

(19)



(11)

EP 1 472 199 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
31.03.2010 Bulletin 2010/13

(21) Application number: **03700650.9**

(22) Date of filing: **13.01.2003**

(51) Int Cl.:
C06B 23/00 ^(2006.01) **F42B 5/24** ^(2006.01)

(86) International application number:
PCT/SE2003/000028

(87) International publication number:
WO 2003/066544 (14.08.2003 Gazette 2003/33)

(54) **DECOPPERING AGENT**

ENTKUPFERUNGSMITTEL

AGENT DECUIVRANT

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT SE SI SK TR**

(30) Priority: **08.02.2002 SE 0200366**

(43) Date of publication of application:
03.11.2004 Bulletin 2004/45

(73) Proprietor: **Eurenco Bofors AB
69186 Karlskoga (SE)**

(72) Inventor: **JOHANSSON, Sven-Eric
S-691 33 Karlskoga (SE)**

(74) Representative: **Falk, Bengt
Saab Bofors Support AB
Patents and Trademarks
691 80 Karlskoga (SE)**

(56) References cited:
WO-A1-96/18862 US-A- 5 463 956

EP 1 472 199 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

FIELD OF THE INVENTION

[0001] This invention relates to an addition to every kind of propellant effective for removing copper deposits from the inside surfaces of a gun barrels. More particularly, a composite addition has a pulverized decoppering agent mixed into the propellant.

BACKGROUND OF THE INVENTION

[0002] Most guns have a barrel with a rifled internal bore that imparts a stabilizing spin on an expelled projectile. The internal bore may be coated with a hard facing material, such as chromium, to minimize erosive wear increasing the number of projectiles that may be fired from the gun.

[0003] The typical large caliber projectile has a diameter slightly less than the diameter of the internal bore. One or more obturator, or rotating, bands gird the circumference of the projectile. At the bands, the diameter of the projectile is slightly larger than the internal diameter of the gun barrel. When the projectile is expelled, the rotating band is engraved by the rifling, contacting the rifling throughout the length of the tube imparting the projectile with a stabilizing spin. Projectiles for rifles and pistols normally do not have a rotating band but they very often have a jacket made of tombac, which is engraved by the rifling.

[0004] The gun barrel is manufactured from a material such as steel and sometimes coated with a hard material such as a chromium facing. The gun barrel is harder than the rotating band or jacket, which is typically copper or a copper alloy. As a result, a portion of the copper from the rotating band or the jacket is deposited on the rifling inside the gun barrel. This copper deposition referred to as "copper fouling" can affect the ballistics of the projectile and major fouling can prevent the projectile from being inserted and seated, positioned in the barrel prior to firing, properly.

[0005] Copper fouling is currently a major problem for large artillery weapons, such as 155-millimeter howitzers, and is also noted in small and medium caliber cannons, such as 20-millimeter canons. It has become a bigger problem in rifles today because of the use of the lead-free primers. Before the primer contained lead and that small amount of lead worked as a decoppering agent. The current solution to copper fouling is including a decoppering agent into the propellant. The decoppering agent removes the copper without damaging the gun barrel of the rifling.

[0006] A common decoppering agent is a sheet of lead foil deposited between the propellant and the projectile. On ignition of the propellant charge, the lead is vaporized and diffuses into the copper. The resultant alloy is brittle and easily shattered. The combination of the heat generated by the burning propellant and the mechanical

movement of the propellant gases separates the brittle lead/copper alloy from the surface of the barrel. The fractures debris is swept from the muzzle of the gun with the propellant gases.

[0007] A second theory as to why the lead foil is effective as a decoppering agent is that the heat generated by the burning propellant melts the lead foil. Liquid lead contacts the copper deposition and dissolves the copper, the copper bearing lead solution is expelled as a liquid from the muzzle with the propellant gases.

[0008] While metallic lead and lead compounds are effective decoppering agents, the materials are toxic to humans working around the weapons. There is a need for a lead free decoppering agent

[0009] Among the lead free decoppering agents that have been proposed are bismuth, bismuth subcarbonate (BiCO₃, sub 3), tin and tin alloys. Bismuth compounds are very brittle and even metallic bismuth cannot be rolled into a thin foil, but the alloys are very expensive and less effective as a decoppering agent.

