

Grenade, in particular 40 mm grenade

The invention relates to a grenade, especially a 40 mm grenade, with a cartridge, a projectile and a high pressure-low pressure ignition system comprising a hollow cylindrical chamber component with a high pressure chamber accommodating a propellant charge and a low pressure chamber that is disposed outside the chamber component, the chambers being able to be connected by means of one or a plurality of channels in the chamber component that can be opened by means of pressure arising when the propellant charge is ignited.

Grenades are known of different construction types and of different calibers and are primarily used to combat more distant targets. Besides very large caliber grenades, which have very long ranges, smaller caliber grenades, especially 40 mm grenades, are also known, which are mainly used in the infantry field and which enable even targets lying outside the maximum throwing range of hand grenades to be attacked without depending on the support of other weapons or weapons systems. A 40 mm grenade is a cartridge ammunition that can be launched by means of a grenade launcher. Grenades, especially 40 mm grenades, work with a high pressure-low pressure ignition system. This comprises two chambers, i.e. a high pressure chamber and a low pressure chamber. The high pressure chamber is implemented by means of a hollow cylindrical chamber component. The high pressure chamber contains a propellant charge that can be ignited by means of a percussion cap or similar. During combustion of the propellant charge, a pressure > 1000 bar forms in the high pressure chamber. From a defined pressure, one or a plurality of channels provided in the chamber component open(s), which lead into the low pressure chamber surrounding the chamber component. Said low

pressure chamber is connected to the base of the projectile, or rather is delimited by the same. The projectile is then fired out of the cartridge by the gas pressure arising on the base of the projectile
5 after the channels in the low pressure chamber open.

In order to be able to fire the projectile with a tolerably defined speed, it is necessary to implement a defined ratio of high pressure chamber volume to low
10 pressure chamber volume. Thus, for example, there are 40 mm grenades of three different known grenade types, i.e. a "low velocity" grenade with a firing speed of the projectile of approximately 75 m/s, a "medium velocity" grenade with a firing speed of approximately
15 100 m/s and a "high velocity" grenade with a firing speed of approximately 240 m/s. Besides the ratio of the chamber volumes, the quantity of propellant charge of course also plays a part in the achievement of a desired firing speed, wherein mostly only a relatively
20 small quantity in the gram range is necessary. Said propellant charge is disposed as stated in the high pressure chamber, which is formed by the hollow cylindrical chamber component. This is, however, significantly greater than the propellant charge in
25 terms of volume. The propellant charge is consequently displaceable in the high pressure chamber, i.e. there is no defined position relative to the percussion cap or similar, by means of which the propellant charge is ignited. The result of this, depending on the position
30 of the propellant charge relative to the percussion cap, is that undefined ignition conditions occur, resulting in undefined combustion from shot to shot and consequently also in undefined pressure generation, which in turn results in a non-reproducible firing
35 speed. This means that the individual projectile is launched with a higher or lower speed depending on an actual running ignition process. This is however not

desired, because different firing speeds result in corresponding scatter for a given weapon position.

5 The aim is consequently to specify a grenade, especially a 40 mm grenade, which, preferably when implementing a "medium velocity" grenade, enables a defined ignition process and thus enables the firing of individual grenades with a highly reproducible speed.

10 In order to solve this problem with a grenade of the above-mentioned type, it is provided according to the invention that the high pressure chamber is divided by means of a rupture diaphragm into a first chamber segment accommodating the propellant charge and a
15 second chamber segment.

The grenade according to the invention finally provides a three chamber ignition system, comprising a high pressure chamber, which consists of two individual
20 chambers, and the low pressure chamber. The first chamber segment of the high pressure chamber has a volumetric size such that it is preferably completely filled with the propellant charge, so that the same is consequently non-displaceable and is always disposed in
25 a defined position relative to the percussion cap or similar. The first chamber segment is separated from the second chamber segment by means of a rupture diaphragm, wherein the first chamber segment and the second chamber segment form the overall high pressure
30 chamber and have an overall volume dimension such that the defined, necessary volume ratio of the high pressure chamber to the low pressure chamber results.

