

The invention relates to a cartridge, more particularly a grenade cartridge, consisting of a cartridge case having at the base an ignition chamber to receive a detonating agent, a pressure cartridge forming a high-pressure chamber for filling with a propellant charge, and a projectile disposed in the case, the high-pressure chamber of the cartridge communicating, on the one hand, with the ignition chamber via an axial ignition channel and, on the other hand, with a cavity acting as a low-pressure chamber between the projectile and the case, by way of at least one gas outlet opening which may be covered by an insulating insert.

Cartridges fired from small arms should not recoil with a force exceeding the amount which can be tolerated by the marksman, and consequently the "high and low-pressure" system for igniting the propellant charge is used, particularly for larger calibres, especially 40-mm grenade cartridges. In the high and low-pressure system, the propellant charge is disposed in a high-pressure chamber in a cartridge or the like, which merges via gas outlet openings into a low-pressure chamber formed by the cartridge case and the projectile disposed in it. The high-pressure chamber is also accessible from the base of the case, via an ignition channel, so that the propellant charge in the high-pressure chamber can be ignited through the ignition channel by an ignition jet generated by a base detonator. When the propellant charge burns, a gas pressure builds up in the high-pressure chamber and when the pressure reaches a certain level depending on the opening cross-sections and an insulating insert covering the openings, the combustion gases in the propellant charge break through the gas outlet openings and flow from the high-pressure chamber into the low-pressure chamber, in which the gas pressure rises until the force for extracting the projectile from the case is exceeded and the projectile is ejected through the gun barrel. This results in a lower muzzle velocity, but sufficient, e.g. in the case of grenade cartridges, to obtain the desired range of a few hundred metres, thus reducing the energy of the recoil to a desired amount.

In the known cartridges (EP-A1-0 279 301, AT-B-383 891, DE-A1-35 01 191, DE-A1-35 07 643), where the pressure cartridges and the propellant charge are inserted either in the case base or in the projectile base or are made up of parts situated therein, the ignition channel is a central borehole in the flat cartridge

base, irrespective of the arrangement of the gas outlet openings, so that during ignition, the ignition jet penetrates freely and in uncontrolled manner into the propellant charge in the high-pressure chamber. Since, as a result of manufacturing tolerances, fluctuations in the amount and composition of the detonating agent occur and influence the intensity of the ignition jet acting upon the propellant charge, the ignition jet penetrates into the propellant charge to a depth which varies from cartridge to cartridge, thus varying the intensity of ignition and the pressure build-up in the high-pressure chamber from one shot to another. In addition, the gas outlet openings from the high-pressure chamber into the low-pressure chamber are usually disposed near the cover of the cartridge and the outlet of the ignition channel at the base, so that ignition mainly occurs near the base and the combustion front propagates from the base towards the gas outlet openings, i.e. towards the cover. As a result of the exothermic reaction, during combustion the gases propagate likewise from the ignition channel to the gas outlet openings, and when the covers on the gas outlet openings are broken by the pressure increase, the combustion gases flowing out into the low-pressure chamber entrain unburnt particles of propellant charge, which thus do not undergo an exothermic reaction. The proportion of unburnt particles is unacceptably large compared with the total amount of propellant charge, and the differences in pressure build-up from shot to shot and the variations in the amount of unburnt propellant-charge particles result in fluctuations of 15% or more in muzzle velocity, thus greatly impairing the accuracy of aim.

The object of the invention therefore is to eliminate these drawbacks and construct a cartridge of the initially-described kind characterised by uniform combustion of propellant charge and consequent particularly high accuracy of aim.

To this end according to the invention, the ignition channel extends axially in the high-pressure chamber as far as the area in which the gas outlet openings are located and the or each outlet of the ignition channel is directed radially and/or on to a radial deflecting surface. As a result of this positioning of the ignition-channel outlets relative to the gas outlet openings, the propellant charge is ignited in the region between the ignition-channel outlets and the gas-outlet openings and consequently the combustion

front moves away from the gas-outlet openings, so that after the pressure has built up and the combustion gases have overflowed from the high-pressure to the low-pressure chamber, the pressure increase is permanent and ignition occurs in the opposite direction, so that no unburnt powder particles can be entrained into the low-pressure chamber. Also, owing to the radial deflection of the ignition jet in the outlet region, either because of the construction of the ignition channel itself or of a deflecting surface opposite the ignition-channel mouth, the place where the propellant charge is ignited in the high-pressure chamber is exactly determined irrespectively of the intensity of the ignition jet, thus ensuring that always the same amount of powder is ignited. This is because the deflection prevents the ignition jet from penetrating into the propellant charge to a depth which varies with intensity and ensures that the ignition jet always comes into contact with the same amount of propellant charge and at the same place. This automatically results in uniform ignition, uniform combustion and uniform build-up of pressure. The propellant charge is completely ignited, used more efficiently, and its effect is more uniform, resulting in a more uniform muzzle velocity and more accurate aiming.

