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(54) Titre : COMPOSITION DESTINEE A UNE POUDRE PROPULSIVE A BASE UNIQUE DESTINEE A UNE MUNITION
ET MUNITION COMPRENANT UNE TELLE COMPOSITION
(54) Title: COMPOSITION FOR SINGLE-BASE PROPELLING POWDER FOR AMMUNITION AND AMMUNITION
PROVIDED WITH SUCH COMPOSITION

(57) **Abrégé/Abstract:**

The present invention relates to a composition for single-base propelling powder for ammunition consisting of nitrocellulose as an explosive base, an inert plasticizer component, at least one nitrocellulose stabilizer component, and optionally a flash-reducer component and traces of one or more solvents and water. The aforementioned inert plasticizing component is dibutyl sebacate (DBS). Preferably, the dibutyl sebacate is present with a content between 2% and 7% by weight.

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(54) Title: COMPOSITION FOR SINGLE-BASE PROPELLING POWDER FOR AMMUNITION AND AMMUNITION PROVIDED WITH SUCH COMPOSITION

(57) Abstract: The present invention relates to a composition for single-base propelling powder for ammunition consisting of nitro-cellulose as an explosive base, an inert plasticizer component, at least one nitrocellulose stabilizer component, and optionally a flash-reducer component and traces of one or more solvents and water. The aforementioned inert plasticizing component is dibutyl sebacate (DBS). Preferably, the dibutyl sebacate is present with a content between 2% and 7% by weight.



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DESCRIPTION

**"Composition for single-base propelling powder for
ammunition and ammunition provided with such composition"**

SCOPE

5 [0001] The present invention relates to a composition for
single-base propelling powder for ammunition and an
ammunition provided with such composition for propelling
powder.

[0002] In particular, the composition for propelling powder
10 according to the invention may be used in artillery
ammunition, particularly in ammunition with a caliber
comprised between 40mm and 155mm.

STATE OF THE ART

[0003] In general, an ammunition, both civil and military,
15 consists of the assembly of a projectile and a propelling
charge. In turn, the propelling charge consists of a so-
called propelling powder and an ignition system.

[0004] The main element of the propelling charge is the
propelling powder.

20 [0005] Propelling powders are classified according to the
number of active components that constitute them, that
is, in other words, the number of explosive bases.
"Active component" or "explosive base" is intended to
mean a compound capable of developing propulsion energy.

25 [0006] Depending on the number of explosive bases,

conventional propelling powders are divided into four types:

[0007] - single-base, wherein the active component (single or main) is nitrocellulose;

5 [0008] - double-base, wherein, in addition to nitrocellulose, as an active component there is also a nitroester, typically nitroglycerine;

[0009] - triple-base, wherein the active components are nitrocellulose, a nitroester and a nitroamine (for
10 example, nitroguanidine); and

[0010] - multi-base, wherein the active components are typically four: nitrocellulose, a nitroester and two nitroamines, generally nitroguanidine and cyclotrimethylentrinitroamine (RDX).

15 [0011] Generally, nitrocellulose with high nitrogen content (known as gun cotton) and nitrocellulose with a medium nitrogen content (known as collodion cotton), typically obtained from cotton flakes or from other plant forms, i.e. so-called arboreal nitrocellulose, are used in the
20 production of propelling powders.

[0012] In the compositions of propelling powders, in addition to the active components, other components are present with a specific function, listed below: - plasticizers, which enable the workability of the
25 nitrocellulose; - stabilizers, adapted to ensure the

safety and stability over time of the propelling powder. In some cases, flash-reducer components may also be included directly in the propelling powder, so as to reduce the so-called muzzle flash at the mouth of the
5 barrel of the weapon system.

[0013] The plasticizers used in single-base propelling powders are constituted by inert materials, while in the other families, the nitroester, in addition to acting as an active component, also acts as a nitrocellulose
10 plasticizer.

