

Propellant Charge Case for Cartridge Ammunition

The invention relates to a propellant charge case for cartridge ammunition, comprising a cartridge casing
5 with a high pressure chamber for accommodating a propellant charge and a low pressure chamber that communicates with the high pressure chamber when the propellant charge is ignited.

10 Cartridge ammunition is known from WO 2012/126554 A1 that comprises a propellant charge case of the described type. The propellant charge case comprises a high pressure chamber containing a pyrotechnic
15 propellant charge. The high pressure chamber is followed by a low pressure chamber in the direction of the base of the projectile, the low pressure chamber communicating via overflow openings with the high pressure chamber. Furthermore, the propellant charge
20 case, which usually consists of aluminium, comprises a pressure plate in which a percussion cap is provided in a suitable seating.

With such a two-stage construction propellant charge there is the problem that the munition explodes if it
25 is exposed to a fire or other high temperatures above the ignition temperature of the propellant charge. For this purpose it is known to provide a safety mechanism that enables controlled ventilation in order to enable a pressure reduction in the event of thermally
30 initiated combustion of the propellant charge. A munition of this type is known as an insensitive munition.

In the case of the insensitive munition known from WO
35 2012/126554 A1 with a two-stage construction propellant charge case described therein with a high pressure chamber and a low pressure chamber, a fusible securing

ring is provided as a safety mechanism, by means of which a pressure plate, in which the percussion cap is accommodated, is fixed to the base of the case in the assembly position. An annular duct leading outwards is provided between the pressure plate and the base of the case. If there is a suitable thermal load, e.g. as a result of a fire or similar, then the securing ring melts, its melting temperature being below the ignition temperature of the ignition charge of the percussion cap or rather of the propellant charge. The molten material is intended to flow out through the annular duct, so that the pressure plate is released and loses the mechanical hold on the propellant charge case. Even if another thermal load now occurs and the propellant charge burns, an explosion does not occur because in the event of combustion a pressure reduction is possible as a result of the pressure plate falling from the propellant charge case and the resulting larger opening in the base of the case.

The safety function is thus based here on melting of the securing ring. For a suitable mechanical decoupling of the pressure plate it is necessary that the securing ring is ultimately completely melted. This may not always be possible depending on the temperature response or rather the temperature distribution. Moreover, blockages within the narrow annular channel can occur, so that sometimes a discharge of the molten material is not guaranteed or rather jamming can occur.

The invention is therefore based on the problem of specifying a propellant charge case that allows a thermally induced opening in a functionally reliable manner to allow ventilation.

In order to solve said problem, according to the invention a propellant charge for cartridge ammunition

is provided comprising a cartridge casing with a high pressure chamber for accommodating a propellant charge and a low pressure chamber that communicates with the high pressure chamber when the propellant charge is
5 ignited, as well as a pressure plate for accommodating a percussion cap, wherein the pressure plate is releasably disposed on the cartridge casing or a supporting plate by means of a thermally operated securing element, and wherein one or more retaining
10 elements that fix the pressure plate axially are provided, which can be or are radially displaced from their fixing position in the event of the thermally activated operation of the securing element.

15 In the case of the propellant charge case according to the invention, one or more radially displaceable retaining elements are provided that axially fix the pressure plate on a supporting plate, which is fixed on the base of the case of the cartridge casing in a
20 suitable manner, or on the base of the case itself. The retaining element(s) is or are coupled in a suitable manner to the securing element. The securing element is thermally activated as described, and is thus capable of enabling radial mobility of the securing element(s)
25 from its or their fixing position in the event of a temperature increase that occurs in some way. This means that the axial fixing of the pressure plate is actively mechanically released, ensuring that in this case the pressure plate is also actually released and
30 the ventilation can take place.

In this case, in the event of thermal activation the securing element can change its physical state, i.e. it can melt. However, in the case of activation it can
35 also change its shape, i.e. it can consist of a memory material, which changes from a first shape to a second shape on reaching a transition temperature. Regardless

of how the actual activation takes place, it is ensured in any case that the securing element(s) is or are either directly radially displaced as a result of said thermal activation, or if it or they is or are no longer radially fixed so that it or they can be displaced radially and basically the axial fixing of the pressure plate is released.

