not to achieve something which could be called a sound reducer for the weapon in question but rather to obtain something which in the case of small calibre weapons has the American designation "moderator" where the other two alternative devices for a progressively greater reduction of the

weapon's effect on the environment have the designations "suppressor" and "silencer".

These three types of devices for reducing the effect on the environment when firing small calibre weapons such as pistols, rifles and machine guns, are based on the propellant gases leaving the barrel being allowed to expand and cool inside the chamber which is divided into a large number of spaces created by a widely-spaced wire mesh, or a chamber which has a number of partitions or baffles transverse the projectile trajectory with central orifices arranged around the extension of the line of the barrel bore.

Even in the case of small calibre weapons, however, these constructions have a very limited service life and are therefore unusable in the case of artillery guns.

In accordance with the present invention, the problem of reducing blast over pressure when firing is solved by allowing the propellant gases leaving the barrel to expand and cool in a chamber the sides of which are closed to the environment and which has no inserts, baffles or suchlike. The ratio between the chamber's inlet and outlet that are centred around the extension of the bore of the barrel and the total volume of the chamber are critical criteria for the chamber. It is these factors which make possible the combination of expansion and cooling of the propellant gases which provide the desired results.

The problem of the muzzle flash remains, however, and this can be serious if it becomes too powerful which is in fact the case if the propellant gases following expansion in a chamber as referred to above, are allowed to flow freely out into the surrounding atmosphere.

It has, however, been demonstrated that it is possible to reduce muzzle flash to an acceptable level even in this case if an expansion chamber of the type referred to above is combined with a standard type of flash guard of funnel or nozzle form and is directly connected to the chamber outlet where the diffuser effect thus obtained is also thought to have a favourable effect on the reduction of blast over pressure. A further advantage of combining an expansion chamber with a diffuser flash guard is that the pressure is directed more to the front and beyond the gun than is normally the case.

A further advantage of the device in accordance with the invention has been demonstrated: in spite of the projectiles being fired through the expansion chamber entirely without support between the chamber inlet and outlet, the weapon can still be used for firing sub-calibre penetrator ammunition.

In accordance with the invention, the expansion chamber connected to the barrel muzzle inlet shall have a diameter 1.0 to 1.5 times the barrel calibre while the chamber's corresponding outlet shall have a diameter 2.0 to 2.5 times greater than the barrel calibre at the same time as the expansion chamber volume shall be 0.8 to 1.0 times the barrel volume. An expansion chamber designed in accordance with the above stated dimensions, shall in its turn be combined with a diffuser-formed flash guard of preferably cone or bell form, and an outlet or cone top angle of preferably 20-30°.

The invention is defined in the following patent claims and it is now further described in relation to the enclosed figure.

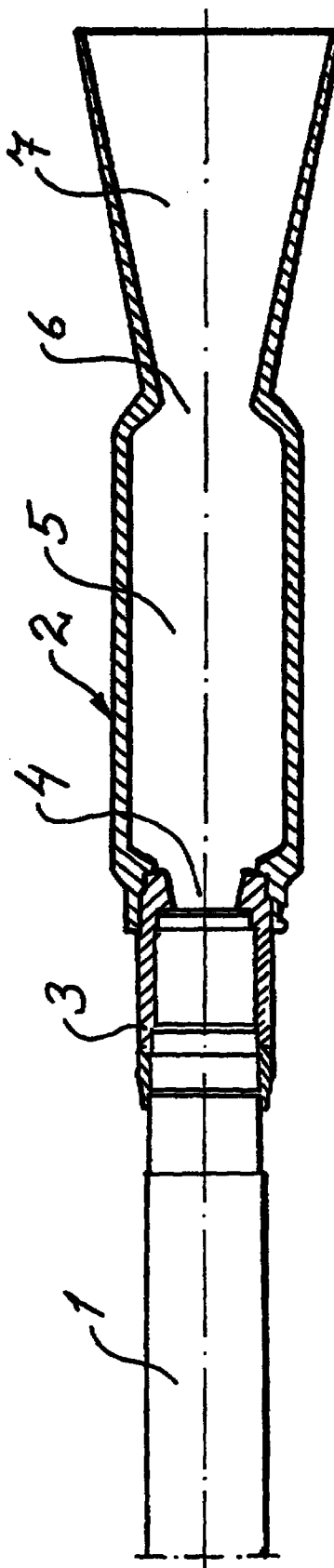
The figure shows the front section of a barrel belonging to one of Bofors AB's famous 40 mm automatic air defence guns with the type designation L70. This is a later generation of this type of gun and has a very high level of performance. The front section of the barrel 1 is not drawn in section while the combined expansion chamber and flash guard 2 at the barrel muzzle are drawn in section. In reality, the expansion chamber/flash guard 2 consists of two connected parts and also includes an adapter 3 which determines the inlet 4 diameter. From the inlet 4, the expansion chamber 5 widens out and, as previously mentioned, it is mainly the volume of the chamber which is critical. It is a precondition, however, that the chamber diameter is greater than both the inlet 4 and the corresponding outlet 6. The latter opens out directly into the diffuser-formed flash guard 7.