[0010] There are also solutions described in patent document No WO 96/18862 where one use especially made pellets of bismuth in nitrocellulose binders, which will be added to the propellant charge.

[0011] There remain, therefore a need for a method to effectively introduce a lead free decoppering agent into the propellant. To include the decoppering agent in the propellant composition makes it easier and cheaper when having to add a special made decoppering additive to the charge.

SUMMARY OF THE INVENTION

[0012] According to the present invention, a decoppering agent for a propellant, which comprises essentially of a lead free pulverized additive, consisting of a mixture of tin and bismuth compounds selected from the group consisting of metallic bismuth, bismuth alloys, bismuth compounds, metallic tin, tin alloys and tin compounds for effectively removing copper deposits from a gun barrel, which agent may be mixed into every kind of propellant generating a minimal amount of residue when burned, is provided. The decoppering agent is characterized in that the ratio between the tin and bismuth are between 10-62 % Sn and 90 - 38 % Bi.

[0013] We have found that the optimal mixture is 42% SN and 58% Bi.

[0014] The melting point the optimal mixture is 13 8 degree C, much lower than the melting point of each of components.

[0015] The bismuth and tin either vaporizes or liquefies when the propellant is ignited and either embrittles or dissolves facilitating removal.

[0016] Accordingly, it is an object of the invention to provide an essentially lead free decoppering agent that is included in the propellant. It is a feature of the invention that the decoppering agent is apart of the propellant and distributed homogeneously.

[0017] It is an advantage of the invention that the decoppering agent is distributed to the barrel and through the barrel with the propellant gas. When the decoppering agent is included in the propellant that also means that the powder gases always contain the same amount of decoppering agent.

[0018] The biggest advantage with this invention is that the decoppering agent always is there, it makes the loading easier and cheaper for decoppering.

Claims

1. A decoppering agent for a propellant, which comprises essentially of a lead free pulverized additive, consisting of a mixture of tin and bismuth compounds selected from the group consisting of metallic bismuth, bismuth alloys, bismuth compounds, metallic tin, tin alloys and tin compounds for effectively removing copper deposits from a gun barrel, which agent may be mixed into every kind of propellant generating a minimal amount of residue when burned, **characterized in that** the ratio between the tin and bismuth are between 10 - 62 % Sn and 90 - 38 % Bi.
2. The decoppering agent of claim 1, **characterized in that** the mixture is 42 % Sn and 58% Bi.

Patentansprüche

1. Entkupferungsmittel für ein Treibmittel, das im Wesentlichen ein bleifreies pulverisiertes Additiv umfasst, das aus einer Mischung aus Zinn- und Bismutverbindungen ausgewählt aus der Gruppe bestehend aus metallischem Bismut, Bismutlegierungen, Bismutverbindungen, metallischem Zinn, Zinnlegierungen und Zinnverbindungen zum effektivem Entfernen von Kupferablagerungen aus einem Geschützrohr besteht, wobei das Mittel in alle Arten von Treibmittel gemischt werden kann, die eine minimale Menge an Rückstand erzeugen, wenn sie abgebrannt werden, **dadurch gekennzeichnet, dass** das Verhältnis zwischen dem Zinn und Bismut zwischen 10-62% Sn und 90-38% Bi ist.
2. Entkupferungsmittel nach Anspruch 1, **dadurch gekennzeichnet, dass** die Mischung 42% Sn und 58% Bi ist.

Revendications

1. Agent décuivrant pour un propulseur, qui comprend essentiellement un additif pulvérisé sans plomb, consistant en un mélange de composés d'étain et de bismuth choisis dans le groupe constitué de bis-

muth métallique, d'alliages de bismuth, de composé de bismuth, d'étain métallique, d'alliages d'étain et de composés d'étain, pour éliminer efficacement les dépôts de cuivre d'un tube de canon, ledit agent pouvant être mélangé dans chaque type de propulseur générant une quantité minime de résidu quand il est brûlé, **caractérisé en ce que** le rapport entre l'étain et le bismuth est compris entre 10-62 % de Sn et 90-38 % de Bi.

2. Agent décuivrant selon la revendication 1, **caractérisé en ce que** le mélange est de 42 % de Sn et de 58 % de Bi.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 9618862 A [0010]