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(54) **PROPELLANT POWDER CHARGE FOR BARREL WEAPON**

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POUDRE DE CHARGE PROPULSIVE POUR ARME A CANON

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Description

[0001] The present invention relates to a propellant powder charge with high progressivity and an extremely high degree of filling or loading density, intended primarily for large-bore barrel weapons.

[0002] In what today is the most common way of producing progressive propellant powder charges intended for large-bore barrel weapons, use is made primarily of what is known as granular holed powder, i.e. powder produced by extrusion in a matrix, cut up into short rods or cylinders, with one, seven, nineteen or thirty seven longitudinal priming channels. Because of its geometric configurations throughout its burn time, except during the absolutely final stage, multiple-hole powder of this kind has good progressive burn properties by virtue of the fact that as they are primed they burn from all the surfaces available for priming, i.e. from the outsides of the grains and from the insides of the priming channels, and, from these surfaces thereby primed, the powder will burn towards other primed surfaces during a successive increase of the burn area, and the gas release thereby also increases.

[0003] In order to launch a defined missile from a defined barrel weapon with a predetermined Vo, i.e. with a defined launch velocity immediately outside the barrel mouth, the propellant powder has to be able to deliver a certain additional amount of energy. This additional energy, which can be calculated theoretically with great accuracy, must be delivered during the missile's travel through the barrel. This in turn means that the propellant powder must have time to burn out during the time the missile is on its way through the barrel. The period of time which the propellant powder should then have to burn out and which is thus the same as the time the missile has to pass through the barrel can be called the "burn time".

[0004] If at the same time the length which a powder with the chemical composition in question is able to burn is also called the "burn time", this means that the distance between two adjacent priming channels in a multiple-hole powder which has the desired burn time will correspond to twice the burn length which the burn time in question permits. The distance from respective priming channels to the outer side of the granular powder in which the priming channel is formed must be the same size, provided that the powder grains have not been surface-treated with a burn inhibitor, which is sometimes done in order to increase the powder's progressivity. In summary, it is readily possible to produce multiple-hole powders with different progressivity using different numbers of priming channels, the individual powder grains being given a greater inherent volume depending on the number of priming channels. The progressivity of the powder can then in turn be accentuated by surface treatment with a suitable substance which is more difficult to ignite, but burnable.

[0005] The main trends in modern-day arterillery technology are to attempt by all possible means to increase the artillery's range of fire and its firing speed. In view of the refined methods which have been developed in recent years, and which allow an opponent to determine quickly and with very great accuracy from where he has been shot at, it is thus also necessary to rapidly change the site of firing each time the barrel has been opened.

[0006] Increased firing speed is mainly achieved by the introduction of mechanized loading systems, and these will not be discussed in any detail here, nor will the tactical need for rapidly changing the firing positions. By contrast, it has been found that older artillery pieces too which are in good condition can be given much longer ranges of fire by means of newly developed and high-energy powder charges and possibly also newly developed shells. However, a problem in this context, which is often more serious than the strength limits of barrel and mechanism, is that the space in the rear part of the barrel, i.e. its chamber position, which is available for the actual propellant charge is too small to accommodate a conventionally configured propellant powder charge with sufficient energy content for this desired increase in the range of fire.

[0007] The present invention now relates to a method using holed or unholed granular powder to produce progressive propellant powder charges with a higher degree of filling or loading density and thus also loading weights than has previously been possible. The invention also includes propellant powder charges produced in accordance with said method.

[0008] The starting point for the method according to the invention is that, between the grains of a granular powder introduced into a container without any kind of organized order, there will automatically be a very large number of greater or lesser empty volumes which are many but small in the case of a finely grained powder and which are fewer but also larger in a coarser-grained powder.

[0009] Our solution to the problem now is so simple that it is astonishing that it has not been done earlier. According to the underlying principle of the present invention, we in fact mix two or more different sorts of granular powder in proportions adapted for the particular purpose, where the more finely grained powder is able to fill the otherwise empty space between the larger powder grains. By suitable choice of powder types and suitable proportions between them, it is thus possible to produce charges which have loading densities lying very near to or higher than those one would have obtained if the powder grains had been rammed in manually for the best degree of packing, and the latter method is entirely excluded for practical use. The only additional measure which may be required in connection with the present invention is that the charges are vibrated during powder filling, which is also preferably done simultaneously with the two powder types. One or more of the powder types used can additionally be surface-treated or surface-inhibited in order to further control the progressivity.