PATENT CLAIMS

We hereby claim and desire to secure by Letters Patent the following.

1. A method for reducing blast over pressure and limiting muzzle flash when firing barrel weapons mainly in the case of fully-automatic large calibre weapons such as automatic air defence guns and similar w h e r e i n the propellant gases formed directly outside the muzzle when firing are allowed to expand in a chamber (5) with enclosed sides from where they are led out in the same direction (6) as the projectiles fired from the weapon via a flash guard (7) of known design which functions as a diffuser.
2. A device in accordance with the method in Claim 1 to reduce blast over pressure and limit muzzle flash when firing barrel weapons mainly in the case of large calibre weapons such as automatic air defence guns and suchlike w h e r e i n an expansion chamber (5) with enclosed sides is fitted to the weapon barrel muzzle (11) and the only outlet (4) at the rear of the chamber is connected to the barrel muzzle (1) and the only outlet at the front of the chamber (6) consists of an opening which in its turn is directly connected to a diffuser-formed flash guard (7) itself of known form.
3. A device as claimed in Claim 2 w h e r e i n the expansion chamber (5) rear opening (4) directly connected to the barrel muzzle has a diameter of 1.0 to 1.5 times the weapon calibre while its corresponding front opening (6) has a diameter 2.0 to 2.5 times the weapon calibre at the same time as the total volume of the expansion chamber corresponds to 0.8 to 1.0 times the total volume of the barrel.
4. A device as claimed in Claim 2 or 3 w h e r e i n the flash guard (7) is of funnel or bell form and widens in the direction of the fired projectile with a peak angle of 20° -30° preferably around 25°.
5. A device as claimed in any of Claims 2-4 w h e r e i n the inner diameter of the expansion chamber is greater than that of its inlet (4) and its outlet (6).

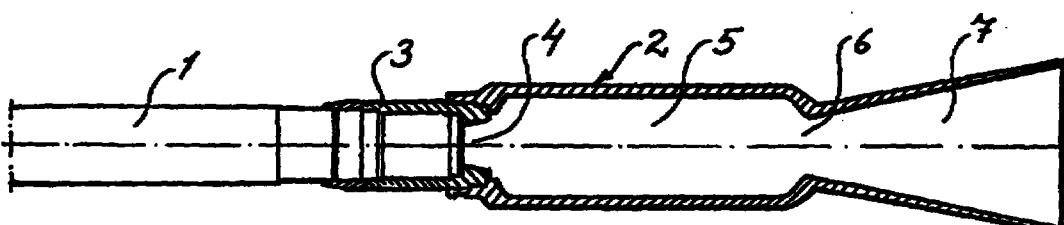




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(21) International Application Number: PCT/SE96/00470 (22) International Filing Date: 11 April 1996 (11.04.96) (30) Priority Data: 9501521-0 25 April 1995 (25.04.95) SE (71) Applicant (for all designated States except US): BOFORS AB [SE/SE]; S-691 80 Karlskoga (SE). (72) Inventors; and (75) Inventors/Applicants (for US only): BRINK, Joakim [SE/SE]; P1 8589:A, S-691 93 Karlskoga (SE). ERIKSSON, Leif [SE/SE]; Fridhem 8231, S-691 93 Karlskoga (SE). (74) Agent: FALK, Bengt; Bofors AB, Patents and Trademarks, S- 691 80 Karlskoga (SE).		(81) Designated States: NO, <u>SG</u> , US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>
(54) Title: MUZZLE DEVICE FOR COMBINED BLAST OVER PRESSURE AND MUZZLE FLASH REDUCTION  (57) Abstract The present invention relates to a method and a device for reducing blast over pressure and limiting muzzle flash when firing barrel weapons mainly of the fully automatic larger calibre type such as automatic air defense guns. The invention is based on allowing the propellant gases when they have left the barrel to expand in a chamber (5) with enclosed sides and the only inlet to the chamber is the barrel muzzle (1) and the only outlet is an opposite opening (6) which is directly connected to a diffuser-formed flash guard (7). The invention also includes certain critical relationships between the components included.		