35 If the propellant charge is ignited, then it initially combusts exclusively in the first chamber segment and pressure generation takes place in the first chamber segment. On reaching a rupture pressure, which e.g.

lies in the range from 200 - 300 bar, the rupture diaphragm ruptures, the two chamber segments combining to form a common high pressure chamber. As a result of the progressing pressure increase in the case of combustion of the propellant charge powder occurring as previously, the channels open on achieving a suitable pressure level, e.g. from 1200 - 1300 bar, and in turn connect the high pressure chamber to the low pressure chamber. The gas can now discharge into the low pressure chamber and becomes disposed at the base of the projectile. Firing then takes place with sufficient pressure.

Once the propellant charge is positionally fixed in the grenade according to the invention, the same ignition conditions consequently result for each grenade, i.e. the same ignition conditions and thus combustion conditions and pressure generation conditions always result from shot to shot. The result of this is that reproducible projectile speeds can be achieved from shot to shot. Moreover, once displacement of the propellant charge is excluded by the chamber division according to the invention, the result is thus that optimal ignition conditions, also an increase of the speed of the projectile, can be achieved, e.g. in the case of "medium velocity" grenades up to 120 m/s, resulting from the fixing of the propellant charge and the optimization of the charge density in the first chamber segment.

The channel(s) can thereby be disposed in the region of the first or second chamber segment. Because the channels only open if a suitable high pressure of 1200 - 1300 bar occurs, for which a corresponding quantity of propellant charge must have combusted previously, it is consequently also possible to provide the channel(s) in the region of the first chamber segment originally containing the propellant charge. They can, however,

also be provided as described in the region of the second chamber segment, which does not contain the propellant charge.

5 A particularly advantageous development of the invention provides that the rupture diaphragm is displaceable in the high pressure chamber and is accommodated in the respective position in a clamped manner. Said embodiment according to the invention
10 enables the volumes of the first and second chamber segments to be able to vary somewhat depending on the positioning of the rupture diaphragm. I.e., depending on the arrangement of the rupture diaphragm, the volume of the first chamber segment and thus the quantity of
15 propellant charge can be larger or smaller, by means of which the charge density can consequently be adjusted in a simple manner.

Alternatively, it is conceivable to arrange the rupture
20 diaphragm in contact with a stop, consequently in an always defined position in the chamber component, so that consequently a respective defined volume of the first and second chamber segments always results.

25 According to a particularly advantageous embodiment according to the invention, it is provided that the rupture diaphragm is disposed on a bowl whose cylindrical segment covers the channel(s). As described, the channels are only opened if there is a
30 suitable high pressure in the high pressure chamber. Prior to that they are closed. According to said embodiment according to the invention, a bowl, which moreover also comprises the rupture diaphragm, is used in order to close the channels. If the rupture pressure
35 is reached then the diaphragm ruptures, but the cylindrical annular collar of the bowl is still closing the channel(s) as before. Only if the relevant pressure level of e.g. 1200 or 1300 bar is reached in the high

pressure chamber does the bowl material also tear in the region of the channel(s); it is literally punched out, and the channels open. Thus the bowl has multiple functions, i.e. on the one hand to act as a support for the rupture diaphragm, but on the other hand also to serve as a channel closure, as well as the clamped fixing of the bowl, or rather of the rupture diaphragm, in the chamber component being carried out by means of its cylindrical segment.

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As an alternative to the use of the bowl, i.e. of only one component, it is conceivable to provide a separate ring that covers the channel(s). Said ring only has the function of closing the channels and of opening the channels when a sufficiently high pressure is applied. The rupture diaphragm itself is implemented as a separate component that comprises a retaining ring, in which the actual diaphragm segment is disposed, wherein the rupture diaphragm is fixed in the chamber component in a clamped manner by means of the retaining ring.

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The rupture diaphragm itself, potentially the entire bowl or the ring, is preferably made of metal, especially a metal sheet, wherein especially copper, brass or aluminum is suitable as the metal.

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The retention of the projectile itself in the cartridge can be carried out in a different way. Firstly a threaded connector can be provided on the chamber component that can be detached by means of a predetermined breaking point and onto which the projectile is screwed. The threaded connector tears in the region of the predetermined breaking point if there is sufficient pressure in the low pressure chamber. An alternative provides for detachably connecting the projectile to the cartridge by means of a crimped

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connection, i.e. wherein the fixing of the projectile takes place directly on the cartridge.

