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(54) **Title:**
METHOD FOR PRODUCTION OF A PROJECTILE, AS WELL AS A PROJECTILE

(57) **Abstract:**
-12- METHOD FOR PRODUCTION OF A PROJECTILE, AS WELL AS A PROJECTILE ABSTRACT The invention relates to a projectile (1) having a sub-calibre projectile core (2) and a guide cage (3) which comprises a driving element (4), which acts on the projectile core (2) at the rear, is in the form of a plate and is composed of metal. In order to produce a projectile (1) such as this at low cost, the invention proposes that the projectile core (2) and the driving element (4) which is in the form of a plate be inserted as inserts into an injection-moulding tool, and be extrusion-coated, with the injection-mould shape being chosen such that the contour of the guide cage (3) of the projectile is produced after the injection-moulding process. Fig. 1

METHOD FOR PRODUCTION OF A PROJECTILE, AS WELL AS A PROJECTILE

ABSTRACT

The invention relates to a projectile (1) having a sub-calibre projectile core (2) and a guide cage (3) which comprises a driving element (4), which acts on the projectile core (2) at the rear, is in the form of a plate and is composed of metal. In order to produce a projectile (1) such as this at low cost, the invention proposes that the projectile core (2) and the driving element (4) which is in the form of a plate be inserted as inserts into an injection-moulding tool, and be extrusion-coated, with the injection-mould shape being chosen such that the contour of the guide cage (3) of the projectile is produced after the injection-moulding process.

Fig. 1

DESCRIPTION

Method for production of a projectile, as well as a projectile

The invention relates to a method for production of a projectile, and to the projectile produced in this way, having a subcaliber projectile core and a guide sabot which has a drive element, which is in the form of a plate and acts on the projectile core at the rear end, and to an essentially cylindrical guide sabot which is adjacent to the drive element and is composed of plastic.

DE 36 35 738 A1 discloses a discarding sabot projectile, in which the front-end support and centering of the projectile core are carried out by a relatively narrow annular holder, which is connected via short ribs to the outer wall of the discarding sabot. A second centering holder is located in the unobstructed internal cross section/caliber of the projectile.

A discarding sabot for a subcaliber projectile has been published in DE 43 30 417 C2. In this case, the discarding sabot is a segmented, essentially hollow-cylindrical, guide sabot composed of a lightweight material which is less strong than steel. A conical drive element is inserted detachably in an inner circumferential groove at the lower end of the guide sabot, in the projectile direction. The subcaliber projectile is additionally surrounded at its lower end by the guide sabot and is centered at its front to central area by a supporting wall on which there is or are a hole or holes. The drive element (pusher plate) pushes the projectile through a weapon barrel, while the discarding sabot or guide sabot pulls the projectile.

These known discarding sabot projectiles have the disadvantage, inter alia, that their production is relatively complex because the discarding sabot must be assembled from a plurality of components and the projectile core must be separately connected to the discarding sabot. Furthermore, the rubber elements as well as insert parts must be introduced into the discarding sabot shells. In this case, the insertion and attachment of the rubber elements are highly time-consuming, for tolerance compensation.

The invention is based on the object primarily of specifying a method in particular for a kinetic-energy exercise projectile, which allows cost-effective production without any negative influence on the durability and hit accuracy of the projectile.

With regard to the method, this object is achieved according to the invention by the features of claim 1, and with regard to the projectile it is achieved by the features of claim 4. Further, particularly advantageous, refinements of the invention are disclosed in the dependent claims.

The invention is essentially based on the idea of producing a cost-effective projectile by inserting a projectile core together with a drive element as an insert, into an injection-molding tool, and insert-molding it, wherein the injection-molding mold is chosen such that the injection-molding process results in the contour of the guide sabot (inner core and outer shell) of the projectile sabot. The guide sabot is generated directly by an injection-molding process, and is connected to the insert parts (drive element, projectile) which are composed of metal, aluminum, etc. There is no need for subsequent assembly and setting to a specific external dimension (caliber dimension), thus

reducing the manufacturing and assembly time, and thus producing a more cost-effective projectile.

The material to be injection molded may be a plastic, a fiber-reinforced plastic or a material which is similar to a plastic.