[0014] Currently, the plasticizers used in single-base propelling powders are dinitrotoluene (DNT) and dibutyl phthalate (DBP).

[0015] Dinitrotoluene (DNT), classified as a carcinogenic
15 compound, has been subjected, like all chemical compounds, to the screening of the European Chemicals Agency (ECHA) and has been banned in a mandatory way both in production and use from August 21, 2015, without possibility of derogation (Commission Regulation (EU) No.
20 125/2012).

[0016] Also, dibutyl phthalate (DBP) has been subjected to examinations and has been classified as harmful to fertility and the fetus (Commission Regulation (Eu) No. 143/2011 and the related Corrigenda). In this case,
25 however, the date established for the end of its use, or

February 21, 2015, has been postponed to February 21, 2027. The derogation is temporary and valid until the replacement/elimination of the DBP.

[0017] In the ammunition field, for reasons relating to
5 occupational safety and the environmental impact of the chemical substances used, it has been made necessary to launch research programs aimed at eliminating or replacing the two substances, dinitrotoluene (DNT) and dibutyl phthalate (DBP), from propelling powders, without
10 however affecting their workability and performance.

[0018] To date compositions of single-base propelling powder for ammunition that are devoid of dinitrotoluene (DNT) and dibutyl phthalate (DBP) and that at the same time guarantee workability and performance similar to
15 those of propelling powders containing these two substances are not known. "Workability" is intended to mean both the capacity of the composition to be subject to a gelatinization process by which the nitrocellulose mass coagulates into a gelatinous state (gel) without
20 separation of liquid, and the capacity of the materials used to mix themselves homogeneously and with stability over time. The performance is, however, tied to the energy of the final composition, represented, for the propelling powders, by the calorific value.

25 [0019] In addition to the composition, also the geometry

of the grains into which the propelling powder is formed, contributes to the ballistic performance. Generally speaking, a grain of propelling powder is defined by typical dimensions (variable from case to case): the
5 number of longitudinal through holes, the diameter of the holes, the outer diameter, and the length. It is essential for proper ballistic behavior that the holes are symmetrical and reproducible.

[0020] The obtainment of propelling powder grains having a
10 well-defined geometry is directly related to the workability of the composition. This confirms the importance of the workability of a propelling powder composition.

[0021] In the ammunition field, therefore, there is a
15 strong need for a composition for a single-base propelling powder for ammunition which is devoid of dinitrotoluene (DNT) and dibutyl phthalate (DBP), while at the same time has workability and performance similar to the propelling powders containing these two
20 substances.

PRESENTATION OF THE INVENTION

[0022] Therefore, the object of the present invention is to eliminate in whole or in part the drawbacks of the
aforementioned prior art by providing a composition for
25 single-base propelling powder for ammunition which is

devoid of dinitrotoluene (DNT) and dibutyl phthalate (DBP) and which at the same time ensures workability and performance comparable to conventional single-base propelling powders containing these two substances.

5 [0023] A further object of the present invention is to provide a composition for a single-base propelling powder for ammunition which is devoid of dinitrotoluene (DNT) and dibutyl phthalate (DBP) and which may be made with production costs comparable to conventional single-base
10 propelling powders containing these two substances.

[0024] The technical features of the invention are clearly apparent from the content of the claims provided below, and the advantages thereof will become more apparent in the detailed description that follows, in particular with
15 reference to one or more preferred and non-limiting embodiments.

DETAILED DESCRIPTION

[0025] The present invention relates to a composition for single-base propelling powder for ammunition and an
20 ammunition provided with such composition for propelling powder.

[0026] In particular, the composition for propelling powder according to the invention may be used in artillery ammunition, particularly in ammunition with a caliber
25 comprised between 40mm and 155mm.

[0027] According to a general embodiment of the invention, the composition for single-base propelling powder consists of:

[0028] - nitrocellulose as explosive base;

5 [0029] - an inert nitrocellulose plasticizer component;

[0030] - at least one nitrocellulose stabilizing component;
and

[0031] - optionally, at least one flash-reducer component.

