

PROJECTILE AND METHOD FOR PRODUCING A PROJECTILE

FIELD OF THE INVENTION

The present invention relates to a projectile having a projectile base body which has a recess for receiving explosive and, at least in sections, a preferably cylindrical jacket surface oriented along a longitudinal axis of the projectile base body, and wherein at least one fragmentation group comprising at least two mutually adjacent annular fragmentation bodies is provided, which are threaded along the jacket surface and form a fragmentation section of the projectile. Furthermore, the present invention relates to a method for producing such a projectile.

DESCRIPTION OF THE PRIOR ART

By definition, a projectile is the weaponry term for a solid body that is fired or ejected from a launching or dropping device. Such a projectile has a projectile base body with a cavity containing a war charge or explosive charge which is triggered by a fuse. The external shape of such a projectile should offer as little air resistance as possible.

A generic projectile does not have its own propulsion, but is accelerated from the outside. For this purpose, it may be necessary for such a projectile to include a propellant charge and a propellant charge igniter for launching, for example from a launch tube. After leaving this launching or dropping device, the projectile describes a ballistic trajectory on which it flies like a thrown object. Depending on their design and characteristics, such projectiles are also referred to as grenade bodies, grenade projectiles, grenades or impact bodies.

Irrespective of their respective sizes, such projectiles can be divided into mortar shells and artillery shells.

A mortar or grenade launcher is a steep-fire gun with a short barrel for firing grenades. Mortar shells are projectiles that are fired from a mortar or grenade launcher. Usually, a mortar shell already has a basic propellant charge, which is housed, for example, in a tail stock of a tail fin of the projectile. Such a tail fin,

which can be attached to the projectile base body, serves to stabilize the trajectory of the projectile during flight. For firing, a mortar shell is usually placed on the muzzle of the launch tube and slides down the launch tube. Contact with a firing pin at the closed end of the tube ignites the propellant charge, which propels the mortar shell out of the launch tube.

In an artillery shell, the actual projectile, the propellant charge required to fire the projectile and a propellant charge igniter are usually separate and are only brought together shortly before firing. Although this makes the handling of an artillery shell less simple, it offers increased flexibility. The firing range can be influenced by selecting the appropriate type and quantity of propellant charge and the effect of the combat charge or explosive charge on the target can be influenced by selecting the appropriate ignition device. For example, a proximity fuse can be attached to the tip of the projectile, which ignites the explosive charge on impact with the ground. Alternatively, ignition devices can be used to detonate the projectile while it is still in the air. Artillery shells can be used with or without a tail fin, depending on the intended use. If necessary, artillery shells can include appropriate control and guidance devices and be designed as guided weapons.

In summary, generic projectiles can be configured differently depending on the intended use and may comprise one or more propellant charges, a propellant charge igniter, a tail fin for stabilizing the trajectory and/or an ignition device, for example a proximity fuse.

Numerous designs of projectiles with a fragmentation jacket are already known from the prior art, i.e. with ring-shaped fragmentation elements or fragmentation bodies which are attached to a projectile base body and which produce fragments in the event of an explosion of the explosive charge located in a cavity within the projectile. Such projectiles are generally also referred to as grenades or fragmentation grenades. A grenade is usually a hollow body with a war charge or explosive charge that is triggered by a fuse. Such projectiles are classified according to their functional characteristics as well as their caliber as the measure of their largest outer diameter.

Explosions of conventional projectiles naturally produce projectile fragments of different masses and sizes, which has the disadvantage that such fragments of different sizes also have a different effective range depending on their size. Small

fragments with a comparatively small mass therefore only have a small effect within a smaller effective radius, whereas large fragments with a comparatively large mass can also be projected beyond the intended effective range of the projectile during the explosion and can cause unwanted damage, so-called collateral damage, outside the intended target area of the projectile in question.

In order to standardize the size distribution of the fragments that are produced when a projectile explodes and thus also to improve the desired effect of the projectile within the intended area of effect, different approaches for projectiles with a fragmentation jacket are already known.

For example, EP 0 328 877 A shows a projectile with a fragmentation jacket composed of several individual rings which are pushed onto a cylindrical mandrel of the projectile base body. An explosive charge is located inside the cylindrical mandrel. The rings are each divided into a number of segments, which form predetermined breaking points and fragment into pieces of the desired size, wherein the segments are joined together by sintering within the rings.

The disadvantage of this design, however, is that the production of the segmented rings by sintering is complex and the segmented rings are merely attached to the projectile base body, which is why the achievable explosion pressure and thus the effective radius of the fragments when this projectile explodes essentially only depends on the selected wall thickness of the cylindrical mandrel.

GB 2 052 694 A, for example, discloses a projectile with a casing composed of coaxial rings, wherein the rings have complementary interlocking formations that prevent radial displacement of the rings. The tubular wall of the projectile can therefore consist only of the rings without the need for a projectile base body to form an inner casing or an outer casing for the rings. The rings can be bonded together using a heat-resistant resin.

The disadvantage of this design is at least that both the precise manufacture of the interlocking rings and the assembly of the rings, which have to be glued together to form an assembled casing, are complex. In addition, there is a risk with this projectile that the assembled or glued-together casing will be destroyed when the projectile is fired due to the high stresses involved, thus increasing the safety risk for the operating personnel and the risk of collateral damage when handling or

using such a projectile.

Furthermore, FR 1 257 604 A, for example, discloses a projectile with a fragmentation jacket that can be assembled from the simplest possible prefabricated parts. To assemble the projectile, a guide sleeve is attached to a warhead, for example by welding, wherein the guide sleeve holds a stack of identical rings. A corresponding number of rings can either be threaded onto the outside of the guide sleeve or stacked on top of each other on the inside of the guide sleeve. Finally, a base socket, which is designed as the tail unit of the projectile, is attached to the guide sleeve.

Another disadvantage of this design is that the rings are only fitted in stacks inside or outside the guide sleeve, which is why the achievable explosion pressure and thus the effective radius of the fragments when the projectile explodes essentially depends on the selected wall thickness of the guide sleeve. Furthermore, the rings are made of cast iron or steel, but are not fragmented in themselves, which is why fragments of different sizes are produced in a detrimental way when this projectile explodes.

OBJECT OF THE INVENTION

It is therefore the object of the invention to overcome the disadvantages known from the prior art for a generic projectile and to specify an improved projectile with a fragmentation section formed from at least two or more fragmentation bodies, which is as efficient and cost-effective as possible in its manufacture, wherein the manufacture of such a projectile should be largely standardized and/or automated.

In addition, the invention is intended to provide an improved projectile which, in its handling and in use together with appropriate launching devices, for example with grenade launchers, offers increased safety for the operating personnel and meets corresponding quality standards.

In addition, the improved projectile should have increased strength compared to the projectiles known from the prior art in order to be able to provide projectiles with a large caliber. Furthermore, the projectile according to the invention should also have an increased fragmentation density as well as an increased total fragmentation mass and thus an increased effectiveness compared to conventional

generic projectiles.

By definition, fragmentation density is the number of effective fragments per unit area as a function of the distance from the point of impact of the projectile. The performance characteristic for fragmentation ammunition is usually specified as the respective distance at which the fragmentation density is 1, i.e. one effective fragment per square meter of surface area of a standardized target. By definition, a projectile fragment is classified as "effective" if it penetrates the standardized target - usually steel plates are used - or causes a material crack in this target.

By definition, the total fragmentation mass is the mass fraction of fragmentation elements or fragmentation bodies in relation to the total mass of the projectile. The greater the proportion of the total fragmentation mass of a projectile and the more uniform the size distribution of the resulting fragments, the more effective the projectile is.

It is also the object of the present invention to provide a method for producing such an improved projectile.

SUMMARY OF THE INVENTION

These objects are solved in a generic projectile having a projectile base body which has a recess for receiving explosive and, at least in sections, a preferably cylindrical jacket surface oriented along a longitudinal axis of the projectile base body, and wherein at least one fragmentation group comprising at least two mutually adjacent annular fragmentation bodies is provided, wherein the fragmentation bodies are threaded along the jacket surface and form a fragmentation section of the projectile, according to the invention in that at least respectively adjacent fragmentation bodies of a fragmentation group are connected to one another by means of at least one weld bead.

Further advantageous embodiments and variants of the invention are set out in the description and the dependent claims.

The construction of a projectile according to the invention is based on a projectile base body which has a recess for receiving explosives and, at least in sections, a preferably cylindrical jacket surface oriented in the longitudinal direction of the

projectile base body or a corresponding, preferably cylindrical jacket section. The jacket surface is preferably substantially rotationally symmetrical in design and positioned coaxially in relation to the longitudinal axis of the projectile base body. The projectile according to the invention comprises at least one fragmentation group having at least two or more annular fragmentation bodies, which are threaded adjacent to one another along the cylindrical jacket surface. The at least two annular fragmentation bodies of a fragmentation group, which are arranged adjacent to one another, form a fragmentation section of the projectile.

By definition, the term "weld bead" is understood below to mean any welded connection that is suitable for connecting the at least two annular fragmentation bodies of a fragmentation group, which are arranged adjacent to each other, to each other by welding in a non-detachable or materially bonded manner. The strength and stability of the projectile construction is advantageously increased by the fragmentation bodies welded together by means of at least one weld bead.

In the following, the term "welding" refers to the non-detachable joining of components using heat and/or pressure, with or without the use of filler materials. The result of the welding process, especially in the case of fusion welding processes, is an intimate, materially bonded connection between the joining partners, the welded connection.

The term "weld bead" used here is independent of the selected production method for the welded connection. For example, a pulsed welding process can be used to apply individual weld spots to connect adjacent fragmentation bodies of a fragmentation group, wherein the individual weld spots together form one or more weld beads. Likewise, one or more weld beads can be produced in the form of a continuous weld seam, at least in sections. Likewise, within the scope of the invention, one or more weld beads can be arranged in a suitable manner, for example overlapping, preferably in a spiral, in order to connect at least adjacent fragmentation bodies of a fragmentation group as tightly as possible with a flat welding jacket or to cover the fragmentation bodies on the outside with such a flat welding jacket. In addition, further weld beads can also be provided, for example to fix or connect together the at least two or more adjacent ring-shaped fragmentation bodies, which are arranged in their installation position adjacent to each other and threaded along the casing surface.