The securing element is preferably implemented as a circumferential securing ring in this case, i.e. e.g. either as a circumferential fusible ring or as a circumferential memory metal ring.

In order to enable suitable axial fixing, a circumferential collar or a circumferential groove is preferably provided on the pressure plate, under which or in which the retaining element(s) engage(s) in the fixing position. If as a result the retaining element(s) engage(s) under the collar or in the groove in the radially inner position, a secure fixing of the pressure plate is achieved.

The safety mechanism according to the invention can be configured in different ways, ultimately regardless of whether the securing element or rather the securing ring changes its physical state or its shape.

According to a first invention alternative, the retaining element(s) can be displaceably coupled to the securing element that changes shape, i.e. to the securing ring for example, such that the retaining element(s) is or are radially displaced from the fixing position in the event of a change of shape of the securing element(s). Preferably, for this purpose suitable groove-shaped seatings in which the securing element is accommodated are provided on the retaining

element(s). If e.g. three retaining elements are provided, which expand to a ring in the securing position, thereby therefore extending circumferentially by approx. 120°, and which engage under the collar or rather in the groove, then a suitably groove-shaped seating is provided on each of said retaining elements, through which the securing element, i.e. in this case the securing ring, runs or in which it is accommodated. If a thermally activated change of shape now occurs, in this case an increase in the diameter of the securing ring, then the same inevitably carries the retaining elements with it, i.e. they are displaced radially outwards, thus releasing the mechanical axial locking.

In the case of the described embodiment of the invention, the retaining elements and the securing element are individual elements that are joined to each other. Alternatively, the retaining element(s) can even be formed in one piece on the securing element that changes its shape. This means that the securing element, especially in this case the memory metal securing ring again, has a suitable cross-sectional geometry by default and is dimensioned such that when in its first shape, which it adopts below the transition or change of shape temperature, it engages under the collar or rather in the groove with suitable, radially inner segments forming the retaining element(s). In the case of thermal activation there is inevitably an expansion of the securing ring, so that the engagement under the collar or rather in the groove and hence the axial fixing is released. In the simplest case, the securing ring can be rectangular when viewed in cross-section, the radially inner circumferential edge then forms the annular retaining element in this case, which engages under the collar on the pressure plate side.

If separate retaining elements are used, but also in the case of retaining elements that are formed in one piece, it is conceivable to form an inclined surface on the retaining element(s) on the side facing the pressure plate, wherein the pressure plate comprises a complementary inclined surface. In the securing position the corresponding inclined surfaces are in contact with each other. In the event of thermal activation, in this case a somewhat easier radial displacement is possible than in the case of axially abutting surfaces between retaining elements and pressure plate.

If a securing element is used that changes its physical state, i.e. that melts in the event of its thermal activation, then according to a relevant invention alternative the securing element, again preferably in the form of a securing ring, is disposed radially outwards relative to the retaining element(s), wherein the retaining element(s) and the pressure plate comprise mutually complementary inclined surfaces that abut one another. The securing element or rather the securing ring grips around the retaining elements, which again are e.g. implemented in the form of three or four ring segments, which expand to form a circumferential ring in the assembly position. In the event of the thermal activation the securing ring now melts. This releases the radial fixing of the retaining elements, but they are not actively displaced radially outwards, in contrast to the case of the previously described embodiment with the memory metal securing ring. In order to enable safe opening of the propellant charge case, or rather removal of the pressure plate, in the case in which there is thermally induced combustion of the propellant charge, suitable complementary inclined surfaces, i.e. a conical surface

arrangement, are provided on the retaining elements and the pressure plate, by means of which they abut one another. As a result of the pressure that builds up in the interior of the high pressure chamber, which acts
5 on the pressure plate, the same is forced axially outwards. As a result of the complementary inclined surfaces there is inevitably an outward radial displacement of the retaining elements, so that the pressure plate is released and drops, opening the
10 propellant charge case.

