

DESCRIPTION

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

5 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
10 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.

15 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
20 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
25 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
30 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
35 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.

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

10 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
15 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.
20 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
25 points, and wherein the longitudinal ribs extend axially from the drive element into the nose area of the guide sabot.

30 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.

35 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.

5 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
10 axial direction. In this case, the weak points may extend radially through the sleeve wall as far as the projectile body.

15 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
20 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
25 figures, in which:

figure 1 shows a perspective view of a discarding sabot projectile according to the invention,
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figure 2 shows a front view of the discarding sabot projectile illustrated in figure 1;

35 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
5 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
10 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
15 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
20 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
25 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).

30 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
35 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
5 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
10 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
15 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).

20 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
25 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
30 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.

35 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.

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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.

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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
5	3	Guide sabot
	4	Drive element
	6	Outer wall
	7	Guide area
	8	Weak point (outer wall)
10	9	Guide sabot segment
	10	Spacing element, longitudinal rib
	11	Sleeve
	12	Rear wall
	13	Recess
15	14	Weak point (sleeve)
	15	Longitudinal axis
	16	Weak point (rear wall)
	17	Recess
	18	Conical fin assembly
20		

Claims:

1. A projectile comprising:
 - (a) a subcaliber projectile core; and
 - (b) a sabot provided as a guide sabot that has a drive element, wherein the drive element is in the form of a plate and is disposed to act on the projectile core at a rear end of the projectile core, and the guide sabot is an essentially cylindrical guide sabot disposed adjacent to the drive element, and the guide sabot comprises plastic that is a fiber-reinforced plastic, and the drive element is firmly incorporated in the guide sabot at a rear end of the projectile so that the guide sabot is formed integrally with the drive element,
wherein the guide sabot has an outer wall in which at least two first weak points are provided, wherein the at least two first weak points are arranged and distributed uniformly over a circumference of the outer wall and extend in an axial direction, and the guide sabot has a rear wall that is adjacent to the drive element, and the rear wall extends radially with respect to a longitudinal axis of the projectile and the rear wall is likewise provided with second weak points, wherein the second weak points of the rear wall are adjacent to the first weak points in the outer wall.
2. The projectile as claimed in claim 1, wherein the projectile core is connected to an inner surface of the outer wall of the guide sabot via at least two spacing elements that are in the form of longitudinal ribs, wherein each longitudinal rib is associated with a guide sabot segment, wherein each guide sabot segment is defined by adjacent first weak points formed in the outer wall and that extend axially from the rear wall of the guide sabot into a nose area of the guide sabot.
3. The projectile as claimed in claim 2, wherein the longitudinal ribs have recesses, in the form of pockets, located at a front end of the longitudinal ribs.
4. The projectile as claimed in claim 2, wherein the longitudinal ribs each have a conically tapering profile that extends forward from the rear wall of the guide sabot.

5. The projectile as claimed in claim 2, wherein the first weak points formed in the outer wall of the guide sabot extend to a surface of the projectile core.

6. The projectile as claimed in claim 2, wherein the guide sabot has four first weak points formed in the outer wall of the guide sabot, wherein the four first weak points are arranged and distributed uniformly over an inner circumference of the outer wall and extend in the axial direction, wherein the four first weak points formed in the outer wall of the guide sabot are located so as to be rotated through 45° with respect to the longitudinal ribs.

7. The projectile as claimed in claim 1, wherein the guide sabot at least partially surrounds the drive element on an outside surface of the drive element.

8. The projectile as claimed in claim 7, wherein the projectile core is connected to an inner surface of the outer wall of the guide sabot via at least two spacing elements that are in the form of longitudinal ribs, wherein each longitudinal rib is associated with a guide sabot segment, wherein each guide sabot segment is defined by adjacent first weak points formed in the outer wall and that extend axially from the rear wall of the guide sabot into a nose area of the guide sabot.

9. The projectile as claimed in claim 1, wherein the guide sabot has a sleeve that surrounds the projectile core and is in the form of a web, wherein longitudinal ribs are connected on a projectile side to the web, and the sleeve is also provided with third weak points that extend in an axial direction with respect to a longitudinal axis of the projectile core, and the third weak points of the sleeve are adjacent to second weak points disposed in a rear wall of the guide sabot.

10. The projectile as claimed in claim 1, wherein the fiber-reinforced plastic is a glass-fiber-reinforced polyamide plastic or a carbon-fiber-reinforced polyamide plastic.