[0010] The present invention thus makes it possible to produce propellant powder charges with a high loading density and exactly the high energy content which is required for the case in question. A propellant powder charge produced according to the invention can thus contain 70-95% by weight of a coarsely grained multiple-hole powder, for example a 19-hole or 37-hole powder, and 30-5% by weight of a smaller multiple-hole powder, for example a 1-hole powder or 7-holed powder, and, in view of the desired final result, the powders can each have the same or different chemcial composition and be surface-inhibited (surface-treated with suitable burn inhibitors) or not surface-inhibited. The percentages shown above apply to the outer limits characterizing the invention, whereas, when in practice calculating the charges of the type characterizing the invention, they will in most cases be in the range of 75-85% by weight for the coarser multiple-hole powder and 25-15% by weight for the multiple-hole and more finely grained powder or powders.

[0011] The nearest prior art we are aware of is the charge which is described in US 4,519,855 which describes a propellant powder charge for ballistic ammunition comprising a first powder component consisting of large balls or spheres easily fragmentable into small grains of a first powder component surrounded by a second powder component in the form of a conventionally granular powder which fills the space between the large spheres of powder. Here too the aim has been to produce a powder charge with the highest possible degree of filling taking into consideration the powder types used, but the progressivity of the charges obtained by this method will be based primarily on the large spheres of powder bursting apart during combustion of the powder and thereafter burning like conventionally granular powder, whereas the progressivity for our specific charge is based entirely on the original geometrical shape of the powder grains used.

[0012] The present invention thus relates to a method in which granular powder is used to produce propellant powder charges with high degree of filling or loading density and a high energy content per charge. The invention also covers the charge produced by this method. The invention also makes it possible to produce charges with precisely controlled progressive characteristics by virtue of the fact that it can be built up from different quantities of different powders which have radically different progressive characteristics.

[0013] The invention is thus based entirely on combining two or more types of granular powder having such geometric external shapes and grain sizes that the powder with the smaller grain size will in the best possible way fill the empty space between the larger grains.

[0014] The invention has in all its features been defined in the attached patent claims and it can be illustrated by the following example.

[0015] Example: From a nitrocellulose powder of standard quality which we have used for many years for producing artillery powder, we produced on the one hand a 19-hole powder with grain size of 17 x 17 mm and a 1-hole powder with a grain size of 5 x 5 mm. Of these powders, we mixed 2.3 kg of the 19-hole powder with 0.5 kg of the 1-hole powder and thus obtained a charge with an energy content corresponding to 122% of the energy content in a standard charge which we had previously produced and which was made only from 19-hole powder. Both the charge types are held in the same volume. The invention thus makes it possible to achieve considerable advantages by very small means.

Claims

1. Method for producing progressive propellant powder charges intended for barrel weapons and with a high degree of filling or loading density and thus also a high energy content at which the charge is produced by mixing at least two types of granular powder of different grain size, of which at least the powder type with the largest grain size and thus the most internal priming channels has a progressive burn characteristic, **characterized in that** as subsidiary components of the actual charge, granular powders are chosen whose size, geometric shape and quantities are adapted to give the smallest possible empty spaces between the powder grains.

2. Method according to Claim 1, **characterized in that** the starting material chosen for the charge comprises at least two types of powder whose mutual progressivity has been optimized for the particular purpose.

3. Method according to Claim 1 or 2, **characterized in that** the starting material chosen for the charge is granular powder of the same or different chemical composition but with different grain size and thus with a different number of internal priming channels.

4. Method according to any one of Claims 1-3, **characterized in that**, when choosing the starting material, powder types are chosen of which one or more are surface-inhibited.