If the ignition channel is formed by an ignition tube extending upwards from the cartridge base, the ignition channel can in simple manner be given any desired length into the high-pressure chamber and can be adapted to any position of the gas outlet openings.

Ignition tubes of this kind can have a wide variety of outlet shapes. For example the ignition tube, the end of which preferably bears against the cartridge covering wall situated opposite the base, can have channel outlets in the form of recesses, slots, boreholes or the like in its outer surface. The ignition tube can be closed at one end or alternatively its open end can bear against the cartridge covering wall, so as to force the ignition jet out through the recesses or the like in the outer surface.

Alternatively the ignition tube can end at a distance in front of the cartridge covering wall, and the covering wall can form a deflecting surface for the outlet in the end face of the ignition tube, so that the ignition jet axially leaving the ignition tube strikes the covering wall before being deflected.

The deflecting surface can advantageously be shaped and instead of a flat surface, the covering wall can have an inwardly projecting deflecting cone or the like coaxial with the ignition tube for forming the deflecting surface, resulting in a deflecting surface which is conical or has a similarly axial symmetrical shape, so as more uniformly to distribute and guide the ignition jet.

Advantageously the cone can be formed by a cup-shaped insulating insert inserted into the cartridge, or alternatively can be a shaped part of the cartridge covering wall or a separate inserted part.

Another advantageous construction is obtained if according to the invention boreholes disposed in the cartridge base in a centrally symmetrical arrangement serve as ignition channel, the outlets of which in the high-pressure chamber are roofed by a central deflecting mushroom-shaped element which forms the deflecting surface. In this case the place of ignition can be near the base, and the mushroom-shaped element ensures proper radial alignment of the ignition jet.

If, according to another embodiment of the invention, a central axial borehole of the cartridge base terminating in a coaxial and preferably conical base projection and merging into uniformly distributed radial boreholes serving as outlets, forms the ignition channel, the desired place of ignition near the base is directly secured by the radially aligned outlet boreholes, without an external guiding surface.

According to another particularly advantageous feature of the invention, a preferably conical insulating cap is provided in the high-pressure chamber between the ignition channel outlets and the gas outlet openings, the cap being made of plastics, aluminium or another metal. The insulating cap enables a higher pressure to build up in the high-pressure chamber before the combustion gases overflow into the low-pressure chamber, thus assisting complete combustion of the propellant charge. The insulating cap screens the gas outlet openings from the ignited propellant charge and is not driven away until the pressure reaches a certain level, so that the gas pressure can act on the gas outlet openings or the insulating insert covering them. The insulating cap can be provided in addition to the conventional, usually cup-shaped, insulating insert lining the cartridge, and is used to influence the

pressure and combustion conditions in the high-pressure chamber.

A number of embodiments of the invention are diagrammatically shown in the drawings, in which:

Fig. 1 shows a cartridge according to the invention in axial section, and

Figs. 2 to 9 show various embodiments, each in axial section, of a pressure cartridge in the cartridge.

A grenade cartridge 1 comprises a projectile in the form of a grenade 2 inserted in a cartridge case 3. The base 4 of the case 3 comprises an ignition chamber 5 for a detonating agent 6 and a pressure cartridge 7 is provided for holding a propellant charge. The propellant charge is disposed in a high-pressure chamber 8 in the pressure cartridge 7, connected on the one hand by an ignition channel 9 to the ignition chamber 5 and on the other hand by gas outlet openings 10 of cartridge 7 to a cavity serving as a low-pressure chamber 11 between the projectile 2 and the cartridge case 3. The pressure cartridge 7, as shown in Figs. 1 to 7, can be secured to the case, and can either be incorporated in the base 4 of the case as shown or, as indicated by chain-dotted lines in Fig. 1, can be in the form of an insertion part for screwing into the base 4, in which case the cartridge base 12 will be a closure part for screwing into the case base 4 or the insertion part, and containing the ignition chamber 5 and ignition channel 9. The high-pressure chamber 8 of the cartridge 7 is lined with a cup-shaped insulating insert 13, adapted to seal the high-pressure chamber 8 from the low-pressure chamber 11 until a suitable pressure builds up during the combustion of the propellant charge.