The embodiment according to the invention, according to which at least in each case adjacent fragmentation bodies of a fragmentation group are connected to each other by means of at least one weld bead, offers numerous advantages:

- The manufacture of the at least one weld bead, in order to join together adjacent fragmentation bodies of a fragmentation group of such a projectile, can be largely standardized and/or automated and therefore cost-effective. The projectile according to the invention can therefore be manufactured economically while complying with predefined quality standards.
- The at least one weld bead as a welded connection of at least the respective adjacent fragmentation bodies of a fragmentation group of the projectile increases the strength and thus also the safety during handling of the projectile according to the invention. Particularly advantageously, projectiles according to the invention can also be provided with a large caliber, since sufficient strength or stability of the projectile can be ensured by the welded connection of the at least respectively adjacent fragmentation bodies of a fragmentation group with at least one or more weld beads.
- Collateral damage, in particular undesirable injuries to personnel entrusted with the handling of such projectiles, can be avoided due to the construction of the projectile according to the invention, which is reinforced with one or more weld beads.
- In the case of the projectile according to the invention, a suitable arrangement of one or more weld beads for connecting fragmentation bodies can build up an increased explosion pressure compared to conventional fragmentation projectiles, since the strength and rigidity of the walls of the projectile as a whole is increased by the fragmentation bodies welded together. Increased strength and rigidity of the projectile wall is particularly necessary in order to be able to provide projectiles of large design or large caliber according to the invention.
- Depending on the design of the projectile according to the invention, one or more fragmentation groups may be provided, each comprising at least

two or more annular fragmentation bodies adjacent to one another, wherein the adjacent fragmentation bodies of a fragmentation group are each connected to one another by at least one weld bead. In this way, projectiles according to the invention can be provided, depending on the selected design or depending on the intended use of the projectile, which have an increased fragmentation density as well as an increased total fragmentation mass and thus an increased effectiveness compared to conventional generic projectiles.

Preferably, the fragmentation bodies are made of metal, which is why common welding techniques known to the person skilled in the art can be used for welding metals in order to connect the adjacent fragmentation bodies of a fragmentation group with at least one weld bead. The specific choice of material, which metals or metal alloys are selected to manufacture the individual fragmentation bodies, depends on numerous individual factors. Depending on the intended use and size of the projectile, any quality requirements to be met and ballistic aspects such as the total mass and the adjustment of the position of the center of mass of the projectile, it may be advantageous if individual fragmentation bodies and/or other components of the projectile are made of different metals or metal alloys.

For example, the metal materials used may differ in their alloy composition and/or density. In the context of the invention, for example, individual fragmentation bodies and/or components of the projectile can be made of comparatively light metal materials, so-called light metals. Light metals are generally defined as metals and alloys whose density is below 5.0 g/cm^3 . For example, fragmentation bodies and/or components of the projectile made of aluminum or aluminum alloys fall into this material category.

Individual fragmentation bodies and/or components of the projectile can also be made of heavy metals such as steel or steel alloys. The density of steel is around 7.85 g/cm^3 .

Fragmentation bodies and/or components of the projectile that are made of tungsten or tungsten alloys, for example, offer the advantage that they are particularly heavy. Tungsten is a heavy metal with a high density of around 19 g/cm^3 . Tungsten alloys have approximately twice the density of steel and are used for armor-piercing ammunition. The position of the projectile's center of mass can

be adjusted by selecting the appropriate material for the fragmentation bodies and/or components of the projectile.

Similarly, within the scope of the invention, all fragmentation bodies and/or components of the projectile can be made of the same metal material, for example steel or alloy steel.

In a preferred embodiment of the invention, in a projectile according to the invention, each fragmentation body of a fragmentation group can have an outer surface opposite the jacket surface, wherein the outer surfaces of all fragmentation bodies of a fragmentation group define the surface of the projectile in this fragmentation section.

In the following, the term "surface" of the projectile is understood to mean the outer surface of the respective projectile around which air flows during flight. The individual, ring-shaped fragmentation bodies, which can be disk-shaped, for example, preferably in the form of circular disks, project with their outer surfaces and/or outer edges up to the outer surface of the projectile. The outer surfaces and/or outer edges of each fragmentation body therefore each form a surface section of the surface of the projectile in the corresponding fragmentation section.

Each fragmentation body of a fragmentation group can therefore have an outer surface opposite the jacket surface, which is bounded by outer edges. Opposite outer edges of adjacent fragmentation bodies of a fragmentation group are connected to each other by means of at least one weld bead.

Alternatively, in the case of cutting-edge shaped fragmentation bodies, each fragmentation body of a fragmentation group can have an outer surface which is formed by a single outer edge opposite the jacket surface. The surface of the projectile in this fragmentation section is formed by the cutting edge-shaped, sharp-edged outer edges of the fragmentation bodies. The at least one weld bead for joining adjacent fragmentation bodies can, for example, be arranged in the notches between the cutting edge-shaped outer edges of two adjacent fragmentation bodies.

Furthermore, fragmentation bodies can be used in a projectile according to the invention, wherein at least one of the outer surfaces of the fragmentation bodies of

a fragmentation group has a circular arc-shaped, preferably semi-circular, cross-section. In this case, the transition of the semicircle into the base body of the fragmentation body is regarded as the outer edge.

These possible design variants of the fragmentation bodies are described in detail in the following figure description.

The design of the projectile construction, in particular the design and embodiment of the entire surface of the projectile or its outer contour, depends on numerous ballistic parameters, such as the air resistance of the projectile and its center of mass in relation to the position of the aerodynamic center of the projectile during the flight path of the projectile. In order to avoid undesired spinning movements during the flight of the projectile and to stabilize the projectile on its flight path, the geometric design and structuring of the surface of the projectile can also be decisive in addition to the selection of a suitable tail fin, the suitable weight trim for the exact definition of the position of the center of mass of the projectile in relation to the position of the aerodynamic center, in order to be able to provide a projectile according to the invention with the lowest possible air resistance and the most stable flight path possible. The outer surfaces of all fragmentation bodies of a fragmentation group define the surface of the projectile in this fragmentation section.

For example, annular fragmentation bodies with outer diameters that become larger or smaller when viewed in the longitudinal direction of the projectile base body can be arranged next to one another on the, preferably cylindrical, jacket surface of the projectile base body in order to form thickenings and/or tapers or concave and/or convex surface sections on the outer surface or surface of the projectile according to the invention in this way. The geometry of the outer surface of the projectile and the flow resistance of the projectile during its flight phase can be optimized by suitably selecting the outer diameter of the respective fragmentation bodies of a fragmentation section.

Depending on the thicknesses or widths of the individual fragmentation bodies measured in the longitudinal direction of the fragmentation body or in the longitudinal direction of the projectile base body, the outer surfaces of the individual fragmentation bodies can, for example, form surface sections of the surface of the projectile that run flush with a smooth outer contour without

unevenness between adjacent fragmentation bodies.

Alternatively, individual fragmentation bodies or all fragmentation bodies of a fragmentation section of the projectile can have outer surfaces with outer edges, which outer edges each form a surface section of the surface of the projectile in question. For example, step-shaped or notch-shaped outer edges can be formed on the surface of the projectile in that adjacent fragmentation bodies have different outer diameters in steps and/or are threaded onto the cylindrical shell surface in an inclined or slanted arrangement. The outer edge sections or outer edges of the fragmentation bodies can also be designed with beveled surfaces, so-called chamfers.

In the installation position of such fragmentation bodies, i.e. in a position threaded next to each other along the jacket surface of the projectile base body, surface sections with chamfered edges or cutting edges can result in such a case, which at least in sections result in a roughened, angular surface of the projectile.

In summary, it is expedient if the outer surfaces and/or outer edges of the individual annular fragmentation bodies are designed and shaped in such a way that these surface sections correspond in each case to the desired course of the surface of the corresponding projectile based on ballistic considerations.

Within the scope of the invention, it is also possible that the surface of the projectile is optionally covered at least in sections with a coating and/or with a single-layer or multi-layer wrapping material. However, such a coating or at least partial wrapping with a wrapping material does not change the functionality of the projectile according to the invention.

In an expedient further development of the invention, the at least one weld bead can be applied to the surface of the projectile in the fragmentation section of such a projectile, which facilitates the production of the at least one weld bead.

Advantageously, in a projectile according to the invention, the at least one weld bead can run in an orthogonal plane to the longitudinal axis of the projectile base body and preferably be annular in shape. In this embodiment, at least a sectional, preferably gapless, welding of the annular gap between two respectively adjacent fragmentation bodies is ensured. The at least one weld bead is preferably also

closed in an annular shape in accordance with the course of the annular gap and closes the annular gap along its entire circumferential length. In this way, a particularly stable and tight welded connection can be achieved between the two fragmentation bodies welded together.

In the case of multiple adjacent fragmentation bodies, which are threaded along the jacket surface of the projectile base body, in this case a separate weld bead must be arranged for each annular gap between two adjacent fragmentation bodies in order to weld the respective annular gap with the weld bead at least in sections, preferably without gaps along its entire circumferential length. The two or more weld beads run parallel to each other in an orthogonal plane to the longitudinal axis of the projectile base body. Depending on the selected material thickness or width of the individual fragmentation bodies, the two or more weld beads running parallel to each other can at least partially overlap or, in an alternative embodiment variant, can be spaced apart from each other.

In a further, particularly flexible embodiment of the invention, more than two fragmentation bodies can be provided in a projectile in a fragmentation group and adjacent fragmentation bodies can each be connected to one another by means of a weld bead. In this embodiment, it is advantageously not the positioning of the at least one weld bead in relation to the longitudinal axis of the projectile base body that is important, but the fact that the more than two fragmentation bodies are each connected to the respective adjacent fragmentation bodies with one or more weld beads. The weld beads can also be arranged or welded independently of each other.

In a particularly robust embodiment variant of a projectile according to the invention, the at least one weld bead can be part of a flat welded connection which connects the outer surfaces of each fragmentation body of a fragmentation group. In this embodiment, the outer surfaces of each fragmentation body of a fragmentation group are covered with a flat welding joint, a so-called welding jacket. Depending on the design, this welding jacket can be made of at least one weld bead, which is arranged in a spiral, preferably overlapping, for example, or of several weld beads arranged in strips.

In order to further increase the strength of the projectile, the flat welded connection of a projectile according to the invention can be made up of several

separate weld beads which are applied in an overlapping manner to the surface of the projectile in a fragmentation section. Even in the case of several weld beads arranged in strips, a particularly dense, flat welding jacket is obtained on the outer surfaces of the fragmentation bodies of a fragmentation group if the weld beads arranged in strips at least partially overlap each other. Advantageously, the individual weld beads can be welded separately and independently of each other.