Instead of a fusible securing element or securing ring, it would also be conceivable to provide a securing element that changes its shape or such a securing ring
15 that radially envelops and thus fixes the retaining elements. If it heats up above its transformation temperature then it expands and releases the retaining elements radially. In the case of combustion of the propellant charge, the retaining elements would be
20 forced outwards as a result of the mutually sliding inclined surfaces provided on the pressure plate and the retaining elements, the pressure plate being forced out of the supporting plate or the base of the case so that an open discharge cross-section results.

25 In order to be able to integrate the safety mechanism within the case in a simple manner, a threaded ring bolted onto the cartridge casing or the supporting plate is advantageously provided, the threaded ring
30 fixing the securing element axially, but wherein at the same time the retaining element(s) is or are also suitably axially fixed by this means.

Besides the propellant charge case itself, the
35 invention further relates to cartridge ammunition comprising a propellant charge case of the described type.

Further advantages, features and details of the invention are indicated in the exemplary embodiments
5 described below and using the figures. In the figures:

Fig. 1 shows a sectional view through cartridge ammunition according to the invention,

10 Fig. 2 shows an enlarged partial view of a propellant charge case according to the invention showing a ventilation unit of a first embodiment,

Fig. 3 shows the ventilation unit of Fig. 2 in the
15 opened state,

Fig. 4 shows a partial view of a propellant charge case according to the invention while
showing a ventilation unit of a second
20 embodiment,

Fig. 5 shows a bottom view of the arrangement of Fig. 4,

25 Fig. 6 shows the ventilation unit of Fig. 4 in the open state,

Fig. 7 shows a bottom view of the arrangement of Fig. 6,
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Fig. 8 shows a partial view of a propellant charge case according to the invention with a ventilation unit of a third embodiment, and

35 Fig. 9 shows the ventilation unit of Fig. 6 in the open state.

Fig. 1 shows a sectional view through cartridge ammunition 1 according to the invention, e.g. through a 40 mm cartridge. The cartridge ammunition 1 consists of a propellant charge case 2 according to the invention with a cartridge casing 3, which is joined to the actual projectile 4 in the region of the base of the projectile 5. A propellant charge unit 6 comprising a high pressure chamber 7, in which a propellant charge that is not shown in detail here is accommodated, is provided on the cartridge casing 3. Said high pressure chamber 7 is defined or rather delimited by means of an insert 8, which is terminated at the bottom by means of a plate assembly 9 comprising a ventilation unit 10.

The high pressure chamber 7 communicates by means of bores 11 with a low pressure chamber 12 bounded by the bottom of the projectile 5. The basic design of such a two-stage propellant charge unit 6 is well known.

Essential to the invention is the design of the propellant charge case 2 in respect of the configuration of the plate unit 9 or rather the ventilation unit 10. Said ventilation unit 10 enables the propellant charge case 2 or rather the high pressure chamber 7 to open, the opening being caused by thermal inducement, thus providing a ventilation capability if there is a risk of combustion of the propellant charge in the high pressure chamber 7 because of the prevailing ambient temperature. For this purpose different embodiments of the plate assembly 9 or rather of the ventilation unit 10 are provided, which are shown in detail in Figures 2 to 9.

Fig. 2 shows a first embodiment of a plate assembly 9 that terminates the high pressure chamber 7 and ultimately forms the base of the cartridge casing 3.

The plate assembly 9 comprises a supporting plate 13 having an external thread 14 with which it, see Fig. 1, is screwed into an internal thread 15 of the insert 8, which for its part is screwed into the cartridge casing by means of a threaded joint 16. The supporting plate 13 is made of metal. A metallic pressure plate 17 is disposed centrally in the circular supporting plate 13, being accommodated in a corresponding seating 18 of the supporting plate 13 and basically being axially displaceable relative to the pressure plate 13, i.e. along the longitudinal axis of the cartridge ammunition 1 or rather of the propellant charge case 2. The pressure plate 17 comprises a seating 19 for a percussion cap 20, by means of which the defined ignition takes place for a defined firing of the projectile 4. By means of a bore 21 the percussion cap 20 communicates with the high pressure chamber 7 and thus with the propellant charge, which is also ignited when the percussion cap is ignited.