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

10 Fig. 1 shows a sectional view through a grenade according to the invention,

Fig. 2 shows a sectional view through a chamber component with a displaceably disposed bowl,

15 Fig. 3 shows a chamber component with a separate rupture diaphragm and a separate ring, and

Fig. 4 shows a chamber component with a bowl abutting a stop.

20 Fig. 1 shows a grenade 1 according to the invention, e.g. a 40 mm grenade. It comprises a grenade casing or a cartridge 2, in which a chamber component 3 is inserted. The chamber component 3 comprises, see Fig. 2, a threaded segment 4 that is screwed into a
25 corresponding threaded segment 5 of the cartridge 2 in order to fix the chamber component 3 in the cartridge 2. A closure plate 6 that closes the chamber component 3 is inserted in the chamber component 3. A percussion cap 8 that is used to ignite a propellant charge 9 that
30 is disposed in the interior of the chamber component 3 is disposed in an accommodation chamber 7.

Furthermore, a threaded connector 10 is provided on the chamber component 3 and is screwed into a corresponding
35 threaded bore in a projectile 11, the threaded bore being disposed on the base of the projectile, by means of which the projectile is fixed to the cartridge.

A high pressure-low pressure ignition system is implemented by means of the chamber component and the cartridge 2. The hollow cylindrical chamber component 3, see Fig. 2, defines in its interior a high pressure
5 chamber 12, which is enclosed by a low pressure chamber 13 that is closed by means of the cartridge 2 and the base of the projectile.

The high pressure chamber 12 is for its part divided
10 into two chamber segments, i.e. a first chamber segment 14 and a second chamber segment 15. Both are sealed or rather separated from each other by means of a rupture diaphragm 16, the rupture diaphragm 16 in the exemplary embodiment shown being disposed on a bowl 17 or rather
15 being formed in one piece with said bowl. The bowl 17 is accommodated in a clamped manner in the hollow cylindrical chamber component by means of its cylindrical segment 18, wherein its hollow cylindrical segment 18 closes a plurality of channels 19. Said
20 channels 19 form a connection that can be opened depending on pressure between the high pressure chamber 12 and the low pressure chamber 13.

As Fig. 1 shows, the first chamber segment 14 is
25 completely filled with the propellant charge 9. This is consequently disposed so as to be positionally fixed relative to the percussion cap 8, consequently resulting in ignition conditions that are always defined. Depending on how the bowl 17 is positioned,
30 the volume of the first chamber segment 14 can be adjusted, therefore volume matching and hence optimization of the charge density are carried out.

If the propellant charge 9 is ignited by means of the
35 percussion cap 8, then it combusts and pressure generation takes place in the first chamber segment 14. On reaching a defined rupture pressure, which depends on the thickness of the diaphragm and the

diaphragm material used, the rupture diaphragm 16 opens, so that the two chamber segments 14, 15 are combined to form the whole high pressure chamber 12, i.e. so that the entire chamber volume of the high pressure chamber 12 is available for the subsequent combustion. With a continuing pressure increase during combustion of the propellant charge 9 and on reaching a corresponding pressure level, the bowl 17 or rather its cylindrical segment 18 is punched through at the channels 19, i.e. the channels 19 are opened and the high pressure chamber 12 is connected to the low pressure chamber. The gas can now discharge into the low pressure chamber 13. With continuing pressure increase there is an ever higher gas pressure at the base of the projectile. If sufficient pressure is reached then a predetermined breaking point 20, by means of which the threaded connector 10 is joined to the chamber component 3, breaks and the projectile is fired. The predetermined breaking point 20 can be adjusted very accurately, so that defined pressure-related breaking can be achieved. By means of the defined ignition and combustion conditions, or rather pressure conditions, and the corresponding design of the predetermined breaking point 20 with a small tolerance, a firing speed that is highly reproducible from grenade to grenade can be achieved.

The bowl 17 is preferably made of a copper, brass or aluminum sheet. The appropriate metal material, or rather the appropriate thickness of the metal sheet, is selected depending on the rupture pressure to be set in relation to the rupture diaphragm, or rather the rupture pressure in the region of the channels.