In an alternative embodiment variant of a projectile according to the invention, the flat welded connection can consist of a single weld bead which is applied in an overlapping, preferably spiral, manner. When producing the welded connection, this embodiment offers the advantage that a single weld bead can be applied continuously, i.e. without having to interrupt the welding process. The continuous production of the welded connection can therefore be carried out particularly quickly and cost-effectively.

In order to simplify the manufacture of a projectile according to the invention, it may be expedient if non-adjacent fragmentation bodies of a fragmentation group, preferably all fragmentation bodies of a fragmentation group, are connected to one another by means of at least one further weld bead. In this embodiment, multiple, preferably all, fragmentation bodies of a fragmentation group can be joined together with one or more further weld beads. The at least one further weld bead serves to fix the relative position of the fragmentation bodies of a fragmentation group with respect to each other or with respect to the projectile base body. The at least one further weld bead can, for example, only be used for auxiliary fixing of the fragmentation bodies of a fragmentation group to each other and/or to the projectile base body in order to subsequently be able to weld the adjacent fragmentation bodies to each other as efficiently as possible with at least one or more weld beads.

In an expedient further development of the invention, the at least one further weld bead can be applied to the surface of the projectile in this fragmentation section in the longitudinal direction of the fragmentation section. In this case, the at least one further weld bead runs in the longitudinal direction of the fragmentation section, wherein the longitudinal direction of the fragmentation section also corresponds to the longitudinal direction of the projectile base body.

In order to further facilitate the manufacture of such a projectile, at least two

further weld beads can be provided according to the invention, which are applied opposite one another to the surface of the projectile in a fragmentation section and oriented in the longitudinal direction of the projectile. Advantageously, the at least two additional weld beads are arranged in pairs opposite each other in the longitudinal direction on the surface of the projectile in order to avoid undesirable distortion of the projectile or the fragmentation bodies welded together if longitudinal welding is only performed on one side. The additional weld beads, which are arranged in pairs, are each applied to the surface of the projectile in the circumferential direction, substantially rotated by 180° around the longitudinal direction. Optionally, at least two additional weld beads can be provided in pairs opposite each other. These additional two further weld beads are expediently arranged evenly between the first pair of opposing weld beads, also in the longitudinal direction on the surface of the projectile, so that the individual further weld beads are each arranged in the circumferential direction in a position rotated further by substantially 90° about the longitudinal axis of the projectile base body.

In a particularly advantageous manner, the fragmentation bodies of a projectile according to the invention can be disk-shaped. In this embodiment, the opposing side surfaces of the disk-shaped fragmentation bodies lie in two parallel planes.

The projectile according to the invention can also be designed as a guided missile, but is usually not a guided missile and in this case cannot be actively controlled during the flight phase after launching or firing. Surprisingly, the use of flat, disk-shaped fragmentation bodies has proven to be particularly effective for projectiles that impact the target area in an essentially vertical direction of fall. This is particularly the case when dropping such projectiles from a helicopter or from drones, which drop one or more projectiles according to the invention essentially vertically above the respective target area.

In an alternative embodiment, at least two fragmentation groups can be provided in a projectile according to the invention and the fragmentation bodies of one fragmentation group can have a different angle of inclination in relation to the orthogonal plane than the fragmentation bodies of the other fragmentation group, at least in sections.

As was surprisingly recognized, projectiles according to the invention which have at least two fragmentation groups with fragmentation bodies, wherein the

fragmentation bodies of the at least two fragmentation groups are arranged at different angles of inclination in relation to the orthogonal plane, are particularly effective in the case of oblique projectile trajectories. For example, this is the case when such a projectile is fired from a grenade launcher or a projectile launcher, for example from a howitzer. As mentioned above, a projectile according to the invention is usually not a guided weapon. Optionally, however, a projectile according to the invention can be equipped with corresponding tail units, which can be adjusted by means of a remote control, for example, and in such a case can also serve as a guided weapon. Due to the different angles of inclination of the fragmentation bodies arranged in the two or more fragmentation groups, the actual impact angle of the projectile is compensated depending on the respective angle of its trajectory and the fragmentation density and thus the effectiveness of such a projectile is increased on impact in the target area.

In order to guide the projectile inside the launch tube or to seal it off from the launch tube when firing a projectile according to the invention from a launch tube, at least one of the annular fragmentation bodies can have a largest outside diameter which is smaller than the largest outside diameter of its adjacent fragmentation bodies in order to accommodate a sealing ring. By suitably arranging one or more annular fragmentation bodies with a relatively smaller outer diameter between annular fragmentation bodies with a relatively larger outer diameter on both sides, an annular circumferential notch can be produced on the surface of the projectile in a simple and cost-effective manner, which is intended to accommodate a sealing ring. For example, a so-called O-ring can be used as a sealing ring. O-rings are ring-shaped sealing elements that generally have an essentially round or O-shaped ring cross-section. Such a sealing ring can, for example, be made of plastic, in particular rubber, polyethylene (PE) or polytetrafluoroethylene (PTFE). The sealing ring is expediently arranged in the area of the largest outer diameter of the projectile and is dimensioned in such a way that this sealing ring seals the projectile as gas-tightly as possible against the launch tube during the firing process.

In a further advantageous embodiment, at least two fragmentation groups spaced apart from one another can be provided in a projectile according to the invention, wherein an inner, first positioning element threaded along the jacket surface is provided between the fragmentation groups, and an external, second positioning

element is arranged, which surrounds the internal positioning element, wherein a circumferential groove for receiving a sealing ring is formed in the external positioning element. In this embodiment, an inner, first positioning element and an external, second positioning element, which surrounds the internal positioning element and is preferably pressed with the internal positioning element, have the advantage that the combined positioning element provides a particularly flexible component of the projectile: Depending on the design and size of the combined positioning element, this can be used, for example, to adjust the position of the center of mass of the projectile. For example, the inner, first positioning element can be made of a very light material, while the outer, second positioning element is made of a metal or a metal alloy, for example, and can therefore be welded to the adjacent fragmentation bodies of the two fragmentation groups by means of at least one further weld bead or boundary weld bead.

According to an advantageous further development of such a projectile according to the invention, the inner, first positioning element can be made of aluminum and the outer, second positioning element can be made of a weldable material, preferably steel or a steel alloy, wherein the two positioning elements are pressed together. The inner, lightweight aluminum insert of the first positioning element is advantageous for adjusting the center of mass of the projectile. Furthermore, in connection with the projectile according to the invention, aluminum shows very good fragmentation during the explosion or detonation of the impacting projectile in the respective target area. The external, second positioning element, which is pressed together with the internal aluminum insert and surrounds the internal first positioning element, is advantageously made of a weldable material.

Preferably, the external, second positioning element can be made of steel or steel alloys.

Depending on the design, in a projectile according to the invention, the outermost fragmentation bodies of a fragmentation group can be connected to the projectile base body or to a positioning element and/or to a closure element by means of at least one boundary weld bead. The one or more boundary weld beads are used to weld the outermost fragmentation bodies of a fragmentation group to the projectile base body, to a positioning element adjacent to it and/or to another component of the projectile, for example to a closure element of the recess for holding explosives.

In this way, the outermost fragmentation bodies of a fragmentation group are also connected to adjacent components of the projectile with at least one boundary weld bead, which advantageously further increases the strength and rigidity of the projectile construction.

A projectile according to the invention can be particularly effective, in which the at least one weld bead and/or the at least one further weld bead and/or the at least one boundary weld bead, preferably all weld beads, is or are designed to be gas-tight.

Depending on the requirements for the quality of the welded connections, ring-shaped weld beads or spiral-shaped weld beads between adjacent, adjoining fragmentation bodies and/or full-surface weld beads in the form of a full-surface welding jacket, which is formed on the outside around the fragmentation bodies to be welded, can ensure that the at least two or more adjacent, adjoining fragmentation bodies are welded as gas-tightly as possible. It can be particularly advantageous if, in the case of one or more spiral weld beads, the course of the weld beads is selected to overlap in a spiral, wherein a full-surface welding jacket is formed which covers the outer surface or the surface of the projectile. Thus, in this embodiment variant, a projectile according to the invention is provided with which a particularly high explosion pressure can be achieved during detonation and which is particularly effective in use.

Depending on the application and the individual requirements of the projectile according to the invention, established test methods for the quality of welded connections known to the person skilled in the art can be used for the leak test of the welded connections. For example, a test projectile with a perforated projectile base body can be used to test the tightness of the welded connections, wherein the projectile base body is pressurized with a test gas, for example helium, and any pressure losses in the projectile and/or the amount of test gas escaping from the projectile are recorded.

The objects mentioned at the beginning are also solved according to the invention with a method for producing a projectile according to the invention, wherein the method comprises the following steps:

- Providing a projectile base body with a preferably cylindrical jacket

surface;

- Providing at least two ring-shaped fragmentation bodies;
- Threading the fragmentation bodies onto the jacket surface, wherein a group of adjacent fragmentation bodies form a fragmentation group and each fragmentation body of a fragmentation group has an outer surface opposite the jacket surface and the outer surfaces of all fragmentation bodies of a fragmentation group define the surface of the projectile in one or in this fragmentation section;
- Applying at least one weld bead, which connects at least two adjacent fragmentation bodies to each other.

Depending on the embodiment variant, it may be advantageous if, optionally after threading the fragmentation bodies onto the jacket surface and before applying at least one weld bead, the fragmentation bodies are pushed close together in their threaded position on the jacket surface so that the threaded fragmentation bodies are fixed in their installation position and there are as few gaps as possible between the adjacent fragmentation bodies. This can facilitate the subsequent welding and increase the quality of the weld of the at least one weld bead.

In the case of an embodiment according to the invention, in which the threaded fragmentation bodies are fixed in their installation position on the jacket surface by means of a screwable closure element, it may be expedient to screw the closure element onto the projectile base body with a torque depending on the embodiment, in order to thus fix the threaded fragmentation bodies in their installation position by pressing them together with the screwed-on closure element, if possible without intervening gaps.

The numerous advantages and beneficial effects mentioned above with regard to the projectile according to the invention apply analogously to the manufacturing method according to the invention, with which different embodiments of projectiles according to the invention can be manufactured in a particularly flexible manner. In order to avoid repetition, reference is therefore made to the previous remarks on the projectile according to the invention.