Sometimes it can occur that e.g. in the event of a fire the cartridge ammunition 1 is exposed to a temperature that is close to or above the ignition temperature of the percussion cap 20 or rather of the propellant charge. Without safety precautions there could then be an uncontrolled ignition and thus an explosion. In order to avoid this, a ventilation unit 10 is provided, part of which is finally the supporting plate 13 and the pressure plate 17. This is because as described the pressure plate 17 is basically axially displaceable relative to the supporting plate 13. In the base position the pressure plate 17 is axially secured by means of a securing element 22, in this case a securing ring 23. Said securing ring 23 is fixed by means of a threaded ring 24 that is screwed into the supporting plate 13 by means of a threaded joint 33, therefore it

cannot drop out axially. The securing ring 23 is a metal ring consisting of a memory metal. Said securing ring can adopt two different shapes depending on temperature, namely a first shape of smaller diameter on the one hand, as shown in Fig. 2, and a larger diameter second shape, as shown in Fig. 3. If the temperature to which the securing ring 23 is exposed rises above a defined conversion temperature, then a change of shape takes place as a result of a structural change of the memory metal or shape memory metal, which means that the securing ring 23 changes from the first shape with the smaller diameter into the second shape having the larger diameter. In the initial position according to Fig. 2 the securing ring 23 engages under an annular collar 25 of the pressure plate 17. The securing ring 23 comprises an inner edge forming a circumferential annular retaining element 26, with which it engages under the annular safety collar 25. Because of said engagement by means of said retaining element annular edge 26 and the fact that the securing ring 23 is axially fixed by means of the threaded ring 24, the pressure plate 17 is consequently also fixed.

If there is now a thermal load and the temperature of the securing ring 23 rises above the conversion temperature, then the securing ring changes its shape, see Fig. 3, that is it expands. In this case it happens that the annular edge 26 of the retaining element no longer engages under the annular collar 25 of the pressure plate 17. Indeed, the securing ring 23 is still fixed because of being fixed by means of the threaded ring 24 despite its radial expansion (which is possible once there is a little more radial space in the supporting plate 13 into which it can expand its diameter), but as a result of said radial expansion there is no longer axial fixing of the pressure plate 17.

If in the case of a fire the temperature also rises above the ignition temperature of the propellant charge and the charge burns, then the pressure plate 17 is
5 pushed out axially by the pressure that builds up in the high pressure chamber 7 in this case, i.e. it exits from its seat in the supporting plate 13. This inevitably results in opening of the high pressure chamber 7 and a large free discharge cross-section
10 forms, by means of which the pressure can escape. The connection between the propellant charge case 2 and the projectile 1 is maintained in this case, and the insert 8 or rather a rupture disk in the high pressure chamber 7 remains undamaged.

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A second embodiment of a propellant charge case or rather of a plate assembly 9 with a ventilation unit 10 according to the invention is shown in Figures 4 to 7.
20 Figures 5 and 7 show bottom views of the arrangements of Figures 4 and 6 respectively, wherein the threaded ring 24 is not shown in Figures 5 and 7 respectively for reasons of clarity.

25 The construction of said plate assembly 9, consisting of a supporting plate 13 and a pressure plate 17 as well as their arrangement in a suitable receptacle on the supporting plate etc., corresponds in this respect to that described for Figures 2 and 3. In the case of
30 said embodiment of the invention, however, for axial fixing of the pressure plate 17 in the supporting plate 13 a plurality of retaining elements 27, e.g. four, are provided that expand to an annular form (see the bottom view in Fig. 5), i.e. forming annular segments, which
35 again engage under an annular collar 25 of the pressure plate 17 in the base position, see Fig. 4. The retaining elements 27 are again axially fixed by means

of a threaded ring 24, which is screwed into the supporting plate 13 by means of a suitable threaded joint 33.