[0032] The composition for propelling powder may optionally
10 also contain traces of one or more solvents and water.

[0033] According to the invention, the aforementioned inert plasticizing component is constituted by dibutyl sebacate (DBS). Dibutyl sebacate is present in the composition with a content comprised between 1% and 10% by weight
15 based on the total amount by weight of nitrocellulose, nitrocellulose stabilizing component, inert plasticizer component and, if present, flash-reducer component.

[0034] Here and in the rest of the description, the percentages (%) by weight of the single components
20 (included dibutyl sebacate as stated above) refer to the dry part of the composition, with 'dry part' meaning the composition's total components excluded any solvents and water. The content of any solvents and water is counted "out of a hundred", i.e. as the number of parts by weight
25 per 100 parts by weight of the total of all other

components (dry part of the composition).

[0035] It has been surprisingly found that in the compositions of single-base propelling powders, for the nitrocellulose plasticizer function, dibutyl sebacate, 5 with a content comprised between 1% and 10% by weight, may completely replace the conventional plasticizers used in single-base propelling powders, i.e. dinitrotoluene (DNT) and dibutyl phthalate (DBP), without compromising the workability of the composition, nor the final 10 performance or the stability of the propelling powder over time.

[0036] As already anticipated, "workability" is intended to mean both the ability of the composition to be subject to a gelatinization process, whereby the 15 nitrocellulose mass coagulates into a gelatinous state (gel) without separation of liquid and the capacity of the materials used to mix themselves homogeneously and with stability over time. The material thus obtained may be drawn/extruded and subsequently subjected to a cutting 20 process in order to give it a well-defined shape. The obtainment of propelling powder grains having a well-defined geometry (essential as mentioned above to ensure ballistic performance) is directly related to the workability of the composition. Generally speaking, as 25 already said previously, a grain of propelling powder is

defined by typical dimensions (variable from case to case): the number of longitudinal through holes, the diameter of the holes, the outer diameter, the length. It is essential for proper ballistic behavior that the holes
5 are symmetrical and reproducible. This can only be achieved if the propelling powder composition is workable in the sense specified above.

[0037] Moreover, the performance is tied to the energy of the final composition, represented, for the propelling
10 powders, by the calorific value.

[0038] As can be seen from the comparative examples in the description, the content by weight of dibutyl sebacate in the composition of propelling powder according to the present invention is not higher than the
15 content by weight of dinitrotoluene (DNT) and dibutyl phthalate (DBP) present in conventional single-base propelling powders. This means that replacement of these two compounds with dibutyl sebacate (according to the present invention) does not require a reduction in
20 nitrocellulose content by weight in the composition and, consequently, a lowering of its calorific value (i.e., ultimately, its performance) with respect to conventional propelling powders.

[0039] International safety regulations do not
25 indicate specific use restrictions for dibutyl sebacate

in terms of safety for health. In particular, dibutyl sebacate is neither classified as a carcinogenic compound nor as a compound that is harmful to fertility and the fetus.

5 [0040] In the light of what is shown above, dibutyl sebacate is thus a compound particularly suitable for the complete replacement of dinitrotoluene (DNT) and dibutyl phthalate (DBP) as an inert plasticizer in single-base propelling powders.

10 [0041] In particular, it was established that, with a content of less than 1% by weight, the plasticizing action of dibutyl sebacate is not sufficient to ensure the workability of the propelling powder during the production phase, since it resulted to be excessively
15 viscous. With a content of more than 10% by weight, the plasticizing action of dibutyl sebacate is still effective, although the calorific value is negatively affected, thus affecting the energy performance of the propelling powder. Additionally, for percentages of DBS
20 higher than 10% by weight, swelling phenomena may occur after extrusion.