In the method according to the invention, it is particularly expedient to apply separate weld beads to join respectively adjacent fragmentation bodies. In this method variant, adjacent fragmentation bodies can be joined together independently of each other with separate weld beads. The arrangement and the type of design of the separate weld beads can be individually adapted to the respective requirements.

In an advantageous further development, the separate weld beads can be applied to the surface of a fragmentation section in an orthogonal plane to the longitudinal axis in the method according to the invention. For this purpose, the separate weld beads are designed in a ring shape, preferably as closed rings, each running in the circumferential direction along the gaps between adjacent fragmentation bodies. The weld beads can be welded independently of each other.

The method according to the invention can be carried out particularly expediently if the separate weld beads are applied overlapping each other. In this method variant, a particularly dense welding jacket can be produced on the surface of at least one fragmentation section, wherein a particularly robust projectile with a high-strength design can be obtained in accordance with the method.

In an alternative embodiment of the method according to the invention, adjacent fragmentation bodies can be joined together by means of a single weld bead, preferably applied in a spiral shape, extending along the surface of a fragmentation section. This method variant offers the advantage that a particularly rapid and possibly automated weld can be carried out by means of the individual weld bead, which is applied continuously in spiral form.

In a further advantageous method variant, non-adjacent fragmentation bodies can be joined together by applying at least one further weld bead in the longitudinal direction of the projectile and extending along the surface of a fragmentation section. The one or more additional weld beads can be used to quickly join several or all fragmentation bodies of a fragmentation section together. Subsequently, the at least one or more weld beads for joining and sealing the respective adjacent fragmentation bodies can be carried out particularly precisely and efficiently, as the fragmentation bodies are already fixed in their position relative to the projectile base body by the at least one further weld bead in the longitudinal direction of the projectile.

In the method according to the invention, the welding can be carried out particularly expediently by means of a laser welding process, preferably by means of a pulsed laser welding process.

In the pulsed laser welding process, the energy supply is emitted at timed intervals. After each laser pulse, there is a short pause in which the previously generated melt cools down. This fine welding process is particularly suitable for thin-walled workpieces, for joining components with very different geometries and for materials that are difficult to weld. In pulsed welding, welding points are set in a pulsed manner, wherein the welding pulse can be specifically adjusted to the materials to be joined and the welding depth in the materials to be joined can be regulated.

Advantageously, the pulsed laser welding process can be carried out without long interruptions, as welding is always carried out at the same temperature and the risk of distortion of the materials or components to be joined is therefore low. In the manufacturing process according to the invention, this welding process is preferably used to apply the at least one weld bead for joining at least two adjacent fragmentation bodies.

In contrast to the pulsed laser welding process, laser welding in continuous wave (cw) mode involves a continuous supply of energy during the welding process. The disadvantage of continuous wave laser welding is that the temperature of the components to be joined can rise constantly during continuous operation, resulting in a risk of distortion when welding the components. Welding must therefore be interrupted repeatedly to allow the components to be joined to cool down again, which is why this welding process cannot be used to achieve a consistently stable welding process.

In order to reduce the flow resistance of the projectile during its flight phase, it can be advantageous, according to a further variant of the method according to the invention, if at least a section of the surface of the projectile is surface-treated before the at least one weld bead is applied, preferably by means of a machining process, particularly preferably by means of turning. Moreover, surface treatment of at least one section of the projectile prior to welding can facilitate the application of the at least one weld bead in this surface-treated section.

Alternatively or in addition to a surface treatment of at least one section of the

surface of the projectile prior to the application of the at least one weld bead, in the method according to the invention at least one section of the surface of the projectile can be surface-treated after the application of the at least one weld bead, preferably by means of a machining process, particularly preferably by means of turning or coating, wherein the surface treatment also comprises at least one section of the at least one weld bead. In this case, too, the surface treatment can reduce the air resistance of the projectile during the throwing phase and thus improve the ballistic properties of the projectile.

The positional indications of parts or components of the projectile used in the following, such as the terms "top", "bottom", "above", "below", "front", "rear", "lateral", "inside", "outside", "in axial direction", "in radial direction" and the like, essentially serve to provide a better understanding of the invention, in particular in connection with the following drawings. The positional indications used may possibly refer to specific positions of individual components of the projectile or to individual views in the figures. In any case, such positional indications are familiar to the person skilled in the art.

BRIEF DESCRIPTION OF THE FIGURES

The invention will now be explained in more detail with reference to a number of exemplary embodiments. The schematic drawings are exemplary and are intended to illustrate the idea of the invention, wherein:

- Fig. 1** shows a sectional view from the side of a first embodiment of a projectile according to the invention;
- Fig. 2** shows a side view of a single disk-shaped fragmentation body with notches on both sides;
- Fig. 3** shows an isometric view oblique from above of the fragmentation body shown in Fig. 2;
- Fig. 4** shows a lateral sectional view of the fragmentation body shown in Figs. 2 and 3 according to the sectional plane A-A shown in Fig. 2;
- Fig. 5** shows, in an isometric view from the side, five fragmentation bodies

arranged next to each other as shown in Fig. 2;

- Fig. 6** shows the fragmentation bodies shown in Fig. 5 after the application of separate, ring-shaped weld beads between respectively adjacent fragmentation bodies;
- Fig. 7** shows the fragmentation bodies shown in Fig. 5 after the application of a continuous, spiral-shaped weld bead for joining the fragmentation bodies together;
- Fig. 8** shows the fragmentation bodies shown in Fig. 5 after the application of a continuous, flat welding jacket, which connects and covers the fragmentation bodies;
- Fig. 9** shows, in an isometric view obliquely from the side, five conically shaped fragmentation bodies arranged side by side;
- Fig. 10** shows the fragmentation bodies shown in Fig. 9 after the application of separate, ring-shaped weld beads between adjacent fragmentation bodies;
- Fig. 11** shows the fragmentation bodies shown in Fig. 9 after the application of a continuous, spiral-shaped weld bead for joining the fragmentation bodies together;
- Fig. 12** shows the fragmentation bodies shown in Fig. 9 after the application of a continuous, flat welding jacket, which connects and covers the fragmentation bodies;
- Fig. 13** shows, in a sectional view from the side, a second embodiment of a projectile according to the invention;
- Fig. 14** shows, in a sectional view from the side, a third embodiment of a projectile according to the invention;
- Fig. 15** shows, in a sectional view from the side, a fourth embodiment of a projectile according to the invention;

- Fig. 16** shows, in a sectional view from the side, a fifth embodiment of a projectile according to the invention;
- Fig. 17** shows, in a sectional view from the side, a sixth embodiment of a projectile according to the invention;
- Fig. 18** shows, in a half sectional view from the side, a seventh embodiment of a projectile according to the invention;
- Fig. 19** shows a detailed view of the area B marked in Fig. 16;
- Fig. 20** shows a detailed view of the area C marked in Fig. 17;
- Fig. 21** shows a detailed view of the area D marked in Fig. 18;
- Fig. 22** shows a sectional view from the side of an eighth embodiment of a projectile according to the invention;
- Fig. 23** shows a detailed view of the area E marked in Fig. 22;
- Fig. 24** shows a sectional view from the side of two adjoining fragmentation bodies with a rectangular disk profile;
- Fig. 25** shows a sectional view from the side of two adjoining fragmentation bodies with an essentially rectangular disk profile with rounded outer edges;
- Fig. 26** shows a sectional view from the side of two adjoining fragmentation bodies with a triangular disk profile, each with a tapered, blade-shaped outer edge;
- Fig. 27** shows a sectional view from the side of an eighth embodiment of a projectile according to the invention in the form of a mortar shell;
- Fig. 28** shows a sectional view from the side of a ninth embodiment of a projectile according to the invention in the form of an artillery shell.

MODE OF OPERATION OF THE INVENTION

Fig. 1 shows a sectional view from the side of a first embodiment of a projectile 1 according to the invention. The projectile 1 is of rotationally symmetrical design and has an axis of rotation 2. The projectile 1 shown has a largest outside diameter 3, also known as caliber 3, with the largest outside diameter 3 being arranged in an orthogonal plane ϵ in relation to the axis of rotation 2. The projectile 1 has a projectile tip 4 with an ignition device 5 at its one free end seen in the direction of the axis of rotation 2. At its free end opposite the projectile tip 4, as seen in the direction of the axis of rotation 2, the projectile 1 has a tail section 6, as is usual, for example, in a design of the projectile 1 as a mortar shell for attaching a tail fin. The reference sign 7 designates the surface 7 of the projectile 1, i.e. the outer surface or outer contour of the projectile 1. The surface 7 can have one or more surface-treated sections 8, at least in sections. For example, a surface-treated section 8 is outlined here in Fig. 1, wherein this section 8 of the surface 7 has been smoothed by means of turning, i.e. a rotationally symmetrical machining process.

The tail section 6 is provided here, for example, with an external thread 9, which external thread 9 serves as a connection thread for a tail fin shown in Fig. 27, for example, which can be screwed onto the external thread 9 of the tail section 6. Depending on the intended use of the projectile 1, different tail fins can be attached to the tail section 6. An appropriate tail fin serves to stabilize the trajectory of the projectile 1 and to prevent an undesired spin of the flying projectile 1. By adjusting the center of gravity of the projectile 1 in conjunction with the tail fin, it is ensured that the launched projectile 1 hits a planned target area with its projectile tip 4 first and that the ignition device 5 is activated on impact.

The projectile 1 has a basic projectile base body 10, which is also of rotationally symmetrical design in this case and has a longitudinal axis 11 that coincides with or is identical to the axis of rotation 2 of the projectile 1. The longitudinal axis 11 of the projectile base body 10 defines its longitudinal direction 11. The projectile base body 10 has a cylindrical jacket section 12 with a cylindrical jacket surface 13, which is oriented along the longitudinal axis 11 of the projectile base body 10. The cylindrical jacket section 12 has an outer diameter 14, a wall thickness 15 and an inner diameter 16. Inside the cylindrical jacket section 12 with the cylindrical jacket surface 13 there is a recess 17 for taking up explosives. The ignition device 5 on

the projectile tip 4 interacts with the explosive in the recess 17 and ensures that the explosive in the recess 17 is ignited and explodes when the fired or ejected projectile 1 hits the ground, detonating the projectile 1. To fill the explosive located in the recess 17 in Fig. 1, a closure element 18 is used, which is designed here as a screwing element and which is screwed onto the cylindrical jacket section 12 of the basic projectile base body 10.