5. Method according to Claims 1-4, **characterized in that**, of the powder types intended to be included in the finished charge, all the types are introduced contemporaneously with each other, and at the same time the casing, cartridge or the like to which the powder is added and in which the charge is to be stored prior to use is subjected to vibrations which improve the degree of packing of the charge.

6. Propellant powder charge intended for barrel weapons, with a high degree of filling or loading density and with a high energy content and produced in accordance with the method according to any one of Claims 1-5, **characterized in that** it contains at least

two different types of granular powder of which at least one type has progressive burn characteristics and in which one or more of these powders can be surface-inhibited, and in which the burn characteristics of these different powders are adapted to one another while their mutual grain sizes and the quantities of each powder included in the charge are adapted to one another such that the empty space which necessarily remains between the powder grains is as limited as possible.

7. Propellant powder charge according to Patent Claim 6, with a high degree of filling and with a high energy content, and intended for heavy barrel weapons, **characterized in that** 70-95% of its weight, preferably 75 to 85% of its weight, consists of more coarsely grained powder, such as a 19-hole or 37-hole powder cut into short sections, and 30-5% of its weight, preferably 25-15% of its weight, consists of a more finely grained powder, such as a 1-hole or 7-hole powder, and these two powders have the same or different chemical composition and at least one of them is progressive and one or more can be surface-inhibited.

Patentansprüche

1. Verfahren zur Herstellung von progressiven Pulvertreibladungen für Rohrwaffen mit einem hohen Grad der Füll- oder Ladungsdichte und somit auch einem hohen Energiegehalt, wobei die Ladung hergestellt wird durch Mischen mindestens zweier Typen von körnigem Pulver mit unterschiedlicher Korngröße, wovon mindestens der Pulvertyp mit der größten Korngröße und damit den meisten inneren Zündkanälen eine progressive Abbrenncharakteristik hat, **dadurch gekennzeichnet, dass** als Hilfskomponenten der eigentlichen Ladung körnige Pulver gewählt werden, deren Größe, geometrische Form und Mengen so angepasst sind, dass sich die kleinstmöglichen Leerräume zwischen den Pulverkörnern ergeben.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das für die Ladung gewählte Ausgangsmaterial mindestens zwei Pulvertypen enthält, deren gegenseitige Progressivität für den jeweiligen Zweck optimiert ist.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das für die Ladung gewählte Ausgangsmaterial ein körniges Pulver mit gleicher oder unterschiedlicher chemischer Zusammensetzung, aber mit unterschiedlicher Korngröße und **dadurch** mit einer unterschiedlichen Anzahl von inneren Zündkanälen ist.

4. Verfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** bei der Wahl des Ausgangsmaterials Pulvertypen gewählt werden, wovon einer oder mehrere oberflächenphlegmatisiert sind.

5. Verfahren nach Anspruch 1 bis 4, **dadurch gekennzeichnet, dass** von den für das Einbringen in die fertige Ladung bestimmten Pulvertypen alle Typen gleichzeitig miteinander eingebracht werden und dass gleichzeitig das Gehäuse, die Patronenhülse oder dergleichen, der das Pulver zugegeben werden soll und in der die Ladung vor ihrem Einsatz gelagert werden soll, Vibrationen ausgesetzt wird, die den Packungsgrad der Ladung verbessern.

6. Treibpulverladung für Rohrwaffen, mit einem hohen Grad der Füll- oder Ladedichte und mit einem hohen Energiegehalt, hergestellt nach dem Verfahren gemäß einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** sie mindestens zwei unterschiedliche Typen von körnigem Pulver enthält, von denen mindestens ein Typ eine progressive Abbrenncharakteristik aufweist und in welcher eines oder mehrere dieser Pulver oberflächenphlegmatisiert sein können, und in der die Abbrenn-Charakteristiken dieser unterschiedlichen Pulver aneinander angepasst sind, während ihre jeweiligen Korngrößen und die in der Ladung enthaltene Menge jedes Pulvers derart aneinander angepasst sind, dass der zwangsläufig zwischen den Pulverkörnern verbleibende Leerraum so begrenzt wie möglich ist.