Fig. 3 shows another embodiment that enables the separation of the high pressure chamber 12 into a first chamber segment 14 accommodating the propellant charge and a second chamber segment 15. This is again carried

out by means of a rupture diaphragm 16, but in this case the rupture diaphragm 16 is a separate component and is fixed by means of a retaining ring 21 that is held clamped at the edge in the chamber component 3.

5 The covering of the channels 19 is carried out here by means of a separate ring 22. Here too the rupture diaphragm 16 is displaceable, i.e. the volume of the first and second chamber segments 14, 15 can be adjusted by suitable positioning of the rupture
10 diaphragm 16 and consequently the charge density can be optimized. Defined ignition and thus combustion conditions can again be achieved by this means. The manner of operation is the same as described for the previous embodiment. Here too the rupture diaphragm 16
15 opens, and thus combination of the volumes of the two chamber segments 14, 15 occurs, on reaching sufficient rupture pressure. On reaching sufficient pressure the ring 22 is then punched through to open the channels 19, so that the gas in turn flows into the low pressure
20 chamber and the projectile is fired on reaching sufficient pressure in the low pressure chamber.

Finally, Fig. 4 shows an embodiment with which an annular collar 23, which forms a stop 24 for the bowl
25 17, is provided on the chamber component 3. The bowl 17 again comprises a rupture diaphragm 16, but in this case it is positioned in the inverse arrangement (compared with Fig. 2). Its cylindrical segment 18 is oriented in this case toward the end plate 6. The
30 channels 19, which are only shown by dashed lines here, are provided in this embodiment in the region of the first chamber segment 14 accommodating the propellant charge, whereas with the embodiment according to Fig. 2 they are positioned in the region of the second chamber
35 segment 15. The manner of operation is, however, the same as with the previously described embodiments. On ignition, initially combustion of the propellant charge takes place and hence a buildup of pressure in the

first chamber segment 14 occurs and the rupture diaphragm 16 ruptures if there is sufficient pressure. If there is then a suitable pressure in the now complete high pressure chamber, the bowl 17 is again
5 punched through to open the channels 19, so that the high pressure chamber 12 is connected to the low pressure chamber 13 and as a result the projectile is fired. In contrast to the previously described
10 embodiments of the invention, however, in this case no variation in volume in respect of the volumes of the first and second chamber segments 14, 15 is possible once the bowl 17 contacts the stop 24.

Claims

1. A grenade, especially a 40 mm grenade, with a cartridge, a projectile and a high pressure-low pressure ignition system comprising a hollow cylindrical chamber component with a high pressure chamber accommodating a propellant charge and a low pressure chamber disposed outside of the chamber component, which are connected to each other by means of one or a plurality of channels that can be opened by means of the pressure arising in the chamber component on ignition of the propellant charge, characterized in that the high pressure chamber (12) is divided by means of a rupture diaphragm (16) into a first chamber segment (14) accommodating the propellant charge (9) and a second chamber segment (15).
2. The grenade as claimed in claim 1, characterized in that the channel(s) (19) are disposed in the region of the first or the second chamber segment (14, 15).
3. The grenade as claimed in claim 1 or 2, characterized in that the rupture diaphragm (16) is displaceable in the high pressure chamber (12) and is accommodated in the respective position in a clamped manner, or in that the rupture diaphragm (16) contacts a stop (24).
4. The grenade as claimed in any one of the preceding claims, characterized in that the rupture diaphragm (16) is disposed on a bowl (17), whose cylindrical segment (18) covers the channel(s) (19).

5. The grenade as claimed in any one of claims 1 to 3,
characterized in that
a separator ring (22) is provided that covers the
channel(s) (19).
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6. The grenade as claimed in any one of the preceding
claims,
characterized in that
10 the rupture diaphragm (16), possibly the entire
bowl (17) or the ring (22), is made of metal,
especially of metal sheet.
7. The grenade as claimed in claim 6,
15 characterized in that
it is made of copper, brass or aluminum.
8. The grenade as claimed in any one of the preceding
claims,
20 characterized in that
on the chamber component (3) a threaded connector
(10) detachable by means of a predetermined
breaking point (20), onto which the projectile
(11) is screwed.
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9. The grenade as claimed in any one of claims 1 to 7,
characterized in that
the projectile (11) is detachably connected to the
30 cartridge (2) by means of a crimped connection.