Multiple ring-shaped fragmentation bodies 20 are threaded along the cylindrical jacket surface 13. For a better overview, the annular fragmentation bodies 20 are alternately designated here as first fragmentation body 21 and, adjacent thereto or directly adjacent thereto, as second fragmentation body 22. Here and in the following, the reference sign 20 refers both generally to one or more of the fragmentation bodies shown and also specifically to a particular first fragmentation body 21 or a particular second fragmentation body 22. The annular fragmentation bodies 20 are designed here as disk-shaped first 21 and second 22 fragmentation bodies. The adjacent, disk-shaped fragmentation bodies 21, 22 touch each other on their side surfaces, which are arranged in the direction of orthogonal planes ε , i.e. orthogonal to the longitudinal axis 11 of the basic projectile base body 10. The parting planes τ between adjacent fragmentation bodies 21, 22 are also oriented orthogonally to the longitudinal axis 11 of the basic projectile base body 10 and coincide with the orthogonal planes Σ of the side surfaces of the fragmentation bodies 21, 22.

The multiple ring-shaped fragmentation bodies 20, 21, 22 are shaped in such a way that their inner surfaces or inner diameters can be fitted as accurately as possible onto the cylindrical outer surface 13 of the projectile base body 10. The outer diameters of the multiple ring-shaped fragmentation bodies 20, 21, 22 can vary - as can be seen in Fig. 1 - since the outer surfaces of each fragmentation body 21, 22 each define a section of the surface 7 of the projectile 1, wherein the surface 7 or the course of the outer contour of the surface 7 is designed to follow the aerodynamic requirements of the projectile 1.

In each case, adjacent fragmentation bodies 20, 21, 22 are connected to each other with at least one weld bead 30. In the embodiment shown in Fig. 1, an annular weld bead 31 extends in an orthogonal plane Σ to the longitudinal axis 11 of the projectile base body 10 between the respective adjacent fragmentation bodies 20,

21, 22. The separate annular weld beads 31 are each arranged in such a way that they each run in an orthogonal plane Σ or parting plane τ between adjacent fragmentation bodies 21,22 and weld the annular gap between two adjacent disk-shaped fragmentation bodies 21,22 along its entire circumference. Advantageously, the annular weld beads 31 are each applied separately and thus independently of one another on the surface 7 of the projectile 1 in the region of the respective annular gap between two adjacent fragmentation bodies 21, 22. Boundary weld beads 35 are arranged between the respective outermost fragmentation bodies 20, 21, 22 and the adjoining projectile base body 10 on one side or the adjoining closure element 18 on the opposite, other side, which boundary weld beads 35 are also designed here as annular weld beads and connect the respective outermost fragmentation bodies 20, 21, 22 with the adjoining components 10, 18 of the projectile 1. The annular gaps between the respective outermost fragmentation bodies 20, 21, 22 and the adjacent components 10, 18 of the projectile 1 are sealed here by the annular peripheral boundary weld beads 35.

The multiple adjacent fragmentation bodies 20, 21, 22 threaded along the jacket surface 13, each of which is of disk-shaped design here, form a first fragmentation group 41 as well as a first fragmentation section 51 of the projectile 1. The outer surfaces of all fragmentation bodies 20, 21, 22 of the first fragmentation group 41 define the surface 7 in this first fragmentation section 51. The embodiment of a projectile 1 according to the invention shown in Fig. 1 has only a single fragmentation group 41 comprising a plurality of annular or here disk-shaped fragmentation bodies 20, 21, 22, wherein this single fragmentation group 41 forms a single fragmentation section 51 of the projectile 1.

In the following, embodiments of projectiles 1 according to the invention are also described which have multiple fragmentation groups on different fragmentation bodies or multiple fragmentation sections.

In the embodiment illustrated in Fig. 1, the largest outer diameter 3 - the caliber 3 - of the projectile 1 is formed in the area of the projectile base body 10. A circumferential notch 60, which is formed on this section of the projectile base body 10 with the largest outside diameter 3, is used here to accommodate a sealing ring 63, the profile of which is indicated by a dashed line.

Figs. 2 to 4 show a single disk-shaped fragmentation body 20, 21 with notches 69

on both sides. The following description of the figures refers equally to Figs. 2 to 4.

Fig. 2 shows a side view of the individual disk-shaped fragmentation body 20, 21 with notches 69 on both sides.

Fig. 3 shows an isometric view obliquely from above of the fragmentation body 20, 21 shown in Fig. 2.

Fig. 4 shows a lateral sectional view of the fragmentation body 20, 21 shown in Figs. 2 and 3 according to the sectional plane A-A shown in Fig. 2.

In general, a fragmentation body 20 has an outer surface 201 which is usually bounded by a first outer edge 202 and by a second outer edge 203 of the fragmentation body 20. The first outer edge 202 and the second outer edge 203 can be spaced apart from each other, forming the intermediate outer surface 201 with a thickness 204 or width 204.

According to the embodiment of a fragmentation body 21 with a disk-shaped profile shown in Figs. 2 to 4, wherein the outer surface 211 is bounded by a first outer edge 212 and by a second outer edge 213 of the fragmentation body 21 opposite the first outer edge 212 and the two outer edges 212, 213 are substantially at right angles, the thickness 214 or width 214 of the outer surface 211 substantially corresponds to the thickness 214 or width 214 of the fragmentation body 21 shown.

The width of the outer surface of a fragmentation body or the distance between the opposing outer edges can also be different from the thickness or width of the fragmentation body 20, as shown in Fig. 25.

Alternatively, individual or all fragmentation bodies 20 can also be designed in such a way that they taper outwards in a pointed or cutting edge shape, wherein in such a case the outer surface of the respective fragmentation body 20 is formed by a single outer edge. This variant is illustrated in Fig. 26 below.

Returning to Figs. 2 to 4, a fragmentation body 20 generally has an outer diameter 205 and an inner surface 206 opposite the outer surface 201 with an inner diameter 207. The inner diameter 207 must be adapted to the respective outer diameter 14

of the cylindrical jacket section 12 of the projectile base body 10, so that the respective fragmentation body 20 can be inserted or threaded onto the projectile base body 10 along the jacket surface 13 of the cylindrical jacket section 12. The type of fit selected between the respective inner surface 206 of the fragmentation body 20 and the corresponding jacket surface 13 of the cylindrical jacket section 12 of the projectile base body 10 depends on the quality requirements of the respective projectile 1 and can, for example, be designed as a clearance fit, transition fit or interference fit. The fragmentation body 20 has a first side surface 208 and a side surface 209 opposite the first side surface 208.

The disk-shaped fragmentation body 21 shown here in Figs. 2 to 4 has an outer diameter 215 and an inner surface 216 opposite the outer surface 211 with an inner diameter 217. The two opposite side surfaces 218, 219 of the disk-shaped fragmentation body 21 run parallel to each other. In the installation position of the disk-shaped fragmentation body 21, in which the fragmentation body 21 in question is located threaded along the cylindrical jacket surface 13 of a cylindrical jacket section 12 of the projectile base body 10 of a projectile according to the invention, the two side surfaces 218, 219 are positioned orthogonally to the longitudinal direction 11 of the projectile base body 10.

In the following **Figs. 5 to 8**, five fragmentation bodies 20, 21, 22 arranged next to each other are shown in isometric views, comparable to the fragmentation body 20, 21 illustrated in Fig. 2, as these are arranged adjacent to each other within a fragmentation group 41 in Fig. 1, for example. For the sake of simplicity, the other parts and components of a projectile 1 according to the invention are not shown in Figs. 5 to 8.

In **Fig. 5**, the five identical disk-shaped fragmentation bodies 20 are each designated concentrically in relation to an axis of rotation 2 of the projectile 1, which is not shown, or to a longitudinal axis 11 of a projectile base body 10, which is also not shown, in an alternating manner with the reference signs 21 and 22. The first disk-shaped fragmentation body 21 has a first outer surface 211. The second disk-shaped fragmentation body 22 adjacent thereto has a second outer surface 221.

Fig. 6 shows the fragmentation bodies 20 shown in Fig. 5, i.e. the five respective disk-shaped fragmentation bodies 21, 22 after the application of weld beads 30

between respective adjacent fragmentation bodies 21, 22. The weld beads 30 are designed here as separate, ring-shaped weld beads 30, 31, which are applied in the direction of orthogonal planes Σ or of parting planes τ between adjacent disk-shaped fragmentation bodies 21, 22, i.e. in each case orthogonally to the longitudinal axis 11 of a projectile base body 10 on which the fragmentation bodies 21, 22 are mounted in the direction of orthogonal planes Σ or of parting planes τ between adjacent disk-shaped fragmentation bodies 21, 22, i.e. in each case orthogonal to the longitudinal axis 11 of a projectile base body 10, on which the fragmentation bodies 21, 22 are threaded in the installation position on the projectile 1. As outlined in Fig. 1, the parting planes τ between adjacent disk-shaped fragmentation bodies 21, 22 are also oriented orthogonally to the longitudinal axis 11 of a projectile base body 10 and coincide with the orthogonal planes Σ of the side surfaces of the fragmentation bodies 21, 22. Each annular weld bead 31 extends here in the circumferential direction of the annular gap between respectively adjacent fragmentation bodies 21, 22 and connects or welds them tightly together.

Fig. 7 shows the fragmentation bodies 20, 20 shown in Fig. 5, i.e. the disk-shaped fragmentation bodies 21, 22 after the application of a continuous, spiral-shaped weld bead 32 for the joint connection of the fragmentation bodies 21, 22. For the sake of clarity, the spiral-shaped weld bead 32 is drawn here in such a way that a free space remains between the adjacent sections of the spiral-shaped weld bead 32, which run essentially parallel to each other. In contrast to the separate ring-shaped weld beads 31 shown in Fig. 6, which can be carried out independently of each other, the spiral-shaped weld bead 32 shown in Fig. 7 is carried out as uninterrupted or continuously as possible. In order to achieve the tightest possible welding of the several fragmentation bodies 21, 22 arranged next to each other, the angle of attack or the pitch of the spiral weld bead 32 can be reduced so that the neighboring sections of the spiral weld bead 32 overlap in each case. Alternatively, a further or optionally multiple further spiral weld beads 32 can be arranged offset in the longitudinal direction 11 of a projectile base body 10 in addition to the spiral weld bead 32 already formed in order to cover the corresponding fragmentation section of the fragmentation bodies 21, 22 on the outside with a continuous, full-surface welding jacket 33.