5 In order to bring the retaining elements 27 in a defined and thermally induced manner from the base position shown in Fig. 4, in which the pressure plate 17 is axially fixed, into a released position, as shown in Fig. 6, a securing element 22 in the form of a
10 securing ring 23 that is made of a memory metal or a shape memory alloy is again provided. Said securing ring 23 is inserted into circumferential grooves 28 formed on the retaining elements 27. It is also axially fixed by means of the threaded ring 24.

15 If heating to above the conversion temperature of the securing ring 23 now occurs, the same expands again in terms of its diameter. During this it carries the retaining elements 27 with it, see Figures 6 and 7, the
20 retaining elements 27 being displaced radially outwards and no longer engaging under the annular collar 25 of the pressure plate 17 in the end position shown in Fig. 6. The pressure plate 17 is consequently axially released in said position and is no longer fixed. If a
25 further temperature increase now occurs, which results in ignition or rather combustion of the propellant charge, then a pressure again builds up in the high pressure chamber 7, which in turn, however, causes the pressure plate 17 to be forced out of the supporting
30 plate 13, so that a large open discharge cross-section results, by means of which the charging pressure blows off.

Figures 2 to 7 each show embodiments of plate
35 assemblies or rather ventilation units, in the case of which the thermally induced active mechanical release of the pressure plate 17 from the supporting plate 13

takes place by means of a securing element or rather a securing ring 23 made of a memory metal. Said memory metal can e.g. be a nickel-titanium alloy, which is also known by the name "Nitinol". In principle, however, other memory metals or shape memory alloys can be used, as long as their conversion or transformation temperature lies in a region below the ignition temperature of the percussion cap or rather of the propellant charge.

There is also the possibility of forming the securing element or rather the securing ring of a memory metal that exhibits a one way effect, thus having a one-time change of shape in one direction when the conversion temperature is exceeded and no longer changing back to the initial shape when cooling occurs. In this case the achieved mechanical opening is maintained, wherein said condition can of course be made known by suitable measures, which can be seen on the plate assembly 9, i.e. on the base of the propellant charge case, so that the user immediately sees that said munition cannot be fired. Alternatively, a memory metal that exhibits a two-way effect could also be used. Such a material returns to the initial shape on being cooled again, which means that - of course without this resulting in premature combustion of the propellant charge - the axial fixing of the pressure plate 17 can be achieved again. In principle, in such a case the change of shape that has occurred could also be made visible on the base of the propellant charge case, so that here too the user knows that the munition has already been subjected to higher temperatures once.

Figures 5 and 7 show one possibility for such a visual indication when using a memory metal exhibiting a one-way effect. As mentioned the threaded ring 24 is not shown here in each case. As can be seen in the

bottom view according to Fig. 5, the four retaining elements 27 lie closely adjacent to each other in the initial form, thus forming a closed ring. Here it is finally apparent that the axial fixing is intact.

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The bottom view shown in Figure 7 clearly shows that the four retaining elements 27 have been displaced radially outwards. They are not in contact with each other but rather there are open spaces 32 between them, which - if said form of the securing ring 23 is maintained despite cooling without ignition of the propellant charge - visually indicate that the axial fixing no longer exists.

15 Figures 8 and 9 show another embodiment according to the invention of a plate assembly 9 or rather of a ventilation unit 10, again comprising a supporting plate 13 and a pressure plate 17 inserted into the supporting plate 13. The pressure plate 17 also
20 comprises a collar 25 here, which however comprises an inclined surface 29. A plurality of retaining elements 27 that again expand to an annular form are also provided here that engage under the annular collar 25 in the initial position, see Fig. 8, and that also
25 comprise correspondingly inclined surfaces 30 on the inside, so that a planar contact on the inclined surface 29 of the annular collar 25, i.e. a conical surface arrangement, results.

30 A securing element 22 again radially gripping the retaining elements 27 is provided in the form of a securing ring 23, which, however, is made of a fusible material in this case. Said securing ring 23 has a melting temperature that is below the ignition
35 temperature of the percussion cap or rather of the propellant charge. It is axially fixed, as with the retaining elements 27, again by means of a threaded

ring 24, which is screwed into the supporting plate 13 by means of a threaded joint. The threaded ring 24 comprises a plurality of adequately dimensioned perforations 31, through which the molten material can
5 flow out in the event of the melting of the securing ring 23. Provided there is sufficient space radial to the securing ring 23 into which the melt can be forced, such perforations 31 are not necessary.