In order to fire the grenade 2, the detonating agent 6 is ignited and the ignition jet penetrates through the ignition channel 9 into the high-pressure chamber 8 of the cartridge 7, where it strikes the propellant charge and initiates the combustion process. During combustion of the charge, an exothermic reaction occurs and the resulting combustion gases build up pressure in the high-pressure chamber. As soon as a certain pressure level is reached, the gases break through the insulating insert 13 and flow out of the high-pressure chamber 8 into the low-pressure chamber 11, where a further increase in pressure occurs, finally resulting

in ejection of the grenade 2 from the case 3 with relatively low recoil forces.

In order to obtain uniform ignition and combustion conditions in the high-pressure chamber 8 and prevent unburnt propellant-charge particles being entrained through the gas outlet openings 10, thus automatically obtaining a uniform muzzle velocity and increased accuracy of aiming, the ignition channel 9 extends axially in the high-pressure chamber 8 as far as the area in which the gas outlet openings 10 are located and the ignition jet leaving the ignition channel 9 is radially deflected. On ignition, therefore, the jet always strikes the propellant charge in the neighbourhood of the gas outlet openings 10 and consequently can act only on a uniform amount of propellant charge between the outlet openings 10 and the ignition-channel outlets, so that combustion begins in a uniform manner for each propellant charge and the combustion front also moves away from the gas outlet openings 10, thus ensuring uniform burning of the propellant charge irrespectively of the intensity of the ignition jet, and also preventing unburnt particles of propellant charge being entrained when the combustion gases overflow from the high-pressure chamber 8 into the low-pressure chamber 11.

In order to adjust the ignition channel 9 and the gas outlet opening 10 in the correct position relative to one another and deflect the ignition jet in the neighbourhood of the channel outlet, various methods can be used as shown in the embodiments.

In the embodiment in Fig. 1, the gas outlet openings 10 are near the cartridge covering wall 14 and an ignition tube 15 extending upwards from the cartridge base 12 forms the ignition channel 9. The end of the ignition tube 15 bears against the cartridge covering wall 11 or the insulating insert 13 lining it, and has channel outlets in the form of recesses 16 in its outer surface. The ignition jet penetrating through the ignition channel 9 is therefore held up by the covering wall 14 and travels radially through the surface recesses 16 into the high-pressure chamber. Of course, the recesses 16 can have a wide variety of shapes, i.e. arcuate edge recesses or slots or radial bores, etc.

Fig. 2 shows an embodiment in which the ignition tube 15 terminates at a distance in front of the cartridge covering wall 14 and the covering wall 14 or the

inserted insulating insert 13 forms a deflecting surface 17 for an outlet 18 in the end face of the ignition tube 15. The ignition jet emerging from the smooth, continuous ignition tube 15 therefore strikes the deflecting surface 17 and is consequently deflected radially and distributed circumferentially.

As indicated in the embodiment in Fig. 3, the covering surface 17 may alternatively be formed by an inwardly projecting deflecting cone 19 coaxial with the ignition tube 15, and through which the emerging ignition jet is deflected, likewise from the axial into the radial direction leading to the gas outlet openings 10. The deflecting cone 19 in the present case is a part of the cup-shaped insert 13. Alternatively it can be shaped out of the cartridge covering wall 14 or can be a separate attachment. The shape of the cone 19 can also vary, and can be a pure cone or a shape of revolution differing from the conical surface by being more convex or concave.

If the gas outlet openings 10 are disposed near the cartridge base 12, optionally as shown in the embodiment in Fig. 4 the ignition channel can be in the form of about three or four centrally symmetrical boreholes 20 in the cartridge base 12, the outlets 21 of the bores in the high-pressure chamber 8 being roofed by a central deflecting mushroom-shaped element 22 which forms the deflecting surface 17. The ignition jet, which in the present case emerges in a number of branches, is radially deflected by the element 22 and thus strikes the propellant charge in the base region.

As shown by the embodiment in Fig. 5, in the case of gas outlet openings 10 disposed near the base, optionally a central axial borehole 23 of a cartridge base 12 forms the ignition channel and terminates in a coaxial conical base projection 25 and merges into channel outlets in the form of radial boreholes 24 distributed with central symmetry. In this case also the central ignition jet is deflected by the radial boreholes and is divided when supplied to the propellant charge in the high-pressure chamber 8.