A further weld bead 34 is applied here in the longitudinal direction 11 of the

fragmentation section formed by the fragmentation bodies 21, 22 shown, wherein the further weld bead 34 also connects fragmentation bodies 21, 22 that are not directly adjacent to each other. In order to avoid undesirable distortion during welding, a second further weld bead 34 is arranged opposite the back of the fragmentation bodies 21, 22, which is invisible in Fig. 7, extending transversely across the fragmentation bodies 21, 22 in the longitudinal direction 11. The two further weld beads 34 thus form a pair of weld seams on opposite surface sections of the connected fragmentation bodies 21, 22.

Fig. 8 illustrates the fragmentation bodies 21, 22 shown in Fig. 5 after the application of a continuous, flat welding jacket 33, which connects the five disk-shaped fragmentation bodies 21, 22 to each other and covers them together. The flat welding jacket 33 is produced here by multiple separate, ring-shaped weld beads 31, which are applied overlapping one another. Alternatively, such a flat welding jacket 33 can also be produced - as explained above with regard to Fig. 7 - by appropriately selecting a single, spiral-shaped weld bead 32, which is applied in an overlapping manner. A further weld bead 34 is applied here in the longitudinal direction 11 of the fragmentation section formed by the fragmentation bodies 21, 22 shown, in order to fix the disk-shaped fragmentation bodies 21, 22 in their relative position to one another before the flat welding jacket 33 is applied in strips.

In the following **Figs. 9 to 12** - comparable with the previously discussed Figs. 5 to 8 - five fragmentation bodies 20 arranged next to each other are again shown in isometric views. The fragmentation bodies 23, 24 shown here in Figs. 9 to 12 differ from the respective disk-shaped fragmentation bodies 21, 22 shown previously in Figs. 5 to 8 in that the fragmentation bodies 23, 24 shown here are each conically shaped, wherein the side surfaces of the fragmentation bodies 23, 24 each extending inclined at an angle of inclination in relation to the orthogonal plane Σ to the longitudinal axis 11 of a projectile base body. For the sake of simplicity, the other parts and components of a projectile 1 according to the invention are not shown in Figs. 9 to 12. In other respects, reference is made analogously to the previous description of Figs. 5 to 8.

In **Fig. 9**, the five identical, conically shaped or obliquely inclined fragmentation bodies 20 are each designated concentrically in relation to an axis of rotation 2 of the projectile 1 not shown or to a longitudinal axis 11 of a projectile base body 10,

also not shown, in an alternating manner with the reference signs 23 and 24.

Fig. 10 shows the fragmentation bodies 20 shown in Fig. 9, i.e. the five obliquely inclined fragmentation bodies 23, 24 after the application of weld beads 30 between adjacent fragmentation bodies 23, 24 in each case. Comparable to Fig. 6, the weld beads 30 in Fig. 10 are also designed as separate, ring-shaped weld beads 30,31, which are arranged to extend in the direction of orthogonal planes Σ and of parting planes τ between the adjacent fragmentation bodies 23, 24, i.e. in each case orthogonally to the longitudinal axis 11 of a projectile base body 10. Each annular weld bead 31 extends here in the circumferential direction of the annular gap between adjacent fragmentation bodies 23, 24 and connects or welds them tightly together.

Fig. 11 shows - comparable to Fig. 7 - the disk-shaped fragmentation bodies 23, 24 after the application of a continuous, spiral-shaped weld bead 32 for the joint connection of the fragmentation bodies 23, 24. For the sake of clarity, the spiral-shaped weld bead 32 is again drawn here in such a way that a free space remains between the adjacent sections of the spiral-shaped weld bead 32, which extend essentially parallel to each other. In order to achieve the tightest possible welding of the multiple fragmentation bodies 23, 24 arranged next to each other, the angle of attack or the pitch of the spiral weld bead 32 can be reduced or varied so that the adjacent sections of the spiral weld bead 32 overlap in each case. Alternatively, in each case in the longitudinal direction 11 of a projectile base body 10, a further or optionally multiple further spiral weld beads 32 can be arranged offset to the already executed spiral weld bead 32 and additionally superimposed in order to cover the corresponding fragmentation section of the fragmentation bodies 23, 24 on the outside with a continuous, full-surface welding jacket 33.

A further weld bead 34 is applied here in the longitudinal direction 11 of the fragmentation section formed by the fragmentation bodies 23, 24 shown, wherein the further weld bead 34 also connects fragmentation bodies 23, 24 that are not directly adjacent to one another.

Fig. 12 illustrates - similar to Fig. 8 - the fragmentation bodies 23, 24 shown after the application of a continuous, flat welding jacket 33, which connects the five disk-shaped fragmentation bodies 21, 22 to each other and covers them together. The flat welding jacket 33 is produced here by multiple separate, ring-shaped weld

beads 31, which are applied overlapping one another. Alternatively, such a flat welding jacket 33 - as explained above with regard to Fig. 11 - can also be produced by appropriately selecting a single, spiral-shaped weld bead 32, which is applied in an overlapping manner. A further weld bead 34 is applied here in the longitudinal direction 11 of the fragmentation section formed by the fragmentation bodies 23, 24 shown in order to fix the fragmentation bodies 23, 24 in their relative position to one another before the flat welding jacket 33 is applied in strips.

In the following figures, identical or functionally identical parts and components of a projectile 1 are each marked with the same reference signs. In order to avoid repetition, the following description will therefore essentially only describe different details compared to the figures discussed so far.

Fig. 13 shows a second embodiment of a projectile 1 according to the invention. This second embodiment differs essentially from the first embodiment shown in Fig. 1 in that here an annular fragmentation body 20, which is designed as a disk-shaped fragmentation body 21, has a largest outside diameter 215 which is smaller than the largest outside diameter 225, 235 of its adjacent fragmentation bodies 22, 23, which are also designed as disks. In this way, a circumferential groove is produced in a cost-effective manner to accommodate a sealing ring. This receptacle for the sealing ring not shown in Fig. 13 during the manufacture of the projectile 1 can be provided in a simple manner by threading at least one disk-shaped fragmentation body 21 with a smaller outer diameter 215 between adjacent fragmentation bodies 22, 23 each with a larger outer diameter 225, 235 within the fragmentation group 41 onto the jacket surface 13 of the projectile base body 10. If necessary, the position of the at least one disk-shaped fragmentation body 21 with a smaller outside diameter 215 and thus the position of the circumferential groove for receiving a sealing ring can still be adjusted by correspondingly repositioning this fragmentation body in the longitudinal direction 11 within the fragmentation group 41 before the positions of the fragmentation bodies 21, 22, 23 within the fragmentation group 41 or within the fragmentation section 51 are connected to each other by the annular weld beads 30, 31, which are arranged separately in each case here, and are thus fixed in a non-detachable manner.

Fig. 14 shows a third embodiment of a projectile 1 according to the invention. Two fragmentation groups 41, 42 are provided in this projectile 1. Between the two

fragmentation groups 41, 42, an inner, first positioning element 65 threaded along the jacket surface 13 is provided. An external, second positioning element 66 is arranged such that this external, second positioning element 66 surrounds the internal positioning element 65, wherein a circumferential groove 62 for receiving a sealing ring 63 is formed in the external positioning element 66. In order to be able to adjust the center of mass of the projectile 1 with the combined positioning element 65, 66, the inner, first positioning element 65 is made here of a light metal, for example aluminum. The outer, second positioning element 66 is made of a weldable material, for example steel, and the two positioning elements 65, 66 are pressed together. Optionally, the number of fragmentation bodies 21, 22 of the first fragmentation group 41 or the first fragmentation section 51 and/or the number of fragmentation bodies 23, 24 of the second fragmentation group 42 of the second fragmentation section 52 can be varied during threading along the jacket surface 13 in order to be able to adjust the position of the combined positioning element 65, 66 along the jacket surface 13 and thus the position of the center of mass of the projectile 1. The fragmentation bodies 20, 21, 22, 23, 24 attached to the jacket surface 13 are in turn connected to each other by annular weld beads 31. The outermost fragmentation bodies 20, 21, 22, 23, 24 of a fragmentation group 41, 42 are each connected to the adjacent positioning element 66 or projectile base body 10 or closure element 18 by a boundary weld bead 35.

Fig. 15 shows a fourth embodiment of a projectile 1 according to the invention with three fragmentation groups 41, 42, 43 or with three fragmentation sections 51, 52, 53. Between the first fragmentation group 41 and the second fragmentation group 42, a positioning element 68 in cylindrical ring form is threaded on here, which has a circumferential groove 62 on the outside for receiving a sealing ring. Between the second fragmentation group 42 and the third fragmentation group 43 there is also a positioning element 68 in cylindrical ring form, but without a circumferential groove. The respective disk-shaped fragmentation bodies 21, 22 of the first fragmentation group 41, the respective disk-shaped fragmentation bodies 23, 24 of the second fragmentation group 42 and the respective disk-shaped fragmentation bodies 25, 26 of the third fragmentation group 43 are each connected to one another by a spiral weld bead 32 for each fragmentation group 41, 42, 43.

Fig. 16 shows a fifth embodiment of a projectile 1 according to the invention having three fragmentation groups 41, 42, 43 or having three fragmentation

sections 51, 52, 53.

Fig. 17 shows - comparable to Fig. 16 - a sixth embodiment of a projectile 1 according to the invention, also having three fragmentation groups 41,42,43 or having three fragmentation sections 51,52,53. The two embodiments differ essentially only in details of the respective welded connections, which are shown in the following Figs. 19 and 20. Apart from these different welds, which will be discussed separately, the following description therefore refers equally to Figs. 16 and 17.

The fragmentation bodies 20,21,22 of the first fragmentation group 41 or the first fragmentation section 51 are arranged here at an inclination angle θ in relation to the orthogonal plane Σ . The fragmentation bodies 20, 25, 26 of the third fragmentation group 43 or the third fragmentation section 53 are inclined here at an angle of inclination φ in relation to the orthogonal plane Σ . The two angles of inclination φ , θ are selected differently here, for example, as shown in Fig. 17. The fragmentation bodies 20, 23, 24 of the middle, second fragmentation section 52 are disk-shaped, wherein parting planes τ between adjacent fragmentation bodies 23, 24 are oriented parallel to or in the direction of the orthogonal plane Σ to the longitudinal axis 11 of the projectile base body 10.