[0042] Preferably, the dibutyl sebacate is present in the composition with a content comprised between 2% and 7% by weight. Even more preferably, the dibutyl sebacate
25 is present in the composition with a weight content

between 3% and 5%. The different percentages of plasticizer affect the plasticity of the mixture during extrusion. It has been found that the preferred ranges indicated above allow to obtain more easily a correct
5 extrusion of the composition and the subsequent size of the extrusion in grains of propelling powder, without causing deformation phenomena of the extrusion neither at the output of the extruder, nor after the cutting phase.

[0043] As already highlighted above, the composition
10 for propelling powder according to the invention is single base, wherein the explosive base (or single active component) is constituted by **nitrocellulose**.

[0044] Preferably, nitrocellulose is selected from among nitrocelluloses with high nitrogen content (known
15 as gun cotton) and nitrocelluloses with a medium nitrogen content (known as collodion cotton), typically obtained from cotton flakes or from other plant forms, i.e., so-called arboreal nitrocellulose.

[0045] Preferably, nitrocellulose is present with a
20 content by weight comprised between 82.5% and 98%. Even more preferably, nitrocellulose is present with a content by weight comprised between 89% and 94.5%. The energy, i.e. the calorific value, of the propelling powder is directly linked to nitrocellulose content, in addition to
25 the nitrogen content thereof.

[0046] As already noted above, the composition includes at least one nitrocellulose **stabilizing component**.

[0047] Advantageously, the aforementioned
5 nitrocellulose stabilizer is selected from the group consisting of nitramines, nitrosamines, ureas, derivatives of such compounds or mixtures thereof.

[0048] Preferably, among the nitramines, the aforementioned nitrocellulose stabilizer may be selected from
10 diphenylamine and n-nitrosodiphenylamine, while from their derivatives it may be selected from 2-nitrodiphenylamine, 4-nitrodiphenylamine, N-nitroso-2-nitrodiphenylamine, N-nitroso-4-nitrodiphenylamine, 2,2'-dinitrodiphenylamine, 2,4-dinitrodiphenylamine, 2,4'-
15 dinitrodiphenylamine, 4,4'-dinitrodiphenylamine, N-nitroso-2,4'-dinitrodiphenylamine, N-nitroso-4,4'-dinitrodiphenylamine, N-nitroso-2-nitrodiphenylamine, 2,2'-dinitrodiphenylamine, 2,4-dinitrodiphenylamine, 2,4'-dinitrodiphenylamine, N-nitroso-4-
20 nitrodiphenylamine, 2,4-dinitrodiphenylamine, 2,4'-dinitrodiphenylamine, 4,4'-dinitrodiphenylamine.

[0049] Preferably, among the nitrosamines the aforementioned nitrocellulose stabilizer may be selected from dimethylnitrosamine and n,n-diethylnitrosamine,

25 [0050] Preferably, among the ureas the aforementioned

nitrocellulose stabilizer may be selected from ethyl-centralite (1,3-diethyl-1,3-diphenylurea) and acardite (Type I: 1,1-diphenylurea; Type II: 1-methyl -3,3-diphenylurea), while among their derivatives it may
5 selected from 2-nitroethylcentralite, 4-nitroethylcentralite, 2,2'-dinitroethylcentralite, 2,4-dinitroethylcentralite, 2,4'- dinitroethylcentralite, 4,4'-dinitroethylcentralite, N-nitroso-N-ethylaniline, 2-nitro-N-ethylaniline, 4-nitro-N-ethylaniline, 4-nitro-N-
10 nitroso-N-ethylaniline, 2,4-dinitro-N-ethylaniline.

[0051] Preferably, the aforementioned at least one stabilizing component of nitrocellulose is constituted by ethyl centralite (1,3-diethyl-1,3-diphenylurea).

According to a particularly preferred embodiment of the
15 invention, the composition includes a single nitrocellulose stabilizing component, constituted by ethyl centralite (1,3-diethyl-1,3-diphenylurea).