A projectile which can be produced in this way has a guide sabot with an outer wall which, in a development of the invention, may have at least two but preferably three weak points, which are arranged distributed uniformly over the circumference and extend in the axial direction, and a radially running rear wall, which is adjacent to the drive element and can likewise be provided with weak points which are adjacent to the weak points in the outer wall. When they are provided, the weak points are also injection molded according to the invention, creating a discarding sabot formed from a plurality of parts, which can break up more easily. The projectile core is supported via at least three spacing elements, which are in the form of longitudinal ribs, on the inside of the outer wall, wherein in each case one longitudinal rib is associated with one guide sabot segment, which is defined by adjacent weak points, and wherein the longitudinal ribs extend axially from the drive element into the nose area of the guide sabot.

Furthermore, it has been found to be advantageous for the integrally formed guide sabot to also at least partially surround the drive element at the rear end.

In order to assist an advantageous separation behavior for the guide sabot segments, the longitudinal ribs may have recesses in the form of pockets at the front end.

In addition, a conically tapering profile of the longitudinal ribs extending forward from the rear wall,

makes it easier to remove from the injection-molding tools during the mold-removal process.

In a further embodiment of the invention, the guide sabot contains a sleeve which holds the projectile body and is in the form of a web, by means of which the longitudinal ribs are connected at the projectile end, wherein the sleeve which is in the form of a web is also provided with weak points which extend in the axial direction. In this case, the weak points may extend radially through the sleeve wall as far as the projectile body.

The use of a plastic as a projectile sabot can be assisted by the design of the drive element. This drive element is then designed such that it pushes the projectile through a weapon barrel, while the projectile sabot now acts only as a guide sabot for guiding the projectile, without any force being transmitted by the sabot and projectile.

Further details and advantages of the invention will become evident from the following exemplary embodiments, which are explained with reference to figures, in which:

figure 1 shows a perspective view of a discarding sabot projectile according to the invention,

figure 2 shows a front view of the discarding sabot projectile illustrated in figure 1;

figures 3 - 5 show three longitudinal sections through the discarding sabot projectile illustrated in figure 1, along the

section lines annotated III - III, IV - IV and V - V in figure 2.

In figures 1 and 2 - 5, 1 denotes a projectile according to the invention which can be fired from a 120 mm tank gun. The illustrated projectile 1 is in this case an exercise projectile.

The projectile 1 comprises a projectile core 2, for example composed of steel, and a guide sabot 3. In its rear area, the guide sabot 3 surrounds a drive element 4 which is in the form of a plate and is composed, for example of aluminum, and is composed of a glass-fiber-reinforced or carbon-fiber-reinforced plastic (for example polyamide).

The guide sabot 3 has an outer wall 6 which, at the front end, has a guide area 7 which rests against the corresponding inner barrel wall when the discarding sabot projectile 1 passes through a weapon barrel (not illustrated). On the inside, at least two and preferably four weak points 8 are provided in the outer wall 6, which are arranged distributed uniformly over the circumference and extend in the axial direction such that adjacent weak points in this exemplary embodiment define four guide sabot segments 9 (in practice an odd number of grid points and weak points is preferable).

The corresponding guide sabot segment 9 is in each case supported between two adjacent weak points 8 (that is to say in the case of the exemplary embodiment illustrated in figures 1 - 5 rotated for example through 45° with respect to the weak points - although this is not restrictive and other angles are also possible) via a spacing element 10, which is in the form of a longitudinal rib, on a sleeve 11 which surrounds the projectile core 2 and is in the form of a

web. In this case, the longitudinal ribs 10 extend from a rear wall 12, which is adjacent to the drive element 4, into the nose area of the guide sabot 3 and have recesses 13 in the form of pockets at the front end, in order to assist the separation behavior of the guide sabot segments 9 when the sabot projectile 1 is fired.

The sleeve 11, which surrounds the projectile core 2 and is in the form of a web, of the guide sabot 3 likewise has weak points 14 which extend in the axial direction and extend through the sleeve wall to the surface of the projectile core 2, and which are in the same angular position as the weak points 8 in the outer wall 6 with respect to the longitudinal axis 15 of the sabot projectile 1.

As can be seen in particular from figures 2 and 4, the rear wall 12 of the guide sabot 3 has radial weak points 16, which are adjacent to the weak points 8 in the outer wall 6 and to the weak points 14 in the sleeve 11 which is in the form of a web.

In order to produce the projectile 1 according to the invention with the guide sabot 3, the projectile core 2 and the drive element 4 are first of all detachably connected to one another, for example by clamping, and are inserted into an injection molding tool, which produces the contour of the guide sabot 3. The injection molding tool is then closed, and the injection molding process is started. In this case, the four (in this exemplary embodiment) guide sabot segments 9 of the guide sabot 3 are injection molded with the aid of four gates.