A conical ring-shaped positioning element 67 is located between the first fragmentation section 51 with the inclined fragmentation bodies 21, 22 and the second fragmentation section 52 with the fragmentation bodies 23, 24 arranged orthogonally to the longitudinal axis 11 of the projectile base body 10. Similarly, a conical ring-shaped positioning element 67 is threaded between the second and third fragmentation groups 42, 43 or between the second and third fragmentation sections 52, 53. As shown in Fig. 17, a surface-treated section 8 extends here both along the rear section of the projectile base body 10 and along some fragmentation bodies 25, 26 in the region of the third fragmentation group 43.

Fig. 18 shows a section of a seventh embodiment of a projectile 1 according to the invention with two fragmentation groups 41, 42, wherein an inner, first positioning element 65 threaded along the jacket surface 13 is provided between the two fragmentation groups, and an external, second positioning element 66 is arranged, which surrounds the internal positioning element 65, wherein a circumferential groove 62 for receiving a sealing ring is formed in the external positioning element

66. The inner, first positioning element 65 is manufactured here, for example, from aluminum and the outer, second positioning element 66 is manufactured here, for example, from a weldable material, namely from a steel alloy. The two positioning elements 65, 66 are pressed together.

Fig. 19 shows a detailed view of the area B marked in Fig. 16. The inclined or tilted fragmentation bodies 21, 22 of the first fragmentation group 41 are each connected to each other with separate, ring-shaped weld beads 31.

Fig. 20 shows a detailed view of the area C marked in Fig. 17. Here, the inclined or tilted fragmentation bodies 21, 22 of the first fragmentation group 41 are constructed with a flat welded connection 30, 32, 33, 34 consisting of several separate weld beads 32, 34, which are applied overlapping to the surface 7 of the projectile 1 in this first fragmentation section 51 and which form a full-surface weld jacket 33.

Fig. 21 shows a detailed view of the area D marked in Fig. 18. The outermost, disk-shaped fragmentation body 24 of the second fragmentation group 42 is connected here on the one hand to the adjacent projectile base body 10 with a boundary weld bead 35. On the other hand, the disk-shaped fragmentation body 24 is connected to the adjacent disk-shaped fragmentation body 23 with an annular weld bead 31.

Fig. 22 shows a sectional view from the side of an eighth embodiment of a projectile 1 according to the invention having two fragmentation groups 41, 42 with fragmentation bodies 20, 21, 22 inclined in opposite directions.

Fig. 23 shows a detailed view of the area E marked in Fig. 22 with fragmentation bodies 21, 22 inclined at an angle of inclination $\angle$ in relation to the orthogonal plane Σ to the longitudinal direction 11 of the projectile base body 10. The outer surfaces 211, 221 of the fragmentation bodies 21, 22 have notch-shaped recesses on their longitudinal edges, which is why the first outer edges 212, 222 and second outer edges 213, 223, which are opposite each other and delimit the outer surfaces 211, 221, have a smaller distance than the thickness or width of the fragmentation bodies 21, 22. The notch-shaped recesses on the surface 7 offer the advantage that weld beads not shown here, for example annular weld beads 31, can be applied within these notch-shaped recesses to join adjacent fragmentation bodies 21, 22,

wherein the surface 7 of the projectile 1 remains as smooth as possible and is not disturbed by the applied weld beads 31.

Fig. 24 shows a sectional view from the side of two adjoining, respectively disk-shaped fragmentation bodies 21, 22 with a rectangular disk profile. The first fragmentation body 21 has an outer surface 211, a first outer edge 212 and an opposite second outer edge 213, a thickness or width 214, an outer diameter 215, an inner surface 216, an inner diameter 217, as well as a first side surface 218 and a second side surface 219 opposite the first side surface 218. The second fragmentation body 22 has an outer surface 221, a first outer edge 222 and an opposite second outer edge 223, a thickness or width 224, an outer diameter 225, an inner surface 226, an inner diameter 227, as well as a first side surface 228 and a second side surface 229 opposite the first side surface 228. The widths of the outer surfaces 211, 221 correspond here in each case to the thicknesses or widths 214, 224 of the two fragmentation bodies 21, 22 between the respective opposite side surfaces 218, 219 or 228, 229 of the two fragmentation bodies 21, 22. The two fragmentation bodies 21, 22 are connected to one another by an annular weld bead 31. The annular weld bead 31 extends in an orthogonal plane Σ to the longitudinal axis of the projectile base body 10 or in the parting plane τ between the adjacent fragmentation bodies 21, 22.

Fig. 25 shows a sectional view from the side of two adjoining fragmentation bodies 23, 24, specifically a third fragmentation body 23 and a fourth fragmentation body 24, each with a substantially rectangular disk profile with rounded outer edges 232, 233 and 242, 243 respectively. The widths of the outer surfaces 231, 241 are slightly smaller than the thicknesses and widths 234, 244 of the two fragmentation bodies 23, 24 due to the rounded outer edges 232, 233 and 242, 243 respectively. 242, 243 are slightly smaller than the thicknesses or widths 234, 244 of the two fragmentation bodies 23, 24. The thicknesses or widths 234, 244 of the two fragmentation bodies 23, 24 correspond to the distances between the opposing side surfaces 218, 219 or 228, 229 of the two fragmentation bodies 21, 22.

The two fragmentation bodies 23, 24 are connected to each other by an annular weld bead 31, which is arranged in the area of the rounded outer edges 233, 242. The annular weld bead 31 runs in an orthogonal plane Σ to the longitudinal axis of the projectile base body 10 or in the parting plane τ between the adjacent

fragmentation bodies 23, 24.

Fig. 26 shows a sectional view from the side of two adjoining fragmentation bodies 25, 26 with a triangular disk profile, each with a blade-shaped outer edge tapering outwards. The fifth fragmentation body 25 has an outer surface 251, which is formed by the single outer edge 252, has a variable thickness or width 254, an outer diameter 255, an inner surface 256, an inner diameter 257, as well as a first side surface 258 and a second side surface 259 opposite the first side surface 258. The sixth fragmentation body 26 has an outer surface 261 formed by the blade-shaped single outer edge 262, and also has a variable thickness or width 264, an outer diameter 265, an inner surface 266, an inner diameter 267, as well as a first side surface 268 and a second side surface 269 opposite the first side surface 268.

The widths of the outer surfaces 251, 261 of the two fragmentation bodies 25, 26 correspond here to the widths of the respective tapered, blade-shaped outer edges 252, 262 of the two fragmentation bodies 25, 26. The two fragmentation bodies 25, 26 are joined together here by an annular weld bead 31 in the region of the greatest thickness or width 254, 264 of the two fragmentation bodies 25, 26, which region is directly adjacent to the cylindrical jacket surface 13 of the projectile base body 50. The annular weld bead 31 again extends in an orthogonal plane Σ to the longitudinal axis of the projectile base body 10 or in the parting plane τ or, in this case, in the circumferential direction of the notch between the adjacent fragmentation bodies 25, 26.

Fig. 27 shows a projectile 1 according to the invention in the form of a mortar shell. The basic shape of the projectile 1 shown here with the projectile base body 10, which has a recess 17 for receiving explosives, wherein a plurality of adjacent fragmentation bodies 20 are threaded along a longitudinal axis 11 of the projectile base body 10 on a jacket surface of the projectile base body 10, and wherein respectively adjacent fragmentation bodies 20 are connected to each other by at least one weld bead 30, 31, has already been described in detail in Fig. 1 above. Reference is therefore made here to the above description of Fig. 1. In addition to the illustration in Fig. 1, a tail fin 90 is already attached to the tail section 6 of the projectile 1 in the form of the fully assembled mortar shell in Fig. 27. The tail fin 90 is attached with an internal thread to the corresponding external thread 9 of the tail section 6 of the projectile base body 10. The tail fin 90 shown here contains, for

example, a propellant charge and a propellant charge igniter.

An ignition device 5 is screwed onto the projectile tip 4 by means of a screw thread 91 on a closure element 18. The closure element 18 is in turn screwed onto a section of the projectile base body 10 with a further screw thread 92. On the one hand, the closure element 18 shown here serves to press the fragmentation bodies 20 previously threaded onto the jacket surface 13 of the basic projectile base body 10 against each other in their installation position. On the one hand, this ensures that no undesirable gaps occur between the disk-shaped, adjacent fragmentation bodies 20. On the other hand, the pressing between adjacent fragmentation bodies 20 as a result of the screwed closure element 18 facilitates the subsequent application of the weld beads 30, 31, with which adjacent fragmentation bodies 20 are joined together.

After filling the recess 17 with explosives, the recess 17 is closed by screwing the ignition device 5 into the screw thread 91 of the closure element 18. The projectile 1 or the mortar shell shown here is thus ready for firing, for example by means of a mortar.

Fig. 28 shows a projectile 1 according to the invention in the form of an artillery shell. In contrast to a mortar shell as shown in the preceding Fig. 27, the artillery shell here lacks a tail fin. The tail section 6 of the artillery shell therefore also has no connection thread for a tail fin, but is designed here, for example, with a flat bottom surface which is aligned orthogonally to the longitudinal axis 11 of the projectile base body 10. The ignition device 5 is attached to the projectile tip 4 by means of a closure element 18 as a connecting piece with the projectile base body 10 in a similar way to the design shown in Fig. 27. Reference is made to the corresponding description of Fig. 27.

The artillery shell shown has a sealing ring 64 with a guide band at the rear in the area of the disk-shaped fragmentation bodies 20, wherein the sealing ring 64 is shrunk onto the underlying fragmentation bodies 20 or fragmentation disks. The sealing ring 64 is made of plastic, for example, and in this case comprises a guide band made of copper, which serves to seal against a launch tube of a corresponding gun when the artillery shell is fired.