[0052] It has been verified experimentally that ethyl centralite (1,3-diethyl-1,3-diphenylurea / EC), in
20 addition to the stabilizing effect, also provides a plasticizing effect, actively contributing to the workability of the final mixture. In this way, it is possible to reduce the content of dibutyl sebacate (DBS) by weight, enabling the content of this component in the
25 composition to be more easily brought to the preferred

range of 2%-7%, or the particularly preferred range of 3%-5%.

[0053] Preferably, said nitrocellulose stabilizing component is present with a content comprised between 1% and 5% by weight. Even more preferably, said stabilizing component is present with a content between 2.5% and 3.5% by weight. In the above weight percentages, it is possible to incorporate the stabilizer into the final composition in the proper amount so as to guarantee the desired stability of the final product over time.

[0054] Advantageously, the composition may optionally include at least one **flash-reducer component**. Preferably, if provided, the aforementioned at least one flash-reducer component is present with a content by weight comprised between 0.5% and 2.5%.

[0055] According to a preferred embodiment of the invention, the aforementioned at least one flash-reducer component is composed of potassium sulfate (K_2SO_4).

[0056] According to a preferred embodiment of the invention, the composition for single-base propelling powder has the following formulation:

[0057] - nitrocellulose: 82.5% - 98% by weight;

[0058] - dibutyl sebacate (DBS): 1% - 10% by weight;

[0059] - stabilizing component (preferably ethyl centralite): 1% - 5% by weight;

[0060] - flash-reducer component: 0% to 2.5% by weight.

[0061] According to a particularly preferred embodiment of the invention, the composition for single-
5 base propelling powder has the following formulation:

[0062] - nitrocellulose: 89% - 94.5% by weight;

[0063] - dibutyl sebacate (DBS): 3% - 5% by weight;

[0064] - stabilizing component (preferably ethyl centralite): 2,5% - 3,5% by weight;

10 [0065] - flash-reducer component: 0% - 2.5% by weight.

[0066] As already anticipated, the composition for propelling powder may optionally also contain traces of one or more solvents and water. The content of any solvents and water is calculated as content in addition
15 to the dry part of the composition, in terms of the number of parts solvent per 100 parts of the total of other components of the composition. In particular, the total content of solvents (including water) may reach up to 1.5 parts by weight per 100 parts of the dry part of
20 the composition (nitrocellulose, plasticizer, stabilizer and, if present, flash-reducer).

EXAMPLES OF COMPOSITION ACCORDING TO THE INVENTION

[0067] Compositions of propelling powders have been produced for different types of ammunition.

25 [0068] In particular, the compositions of single-base

propelling powder produced according to the invention are shown below for four different artillery ammunitions of which the caliber is reported.

[0069] For some examples of composition, a comparative
 5 example of a conventional composition of single-base propelling powder used for the same ammunition is provided.

EXAMPLE 1

[0070] A first example (example 1) relates to a
 10 composition of single-base propelling powder for 40mm L70 caliber ammunition. Composition values are provided in Table 1.

Component	% by weight	Possible variant % by weight
Nitrocellulose	91.2	± 2.0
dibutyl sebacate	5.0	± 1.2
ethyl centralite	3.2	± 1.0
K ₂ SO ₄	0.6	± 0.2

Table 1 - Example 1

[0071] The following table 2 shows the data relating
 15 to a conventional composition of single-base propelling powder used for the same ammunition.

Component	% by weight	Possible variant % by weight
Nitrocellulose	83.3	± 2.0
Dinitrotoluene	9.8	± 2.0
Dibutyl phthalate	4.9	± 1.0
Diphenylamine	1.0	+ 0.2 / -0.1
K ₂ SO ₄	1.0	± 0.3

Table 2 - Comparative example propelling powder M1

[0072] The composition of propelling powder according to the invention was produced using the same production line and the same production parameters as the conventional one (M1) without any alteration of the finished product. The composition according to the invention thus has a workability similar to the conventional one.