7. Treibpulverladung gemäß Anspruch 6, mit einem hohen Füllgrad und einem hohen Energiegehalt, für schwere Rohrwaffen, **dadurch gekennzeichnet, dass** 70-95% ihres Gewichts, vorzugsweise 75 bis 85% ihres Gewichts, aus grober gekörntem Pulver bestehen, wie zum Beispiel in kurze Abschnitte geschnittenem 19-Loch- oder 37-Loch-Pulver, und dass 30-5% ihres Gewichts, vorzugsweise 25-15% ihres Gewichts, aus einem feiner gekörnten Pulver bestehen, wie zum Beispiel einem 1-Loch- oder 7-Loch-Pulver, und dass diese beiden Pulver die gleiche oder unterschiedliche chemische Zusammensetzung haben und mindestens eines davon progressiv ist und eines oder mehrere oberflächenphlegmatisiert sein können.

Revendications

1. Procédé pour la production de charges de poudre propulsive à combustion progressive destinées à des armes à canon possédant un haut degré de densité de chargement et également un contenu énergétique élevé, dans lequel la charge est produite en mélangeant au moins deux types de poudre granu-

leuse dont la taille des grains est différente, parmi lesquels au moins le type de poudre dont la taille des grains est la plus importante, et ainsi les canaux d'amorçage les plus internes, possède la caractéristique d'avoir une combustion progressive, **caractérisé en ce qu'**en tant que composants subsidiaires de la charge réelle, les poudre granuleuses sont choisies de sorte que leur taille, leur forme géométrique et leur quantité sont adaptées afin que les espaces vides entre les grains de la poudre soient les plus petits possibles.

2. Procédé selon la revendication 1, **caractérisé en ce que** le matériau de base choisi pour la charge comprend au moins deux types de poudre dont la progressivité mutuelle a été optimisée dans ce but particulier.

3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** le matériau de base choisi pour la charge est une poudre granuleuse de composition chimique identique ou différente mais possédant des grains de tailles différentes et possédant ainsi un nombre différent de canaux d'amorçage internes.

4. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que**, lors du choix du matériau de base, les types de poudre sont choisis et une des poudres ou plusieurs sont inhibées en surface.

5. Procédé selon les revendications 1 à 4, **caractérisé en ce que**, les types de poudre qui vont faire partie de la charge finale sont tous introduits en même temps, et l'enveloppe, la cartouche ou analogue, à laquelle est ajoutée la poudre et dans laquelle la charge va être conservée avant son utilisation, est conjointement soumise à des vibrations qui améliorent le degré de tassement de la charge.

6. Charge de poudre propulsive destinée à des armes à canon, possédant un haut degré de densité de chargement et un contenu énergétique élevé, produite conformément au procédé selon l'une quelconque des revendications 1 à 5, **caractérisé en ce qu'**elle contient au moins deux types différents de poudre granuleuse dont un type au moins possède la caractéristique d'avoir une combustion progressive et dont une ou plusieurs de ces poudres peut être inhibée en surface, et dans lesquelles les caractéristiques de combustion de ces différentes poudres sont adaptées les unes par rapport aux autres alors que la taille des grains et la quantité de chaque poudre comprise dans la charge sont adaptées les unes par rapport aux autres de sorte que l'espace vide qui existe nécessairement entre les grains de poudre est aussi faible que possible.

7. Charge de poudre propulsive selon la revendication 6, possédant un haut degré de densité de chargement et un contenu énergétique élevé, destinée à des armes lourdes à canon, **caractérisée en ce que** de 70 % à 95 % de son poids, de préférence de 75 % à 85 %, est constitué d'une poudre à grains plus grossiers, comme un poudre à 19 trous ou à 37 trous coupée en petites sections, et de 30 % à 5 % de son poids, de préférence de 25 % à 15 %, est constitué d'une poudre granuleuse à granulométrie inférieure, comme une poudre à 1 trou ou à 7 trous, ces deux poudres ayant une composition chimique identique ou différente, au moins l'une d'entre elles étant à combustion progressive, et l'une d'elles au moins pouvant être inhibée en surface.

REFERENCES CITED IN THE DESCRIPTION

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