LIST OF REFERENCE SIGNS

1	Projectile
2	Rotation axis of the projectile
3	Caliber, outer diameter of the projectile
4	Projectile tip
5	Ignition device
6	Tail section
7	Surface of the projectile; outer contour of the projectile
8	Surface-treated section
9	External thread; connection thread for tail fin
10	Projectile base body
11	Longitudinal axis of the projectile base body; longitudinal direction
12	Cylindrical jacket section of the projectile base body
13	Cylindrical jacket surface
14	Outer diameter of the cylindrical jacket section
15	Wall thickness of the cylindrical jacket section
16	Inner diameter of the cylindrical jacket section
17	Recess for explosives receptacle
18	Closure element, screwing element
20	Fragmentation body
201	Outer surface of the fragmentation body (or 211, 221, 231, ...)
202	(First) outer edge of the fragmentation body (or 212, 222, 232, ...)
203	(Second) outer edge of the fragmentation body (or 213, 223, 233, ...)
204	Thickness or width of the fragmentation body (or 214, 224, 234, ...)
205	Outer diameter of the fragmentation body (or 215, 225, 235, ...)
206	Inner surface of the fragmentation body (or 216, 226, 236, ...)
207	Inner diameter of the fragmentation body (or 217, 227, 237, ...)
208	First side surface of the fragmentation body (or 218, 228, 238, ...)
209	Second side surface of the fragmentation body (or 219, 229, 239, ...)
21	(First) fragmentation body
22	(Second) fragmentation body
23	(Third) fragmentation body
24	(Fourth) fragmentation body
25	(Fifth) fragmentation body
26	(Sixth) fragmentation body

LIST OF REFERENCE SIGNS (continued)

30	Weld bead
31	Annular weld bead between fragmentation bodies
32	Spiral weld bead (overlapping)
33	Full-surface welding jacket
34	Further weld bead
35	Boundary weld bead
41	(First) fragmentation group, group of fragmentation bodies
42	(Second) fragmentation group
43	(Third) fragmentation group
51	(First) fragmentation section
52	(Second) fragmentation section
53	(Third) fragmentation section
60	Circumferential notch (for sealing ring)
62	Circumferential groove
63	Sealing ring
64	Sealing ring with guide band
65	(First) positioning element, aluminum insert
66	(Second) positioning element, insert ring with groove
67	Positioning element, conical ring
68	Positioning element, cylindrical ring
69	Notch in the fragmentation body
90	Tail fin
91	Screw thread
92	Screw thread
α	Inclination angle α of the fragmentation body to the orthogonal plane ε
β	Inclination angle β of the fragmentation body to the orthogonal plane ε
ε	Orthogonal plane ε to the longitudinal axis of the projectile base body
τ	Parting plane τ between adjacent fragmentation bodies

CLAIMS:

1. Projectile (1) having a projectile base body (10) which has a recess (17) for receiving explosive and, at least in sections (12), a preferably cylindrical jacket surface (13) oriented along a longitudinal axis (11) of the projectile base body (10), and wherein at least one fragmentation group (41, 42, 43) comprising at least two mutually adjacent annular fragmentation bodies (20, 21, 22, 23, 24) is provided, which are threaded along the jacket surface (13) and form a fragmentation section (51, 52, 53) of the projectile (1), **characterized in that** at least respectively adjacent fragmentation bodies (20, 21, 22) of a fragmentation group (41, 42, 43) are connected to one another by means of at least one weld bead (30, 31, 32, 33, 34).
2. Projectile (1) according to claim 1, **characterized in that** each fragmentation body (20, 21, 22) of a fragmentation group (41, 42, 43) has an outer surface (201, 211, 221) opposite the jacket surface (13) and the outer surfaces (201, 211, 221) of all fragmentation bodies (20, 21, 22) of a fragmentation group (41, 42, 43) define the surface (7) of the projectile (1) in this fragmentation section (51, 52, 53).
3. Projectile (1) according to claim 2, **characterized in that** the at least one weld bead (30, 31, 32, 33, 34) is applied to the surface (7) of the projectile (1) in the fragmentation section (51, 52, 53).
4. Projectile (1) according to one of the preceding claims, **characterized in that** the at least one weld bead (30, 31, 32, 33, 34) extends in an orthogonal plane (Σ) to the longitudinal axis (11) of the projectile base body (10) and is preferably of annular design (31).
5. Projectile (1) according to one of claims 1 to 4, **characterized in that** more than two fragmentation bodies (20, 21, 22, 23, 24) are provided in a fragmentation group (41, 42, 43) and adjacent fragmentation bodies (20, 21, 22) are each connected to one another by means of a weld bead (30, 31, 32, 33, 34).
6. Projectile (1) according to one of claims 2 or 3, **characterized in that** the at least one weld bead (30, 31, 32, 33, 34) is part of a flat welded connection

(32, 33) which connects the outer surfaces (201, 211, 221, 223) of each fragmentation body (20, 21, 22, 23) of a fragmentation group (41, 42).

7. Projectile (1) according to claim 6, **characterized in that** the flat welded connection (32, 33) is composed of a plurality of separate weld beads (30, 31, 32, 34) which are applied in an overlapping manner to the surface (7) of the projectile (1) in a fragmentation section (51, 52, 53).
8. Projectile (1) according to claim 6, **characterized in that** the flat welded connection (32, 33) consists of a single weld bead (30, 32) which is applied in an overlapping, preferably spiral, manner.
9. Projectile (1) according to claim 1 to 5, **characterized in that** non-adjacent fragmentation bodies (20, 21, 23, 25) of a fragmentation group (41, 42, 43), preferably all fragmentation bodies (20, 21, 22, 23, 24, 25) of a fragmentation group (41, 42, 43), are connected to one another by means of at least one further weld bead (34).
10. Projectile (1) according to claim 9, **characterized in that** the at least one further weld bead (34) is applied to the surface (7) of the projectile (1) in this fragmentation section (51, 52) in the longitudinal direction (11) of the fragmentation section (51, 52).
11. Projectile (1) according to claim 10, **characterized in that** at least two further weld beads (34) are provided, which are applied opposite one another to the surface (7) of the projectile (1) in a fragmentation section (51, 52, 53) and in the longitudinal direction of the projectile (1).
12. Projectile (1) according to one of the preceding claims, **characterized in that** the fragmentation bodies (20, 21, 22, 23, 24) are disk-shaped.
13. Projectile (1) according to one of claims 1 to 11, **characterized in that** at least two fragmentation groups (41, 42, 43) are provided and the fragmentation bodies (20, 21, 22, 23, 24) of the one fragmentation group (41) have at least in sections a different angle of inclination (α , $^{\circ}$) in relation to the orthogonal plane (ϵ) than the fragmentation bodies (20, 23, 24, 25, 26) of the other fragmentation group (42).

14. Projectile (1) according to one of the preceding claims, **characterized in that** at least one of the annular fragmentation bodies (20, 21) has a largest outer diameter (205, 215) which is smaller than the largest outer diameter (225, 235) of its adjacent fragmentation bodies (22, 23), for receiving a sealing ring (63, 64).
15. Projectile (1) according to one of the preceding claims, **characterized in that** at least two fragmentation groups (41, 42) spaced apart from one another are provided, wherein an inner, first positioning element (65) threaded along the jacket surface (13) is provided between the fragmentation groups (41, 42), and an external, second positioning element (66) is arranged, which surrounds the internal positioning element (65), wherein a circumferential groove (62) for receiving a sealing ring (63, 64) is formed in the external positioning element (66).
16. Projectile (1) according to claim 15, **characterized in that** the inner, first positioning element (65) is made of aluminum and the outer, second positioning element (66) is made of a weldable material, preferably of steel or a steel alloy, and the two positioning elements (65, 66) are pressed together.
17. Projectile (1) according to one of the preceding claims, **characterized in that** the respective outermost fragmentation bodies (20, 21, 22) of a fragmentation group (41, 42) are connected to the projectile base body (10) or to a positioning element (65, 66, 67, 68) and/or to a closure element (18) by means of at least one boundary weld bead (35).
18. Projectile (1) according to one of the preceding claims, **characterized in that** the at least one weld bead (30, 31, 32, 33) and/or the at least one further weld bead (34) and/or the at least one boundary weld bead (35), preferably all weld beads (30, 31, 32, 33, 34, 35), is or are designed to be gas-tight.
19. Method for producing a projectile (1) according to one of the preceding claims 1 to 18, comprising the following steps of:
 - providing a projectile base body (10) with a preferably cylindrical jacket surface (13);

- providing at least two ring-shaped fragmentation bodies (20, 21, 22, 23, 24);
 - threading the fragmentation bodies (20, 21, 22, 23, 24) onto the jacket surface (13), wherein a group of adjacent fragmentation bodies (20, 21, 22) form a fragmentation group (41, 42) and each fragmentation body (20, 21, 22) of a fragmentation group (41, 42) has an outer surface (201, 211, 221) opposite the jacket surface (13) and the outer surfaces (201, 211, 221) of all the fragmentation bodies (20, 21, 22) of a fragmentation group (41, 42) define the surface (7) of the projectile (1) in a fragmentation section (51, 52);
 - applying at least one weld bead (30, 31, 32, 33), which connects at least two adjacent fragmentation bodies (20, 21, 22) to each other.
20. Method according to claim 19, **characterized in that** separate weld beads (30, 31, 32) are applied to join respectively adjacent fragmentation bodies (20, 21, 22).
21. Method according to claim 20, **characterized in that** the separate weld beads (30, 31, 32) are each applied to the surface (7) of a fragmentation section (51, 52) extending in an orthogonal plane (ϵ) to the longitudinal axis (11).
22. Method according to claim 21, **characterized in that** the separate weld beads (30, 31, 32) are applied overlapping each other.
23. Method according to claim 19, **characterized in that** respectively adjacent fragmentation bodies (20, 21, 22) are joined together by means of a single, preferably spirally applied weld bead (32) extending along the surface (7) of a fragmentation section (51, 52).
24. Method according to one of claims 19 to 23, **characterized in that** non-adjacent fragmentation bodies (20, 21, 23, 25) are joined together by applying at least one further weld bead (34) in the longitudinal direction (11) of the projectile (1) and extending along the surface (7) of a fragmentation section (51, 52).
25. Method according to one of claims 19 to 24, **characterized in that** the

welding is carried out by means of a laser welding process, preferably by means of a pulsed laser welding process.

26. Method according to one of claims 19 to 25, **characterized in that** at least one section of the surface (7) of the projectile (1) is surface-treated (8) before the application of the at least one weld bead (30), preferably by means of a machining process, particularly preferably by means of turning.
27. Method according to one of claims 19 to 26, **characterized in that** at least one section of the surface (7) of the projectile (1) is surface-treated (8) after the application of the at least one weld bead (30), preferably by means of a machining process, particularly preferably by means of turning or coating, wherein the surface treatment also comprises at least one section of the at least one weld bead (30).