[0073] The calorific value of the composition according to the invention was found to be in line with the reference (M1), as well as the ballistic characteristics, in particular the velocity at the mouth and the pressure developed in the weapon by the ammunition of which the propulsion system provides for the use of the new propelling powder.

[0074] The composition of the propelling powder

according to the invention has been subjected to chemical-physical and ballistic characterization with complete success. This has confirmed that the composition of the propelling powder according to the invention
5 ensures performance similar to the conventional one.

EXAMPLE 2

[0075] A second example (example 2) relates to a composition of single-base propelling powder for 155mm caliber ammunition, in particular for bottom propelling
10 charges. Composition values are provided in Table 3.

Component	% by weight	Possible variant % by weight
Nitrocellulose	93.3	± 2.0
dibutyl sebacate	3.0	± 1.0
ethyl centralite	3.1	± 1.0
K ₂ SO ₄	0.6	± 0.2

Table 3 - Example 2

[0076] The composition of the propelling powder according to the invention was subjected to chemical-physical and ballistic characterization with complete success. This
15 has confirmed that the composition according to the invention has adequate workability and ensures adequate performance.

EXAMPLE 3

[0077] A third example (example 3) relates to a composition of single-base propelling powder for 100mm caliber ammunition. Composition values are provided in Table 4.

5

Component	% by weight	Possible variant % by weight
Nitrocellulose	91.0	± 2.0
dibutyl sebacate	4.9	± 1.2
ethyl centralite	3.0	± 0.8
K ₂ SO ₄	1.1	± 0.2

Table 4 - Example 3

[0078] Also in this case, the composition of the propelling powder according to the invention has been subjected to chemical-physical and ballistic
10 characterization with complete success. This has confirmed that the composition according to the invention has adequate workability and ensures adequate performance.

EXAMPLE 4

15 [0079] A fourth example (example 4) relates to a composition of single-base propelling powder for 76mm L62 caliber ammunition. Composition values are provided in Table 5.

Component	% by weight	Possible variant % by weight
Nitrocellulose	92.0	± 2.0
dibutyl sebacate	3.0	± 1.0
ethyl centralite	2.8	± 0.8
K ₂ SO ₄	2.2	± 0.4

Table 5 - Example 4

[0080] The following table 6 shows the data relating to a conventional composition of single-base propelling powder used for the same ammunition.

Component	% by weight	Possible variant % by weight
Nitrocellulose	85.3	± 2.0
Dinitrotoluene	9.8	± 2.0
Dibutyl phthalate	2.9	± 1.0
Diphenylamine	1.0	+ 0.2 / -0.1
K ₂ SO ₄	1.0	± 0.3

Table 6 - Comparative example propelling powder M6

[0081] The composition of propelling powder according to the invention was produced using the same production line and the same production parameters as the conventional (M6) one without any alteration to the

finished product. The composition according to the invention thus has a workability similar to the conventional one.

[0082] The calorific value of the composition according to the invention, as well as the ballistic characteristics, was found to be in line with the reference (M6) in particular the velocity at the mouth and the pressure developed in the weapon by the ammunition, the propulsion system of which provides for the use of propelling powder according to the invention.

[0083] The composition of the propelling powder according to the invention has been subjected to chemical-physical and ballistic characterization with complete success. This has confirmed that the composition of the propelling powder according to the invention ensures similar performance to the conventional one.

EXAMPLE 5

[0084] A fifth example (example 5) relates to a composition of single-base propelling powder for 155mm caliber ammunition, produced according to the invention. In this example, the composition is devoid of a flash-reducer component. Composition values are provided in Table 7.

Component	% by weight	Possible variant % by weight
Nitrocellulose	91.8	± 2.0
dibutyl sebacate	5.0	± 1.2
ethyl centralite	3.2	± 1.0

Table 7 - Example 5

[0085] The following table 8 shows the data for a conventional composition of single-base propelling powder used for the same ammunition.