10 If heating to above the melting temperature of the securing ring 23 now occurs in the case of fire, then the securing ring melts. The inevitable result of this is that the retaining elements 27 lose their radial fixing, which means that a radial annular space, in
15 which the securing ring 23 was previously disposed, is cleared or rather arises.

If further heating now takes place to above the ignition temperature of the propellant charge and
20 consequently combustion takes place, then in turn a gas pressure that acts upon the pressure plate 17 arises in the high pressure chamber. Said pressure plate 17 is now axially forced out of the supporting plate 13. This is possible once the retaining elements 27 are no
25 longer fixed when viewed radially. They are forced radially outwards once the conical inclined surfaces 29 and 30 slide on each other, see Fig. 9. The retaining elements 27 can be displaced radially outwards to the extent that the pressure plate 17 is completely
30 released, consequently thus being completely forced out of the supporting plate 13. There is again a large area discharge cross-section, which is preferably larger than 50 mm² depending on the design, via which the charging pressure dissipates. Here too, however,
35 the connection between the actual drive, i.e. the propellant charge case 2, and the projectile remains

undamaged, as with the insert 8 or rather a rupture disk etc.

5 The fusible ring 23 consists of a low melting point metal alloy, which in respect of the melting point is designed such that it lies below the ignition temperature of the percussion cap or rather of the propellant charge.

Reference character list

	1	cartridge ammunition
	2	propellant charge case
5	3	cartridge casing
	4	projectile
	5	base of projectile
	6	propellant charge unit
	7	high pressure chamber
10	8	insert
	9	plate assembly
	10	ventilation unit
	11	bore
	12	low pressure chamber
15	13	supporting plate
	14	external thread
	15	internal thread
	16	threaded joint
	17	pressure plate
20	18	seating
	19	seating
	20	percussion cap
	21	bore
	22	securing element
25	23	securing ring
	24	threaded ring
	25	annular collar
	26	retaining element
	27	retaining element
30	28	groove
	29	inclined surface
	30	inclined surface
	31	perforation
	32	open space
35	33	threaded joint

Claims

1. Propellant charge case for cartridge ammunition, comprising a cartridge casing (3) with a high pressure chamber (7) for accommodating a propellant charge and a low pressure chamber (12) that communicates with the high pressure chamber (7) when the propellant charge is ignited, as well as a pressure plate (17) for accommodating a percussion cap (20), wherein the pressure plate (17) is releasably disposed by means of a thermally operated securing element (22, 23) on the cartridge casing (3) or on a supporting plate (13), and wherein a plurality of retaining elements (26, 27) that axially fix the pressure plate (17) are provided, which can be radially displaced from their fixing position in the event of thermally activated operation of the securing element (22, 23), wherein the securing element (22, 23) changes its shape in the event of thermal activation without changing its physical state, wherein the retaining elements (27) are displaceably coupled to the securing element (22, 23) that changes its shape such that the retaining elements (27) are radially displaced out of the fixing position by the change of shape of the securing element (22, 23), wherein the securing element (22) is a securing ring (23), and wherein the retaining elements (27) comprise a groove-shaped seating (28) in which the securing ring (23) is accommodated.
2. Propellant charge case according to claim 1, wherein the retaining elements (27) comprise an inclined surface on the side facing the pressure plate (17) and wherein the pressure plate (17) comprises a complementary inclined surface.

3. Propellant charge case according to claim 2,
wherein the retaining elements (27) and the pressure
plate (17) comprise mutually complementary inclined
5 surfaces (29, 30) that abut one another.

4. Propellant charge case according to any one of the
preceding claims,
wherein a threaded ring (24) that is screwed onto the
10 cartridge casing (3) or the supporting plate (13) and
that axially fixes the securing element (22, 23) is
provided.

5. Cartridge ammunition comprising a propellant
15 charge case (2) according to any one of the preceding
claims.