As shown in the embodiments in Figs. 6 and 7, a conical insulating cap 26 can be provided in addition to the insulating insert 13 in the high-pressure cartridge 7 and can be disposed between the ignition channel outlets and the gas outlet openings 10, so as to ensure a higher pressure level in the high-pressure chamber,

facilitating complete combustion of the propellant charge. After the propellant charge has been ignited, the resulting gas pressure first has to press the insulating cap 26 against the covering wall 14 or base 12 of the pressure cartridge, before it can act upon and break the insulating insert 13 in the gas outlet region, so that the strength properties of the insulating cap 26 can be used to influence the pressure and combustion conditions in the high-pressure room 8. Depending on whether the channel openings 16 or 24 lie in the cover or the base region, the insulating cap 26 is opened on the base side (Fig. 6) or the cover side (Fig. 7) and thus prevents direct entry of the evolved combustion gases into the gas outlet openings 10.

The embodiments in Figs. 8 and 9 show a pressure cartridge 7 which is not secured to the case but to the projectile, the cartridge 7 forming an independent chamber which is screwed into the base 27 of the grenade 2 and abuts the base 4 with interposition of a sealing ring 28. The case base itself comprises the ignition chamber 5 and the detonating agent 6, and an ignition borehole 29 in the base 4 of the case connects the ignition channel 9 to the ignition chamber 5. The pressure cartridge 7 can be constructed in various ways as in the preceding embodiments, irrespective of whether it belongs to the grenade 2. At present, only the cartridge base 30 is shaped in the screwed part and the cartridge cover wall is formed by the base 27 of the grenade. As before, the ignition duct 9 can be an ignition tube 15 (Fig. 8), or can be a central axial borehole 23 with outlets in the form of radial boreholes 24 (Fig. 9) or can be constructed in a different way.

The cartridge 1 according to the invention, by means of a simple construction, guarantees uniform combustion and pressure conditions in the high-pressure and low-pressure system from shot to shot, and thus guarantees high accuracy of aiming.



C L A I M S

1. A cartridge (1), more particularly a grenade cartridge, consisting of a cartridge case (3) having at the base (4) an ignition chamber (5) to receive a detonating agent (6), a pressure cartridge (7) forming a high-pressure chamber (8) for filling with a propellant charge, and a projectile (2) disposed in the case (3), the high-pressure chamber (8) of the cartridge (7) communicating, on the one hand, with the ignition chamber (5) via an axial ignition channel (9) and, on the other hand, with a cavity acting as a low-pressure chamber (11) between the projectile (2) and the case (3), by way of at least one gas outlet opening (10) which may be covered by an insulating insert (13), characterised in that the ignition channel (9) extends axially in the high-pressure chamber (8) as far as the area in which the gas outlet openings (10) are located and the or each outlet of the ignition channel (9) is directed radially and/or on to a radial deflecting surface (17).

2. A cartridge according to claim 1, characterised in that the ignition channel (9) is formed by an ignition tube (15) extending upwards from the cartridge base (12).

3. A cartridge according to claim 2, characterised in that the ignition tube (15), the end of which preferably bears against the cartridge covering wall (14) situated opposite the base (12) has channel outlets in the form of recesses, slots, boreholes (16) or the like in its outer surface.

4. A cartridge according to claim 2, characterised in that the ignition tube (15) terminates at a distance in front of the cartridge covering wall (14) and the covering wall (14) forms a deflecting surface (17) for the outlet (18) in the end face of the ignition tube (15).

5. A cartridge according to claim 4, characterised in that the covering wall (14) together with an inwardly projecting deflecting cone (19) or the like coaxial of the ignition tube (15) forms the deflecting surface (17).

6. A cartridge according to claim 5, characterised in that the deflecting cone (19) is formed by the cup-



shaped insulating insert (13) inserted into the cartridge (7).

7. A cartridge according to claim 1, characterised in that boreholes (20) disposed in the cartridge base (12) in a centrally symmetrical arrangement serve as ignition channel, the outlets of which in the high-pressure chamber (8) are roofed by a central deflecting mushroom-shaped element (22) which forms the deflecting surface (17).

8. A cartridge according to claim 1, characterised in that a central axial borehole (23) of the cartridge base (12) terminating in a coaxial and preferably conical base projection (25) and merging into uniformly distributed radial boreholes (24) serving as outlets, forms the ignition channel.

9. A cartridge according to any one of claims 1 to 8, characterised in that a preferably conical insulating cap (26) is provided in the high-pressure chamber (8) between the ignition channel outlets and the gas outlet openings (10).