Component	% by weight	Possible variant % by weight
Nitrocellulose	85.0	± 2.0
Dinitrotoluene	9.0	± 1.0
Dibutyl phthalate	5.0	± 1.0
Diphenylamine	1.0	+ 0.2 / -0.1

5 Table 8 - Compar. ex. propelling powder for 155mm cal.

[0086] The composition of propelling powder according to the invention was produced using the same production line and the same production parameters as the conventional one without any alteration of the finished
10 product. The composition according to the invention thus has a workability similar to the conventional one.

[0087] The calorific value of the composition according to the invention, as well as the ballistic characteristics, was found to be in line with the reference, in particular the velocity at the mouth and
5 the pressure developed in the weapon by the ammunition, the propulsion system of which provides for the use of the new propelling powder.

[0088] The composition of the propelling powder according to the invention was subjected to chemical-physical and
10 ballistic characterization with complete success. This has confirmed that the composition of the propelling powder according to the invention ensures similar performance to the conventional one.

* * *

15 [0089] Advantageously, the composition of single-base propelling powder for ammunition according to the invention is obtainable by the same production processes used to produce conventional compositions of single-base propelling powder.

20 [0090] In particular, a production process with solvents or without solvents may be used.

[0091] In particular, the specific compositions of propelling powder of the examples 1 to 5 above and their comparative examples were produced following a production
25 process with solvents.

[0092] More in detail, such propelling powders were produced according to the following production scheme (which should be understood as a purely non-limiting example):

5 [0093] - Step 1: dehydration of nitrocellulose;

[0094] - Step 2: mixing nitrocellulose with the other components of the composition;

[0095] - Step 3: extrusion;

[0096] - Step 4: solvent removal;

10 [0097] - Step 5: drying;

[0098] - Step 6: homogenization.

[0099] Dehydration is necessary to make the nitrocellulose (NC) usable. In fact, in order to be transported, the NC has a water content of approximately
15 30%. In order for the mixing phase to be carried out efficiently, only the solvents capable of gelatinizing the NC must be present. In particular, for single-base powders, the gelatinization of NC takes place using ethyl ether and ethanol, in the ratio 65/35. Gelatinization is
20 a process through which a partial solubilization of the nitrocellulose occurs, through which a macromolecular superstructure is generated that, when the evaporation is completed, leads to the final structure of the grain of the propelling powder.

25 [00100] The mixing of the nitrocellulose with the other

components of the composition (step 1) was carried out in the presence of solvents (in particular water, alcohol and ether) so as to allow the gelatinization of the component mixture and consequently allow its workability.

5 Gelatinization is an exothermic phenomenon, so it is necessary to control the temperature inside the mixer with a water chilling system.

[00101] The extrusion step (step 3) occurs using certain molds according to the application, i.e., the
10 type of ammunition to which the propelling powder is destined. The die speed is able to influence the final structure of the grain of powder. The cutting speed must be correctly adjusted to obtain grains of powder with the desired length. The design of the mold for the die is
15 very important, it must take into account the correct feeding, the stresses transmitted to the mold, and the shrinkage of the propelling powder after drying. At this stage, the action of the plasticizer (DBS) is decisive, which makes it possible to extrude through the die
20 bushings the propelling mixture, so that the final grain maintains the geometric characteristics established in the design phase, to which is associated the ballistic performance in subsequent use.

[00102] The homogenization stage (stage 6)

25 [00103] Stages 4 and 5 relate to the reduction in the

finished product of the content of all volatile substances used during the various stages of production. This has a dual object: to preserve the ballistic features of the final product and to make the product
5 safer after the packaging phase.

[00104] If the composition of the propelling powder according to the invention is produced by a production process with solvents, it may contain traces of solvents and water used in the production process. The total
10 content of solvents, i.e. solvents and water used in the production process, is such that it does not disturb chemical and performance stability over time. In particular, the total content of solvents (including water) may reach up to 1.5 parts by weight per 100 parts
15 of the totality of the other components of the composition (nitrocellulose, plasticizer, stabilizer and, if present, flash-reducer).