The material which flows into the mold areas which form the segments is intended to meet at the weak points which are provided. This results in the creation of so-

called "weld lines" which further additionally weaken the material at the weak point. It is therefore important to fill the four mold areas in parallel. Furthermore, the effect of the weak points is also assisted if the fibers are aligned parallel to the injection direction during the injection process.

After being removed from the mold, the provisional clamping between the projectile and the drive element is removed, and a tracer charge (not illustrated) is screwed into the appropriate recess 17 in the rear-end part of the projectile core 2.

In order to ensure removal from the mold as easily as possible, the longitudinal ribs 10 should taper conically (for example with a cone angle of 1°) in the direction in which they are removed from the mold (which corresponds to the firing direction of the projectile).

If the projectile cores as illustrated in figures 3 - 5 and provided with a conical fin assembly 18 are provided with mold-out areas on the external circumference of the conical fin assembly in order to produce a compensating spin (not illustrated), the longitudinal ribs 10 must engage in these recesses (injection-molded). In this case, care should be taken to ensure that the number of mold-out areas arranged in the fin assembly corresponds to the number of longitudinal ribs and therefore guide sabot segments present. Otherwise, problems can occur during the separation process of the guide sabot segments, because of undercuts, when the discarding sabot projectile is fired.

The invention, is, of course, not restricted to the exemplary embodiment described above. For example, it is possible to dispense with the inner wall of the

guide sabot surrounding the projectile core. In this case, the longitudinal ribs are directly supported on the surface of the projectile core. In addition, the injection-molding apparatus then has a different form.

The projectile according to the invention may also be a live projectile in which the projectile core is, for example, replaced by a penetrator composed of a heavy metal.

Furthermore it is in this way also possible to produce projectiles with a sabot, whose sabots are separated by ram-air pressure or centrifugal force, etc.

List of reference symbols

1	Projectile
2	Projectile core
3	Guide sabot
4	Drive element
6	Outer wall
7	Guide area
8	Weak point (outer wall)
9	Guide sabot segment
10	Spacing element, longitudinal rib
11	Sleeve
12	Rear wall
13	Recess
14	Weak point (sleeve)
15	Longitudinal axis
16	Weak point (rear wall)
17	Recess
18	Conical fin assembly

Claims:

1. A method for production of a projectile, having a subcaliber projectile core (2) and a sabot (3) as a guide sabot which has a drive element (4), which is in the form of a plate and acts on the projectile core (2) at the rear end, and adjacent to the drive element (4), **wherein**

- the essentially cylindrical guide sabot (3) is composed of a plastic or material which is similar to a plastic,
- the drive element (4) and the projectile core (2) are detachably connected to one another, and are inserted as insert into an injection-molding tool, which produces the contour of the guide sabot (3), and are insert molded.

2. The method as claimed in claim 1, **characterized** in that weak points (8, 14, 16) are also injection molded.

3. The method as claimed in claim 1 or 2, **characterized** in that guide sabot segments (9) are injection molded at the same time by means of a number of gates corresponding to the segments, such that the material which flows into the mold areas which form the segments meets at the weak points (16).

4. A projectile having a subcaliber projectile core (2) and a sabot (3) as a guide sabot which has a drive element (4), which is in the form of a plate and acts on the projectile core (2) at the rear end, and an essentially cylindrical guide sabot (3) which is adjacent to the drive element (4) and is composed of plastic, wherein the drive element (4) is firmly incorporated in the guide sabot (3) at the rear end.

5. The projectile as claimed in claim 4, **characterized** in that

- the guide sabot (3) has an outer wall (6) in which at least two weak points (8) are provided which are arranged distributed uniformly over the circumference and extend in the axial direction, and a rear wall (12), which is adjacent to the drive element (4) runs, radially and is likewise provided with weak points (16), which are adjacent to the weak points (8) in the outer wall (6).

6. The projectile as claimed in claim 4 or 5, **characterized** in that the projectile core (2) is connected via at least two spacing elements (10), which are in the form of longitudinal ribs, to the inner surface of the outer wall (6), wherein one longitudinal rib (10) is in each case associated with a guide sabot segment (9) which is defined by adjacent weak points (8) which extend axially from the rear wall (12) into the nose area of the guide sabot (5).

7. The projectile as claimed in one of claims 4 to 6, **characterized** in that the guide sabot (3) is formed integrally and at least partially surrounds the drive element (4) on the outside.