[00105] The homogenization stage (stage 6) allows a batch of powder starting from a production batch. At this
20 stage, the powder grains are mixed to ensure the homogeneity of the powder batch and are packed in suitable containers.

[00106] In particular, the composition of the propelling powder according to the invention is in the
25 form of extruded grains having a prevalent longitudinal

direction of development. Preferably, such grains are provided with a plurality of longitudinal through holes.

* * *

[00107] An object of the present invention is also an
5 ammunition characterized by the fact that it is provided with a propelling powder having a composition according to the present invention and in particular as described previously.

[00108] Advantageously, the aforementioned ammunition
10 has a caliber between 40 mm and 155 mm. Preferably, the ammunition has a caliber of 40 mm, 76 mm, 100 mm or 155 mm.

* * *

[00109] The invention provides many advantages already
15 described in part.

[00110] The composition for a single-base propelling powder for ammunition according to the invention is devoid of dinitrotoluene (DNT) and dibutyl phthalate (DBP), and at the same time ensures workability and
20 performance similar to conventional single-base propelling powders containing these two substances.

[00111] The composition for single-base propelling powder for ammunition is devoid of dinitrotoluene (DNT) and dibutyl phthalate (DBP) and may be achieved by
25 processes similar to those used to obtain conventional

single-base propelling powders. Production costs are therefore comparable to conventional single-base propelling powders containing dinitrotoluene (DNT) and dibutyl phthalate (DBP).

5 [00112] The invention thus conceived therefore achieves the foregoing purposes.

[00113] Obviously, in its practical implementation, it may also take forms and configurations other than those described above without, for this reason, departing from
10 the present scope of protection.

[00114] In addition, all details may be replaced by technically equivalent elements and the dimensions, shapes and materials used may be of any kind according to the need.

Claims

1. Composition for single-base propelling powder for ammunition, constituted by nitrocellulose as explosive base, an inert plasticizing component, at least one
5 nitrocellulose stabilizing component and, optionally, a flash-reducer component and traces of one or more solvents and water, **characterized in that** said inert plasticizing component is constituted by dibutyl sebacate (DBS), wherein the dibutyl sebacate is present with a
10 content comprised between 1% and 10% by weight.

2. Composition according to claim 1, wherein the dibutyl sebacate is present with a content comprised between 2% and 7% by weight.

3. Composition according to claim 2, wherein the dibutyl
15 sebacate is present with a content comprised between 3% and 5% by weight.

4. Composition according to one or more of the preceding claims, wherein said at least one nitrocellulose stabilizing component is selected from the group
20 consisting of nitramines, nitrosamines, ureas, derivatives of said compounds or mixtures thereof.

5. Composition according to one or more of the preceding claims, wherein said at least one stabilizing component of nitrocellulose is constituted by 1,3-diethyl-1,3-
25 diphenylurea.

6. Composition according to one or more of the preceding claims, wherein said nitrocellulose stabilizing component is present with a content comprised between 1% and 5% by weight.

5 7. Composition according to claim 6, wherein said nitrocellulose stabilizing component is present with a content comprised between 2.5% and 3.5% by weight.

8. Composition according to one or more of the preceding claims, wherein the nitrocellulose is present with a
10 content comprised between 82.5% and 98% by weight.

9. Composition according to claim 9, wherein the nitrocellulose is present with a content comprised between 89% and 94.5% by weight.

10. Composition according to one or more of the preceding
15 claims, wherein said at least one flash-reducer component is present with a content comprised between 0.5% and 2.5% by weight.

11. Composition according to claim 10, wherein said at least one flash-reducer component is constituted by
20 potassium sulfate.

12. Ammunition characterized in that it is provided with a propelling powder having a composition according to one or more of the preceding claims.

13. Ammunition according to claim 12, having a caliber
25 between 40 mm and 155 mm, preferably a caliber of 40 mm,

76 mm, 100 mm or 155 mm.