8. The projectile as claimed in one of claims 4 to 7, **characterized** in that the longitudinal ribs (10) have recesses (17), in the form of pockets, at the front end.

9. The projectile as claimed in one of claims 1 to 3, **characterized** in that the longitudinal ribs (10) each have a conically tapering profile which extends forward from the rear wall (12) of the guide sabot (5).

10. The projectile as claimed in one of claims 1 to 5, **characterized** in that the guide sabot (3) has a sleeve (11) which surrounds the projectile core (2) and is in the form of a web, to which the longitudinal ribs (10) are connected on the projectile side, and in that the sleeve (11) which is in the form of a web is also provided with weak points (16) which extend in the axial direction and are adjacent to the weak points (16) in the rear wall (12).

11. The projectile as claimed in claim 6, **characterized** in that the weak points (16) extend to the surface of the projectile core (2).

12. The projectile as claimed in one of claims 1 to 8, **characterized** in that the guide sabot (3) has four weak points (8) which are arranged distributed uniformly over the circumference of the outer wall (6) and extend in the axial direction, wherein the weak points (8) are located rotated through 45° with respect to the longitudinal ribs (10).

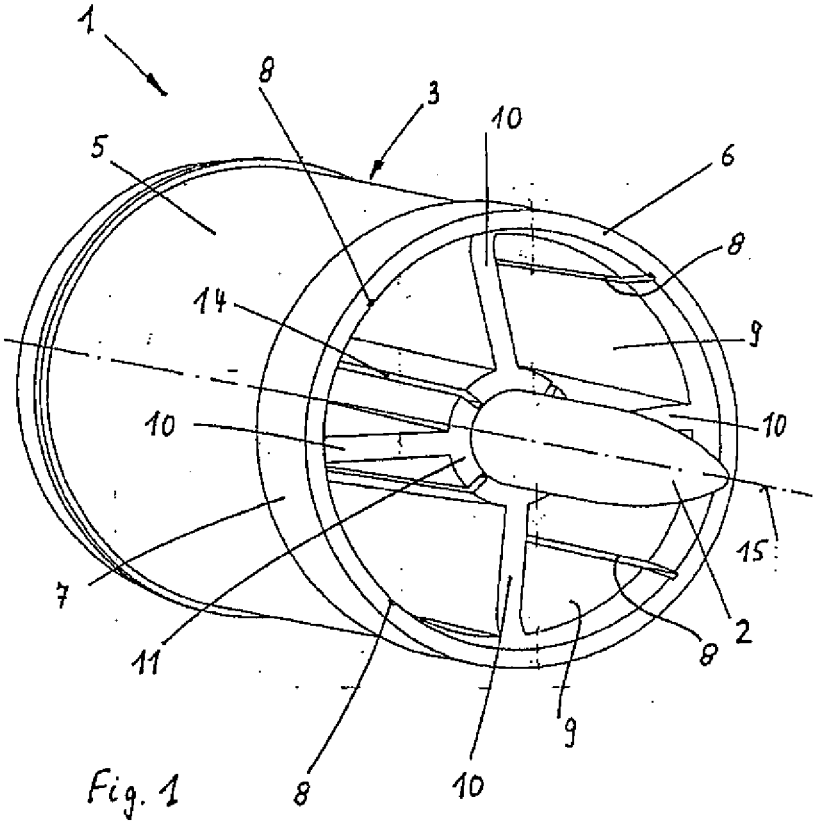

Fig. 1

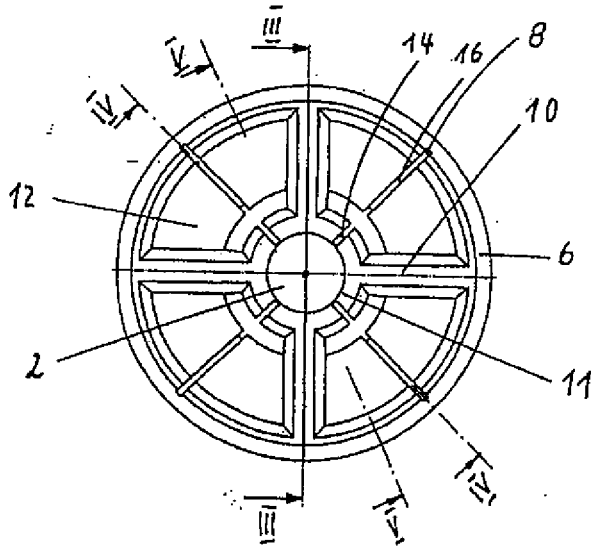

Fig. 2

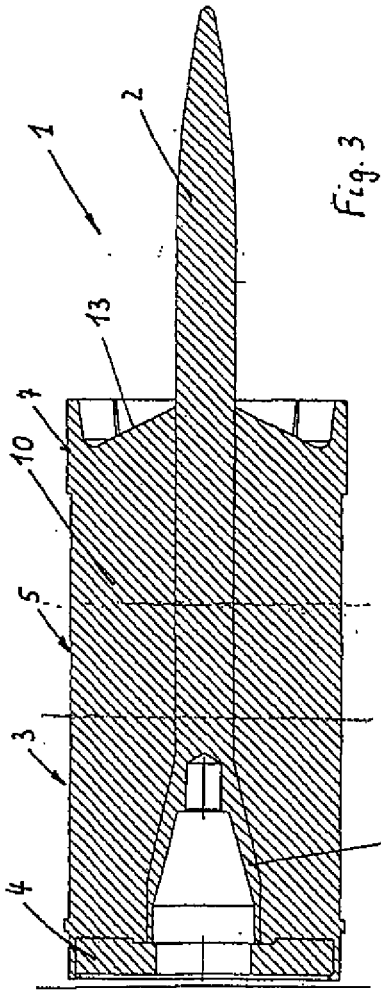

Fig. 3

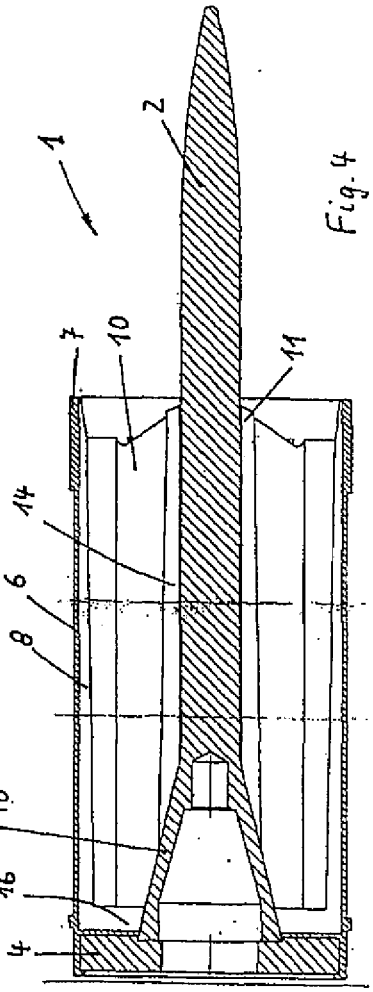

Fig. 4

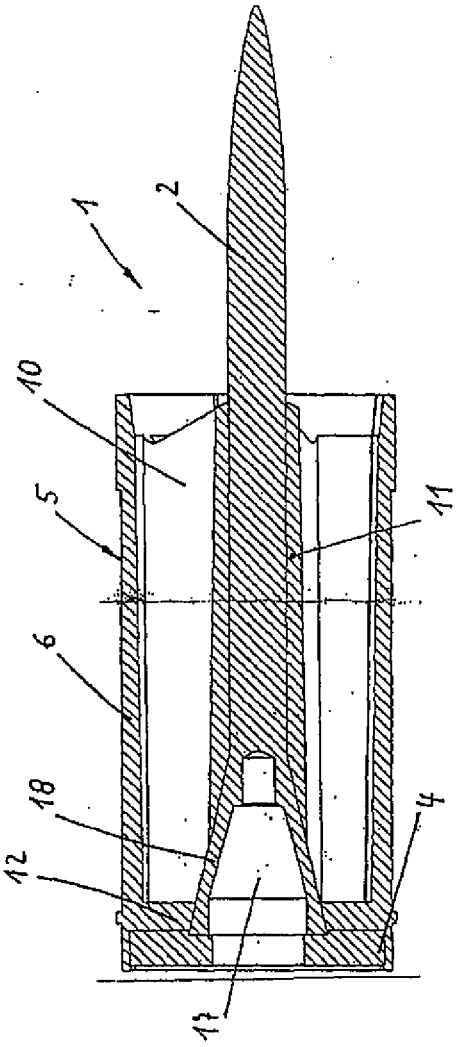

Fig. 5