11. The projectile as claimed in claim 1, wherein the guide sabot includes the first weak points, the second weak points and third weak points formed therein, wherein the first weak points are formed in an outer wall of the guide sabot, and the second weak points are formed in a wall of a sleeve of the guide sabot that surrounds the projectile core, and the third weak points are formed in a rear wall of the guide sabot, wherein at least one first weak point, and at least one second weak point, and at least one third weak point are formed so as to be radially aligned along a single radial line extending from a longitudinal axis of the projectile core, and wherein weld lines are formed in material of the guide sabot at the second weak points formed in the rear wall of the guide sabot, and the weld lines weaken the material at the second weak points formed in the rear wall of the guide sabot.

12. A projectile comprising:

- (a) a sub-caliber projectile core;
- (b) a sabot serving as guide sabot; and
- (c) a plate-shaped drive element acting on a rear side of the projectile core, wherein, adjacent to the drive element, the guide sabot is disposed as an essentially cylindrical guide sabot made of plastic material, wherein the drive element is in the rear of the projectile firmly integrated in the guide sabot, and the guide sabot has an outer wall in which is provided at least two first predetermined weak points that are arranged uniformly distributed over a circumference of the outer wall, extending in an axial direction, and a radially extending rear wall adjacent to the drive element that is likewise equipped with predetermined second weak points that meet with the predetermined first weak points of the outer wall of the guide sabot.

13. A projectile according to claim 12, wherein the projectile core is connected with an interior surface of the outer wall via at least two spacing elements comprising longitudinal ribs, wherein one longitudinal rib is associated with each guide sabot segment defined by adjacent predetermined first weak points that extend axially from the rear wall up to a forward side of the guide sabot.

14. A projectile according to claim 13, wherein the longitudinal ribs have pocket-like recesses disposed in a front portion.

15. A projectile according to claim 13, wherein the longitudinal ribs respectively present a conically tapering course towards a front of the projectile.

16. A projectile according to claim 13, wherein the guide sabot has a bridge-configured sleeve enveloping the projectile core, wherein the sleeve connects the longitudinal ribs on a

projectile side, and the sleeve is provided with predetermined third weak points extending in axial direction that meet with the predetermined second weak points of the rear wall.

17. A projectile according to claim 13, wherein the guide sabot includes four predetermined first weak points that are uniformly distributed over the circumference of the outer wall, extending in the axial direction, wherein the predetermined weak points are located at a 45° angle relative to the longitudinal ribs.

18. A projectile according to claim 12, wherein the guide sabot is constructed in one piece and encloses, at least partially, the driving element on an outside.

19. A projectile according to claim 12, wherein the predetermined second weak points extend up to the surface of the projectile core.

20. A projectile according to claim 12, wherein the guide sabot comprises glass-fiber-reinforced polyamide or carbon-fiber-reinforced polyamide.

21. A projectile according to claim 12, wherein the projectile core is provided with a conical fin assembly.

22. A method for production of a projectile, according to claim 1, comprising the steps of:

- (a) provisionally detachably connecting a drive element and a projectile core to one another to form an insert;
- (b) inserting the insert into an injection-molding tool, and using the injection-molding tool to produce a contour of a guide sabot;
- (c) injection molding the insert in the injection-molding tool with a material so as to produce the projectile, wherein the guide sabot of the projectile is an essentially cylindrical guide sabot comprising a plastic, wherein the plastic is a fiber-reinforced plastic;
- (d) removing the projectile from the injection-molding tool; and
- (e) after the projectile is removed from the injection-molding tool, then removing the provisional connection formed in step (a) between the drive element and the projectile core.

23. The method as claimed in claim 22, wherein weak points are also injection molded in the projectile during step (c).

24. The method as claimed in claim 23, wherein the weak points injection molded in the projectile during step (c) include first weak points, second weak points and third weak points, wherein the first weak points are formed in an outer wall of the guide sabot, and the second weak points are formed in a wall of a sleeve that surrounds the projectile core, and the third weak points are formed a rear wall of the guide sabot.

25. The method as claimed in claim 24, wherein at least one first weak point, and at least one second weak point, and at least one third weak point are formed by injection molding so as to be radially aligned along a single radial line extending from a longitudinal axis of the projectile core.

26. The method as claimed in claim 23, wherein guide sabot segments are injection molded in the projectile at the same time by using a number of gates corresponding to the number of guide sabot segments so the material that flows into mold areas and form the guide sabot segments meet at those weak points formed in a rear wall of the guide sabot.

27. The method as claimed in claim 22, wherein guide sabot segments are injection molded in the projectile at the same time by using a number of gates corresponding to the number of guide sabot segments so the material that flows into mold areas and form the guide sabot segments meet at weak points formed in a rear wall of the guide sabot.

28. The method as claimed in claim 27, wherein weld lines are formed when the material meets at the weak points formed in the rear wall of the guide sabot, and the weld lines weaken the material at the weak points formed in the rear wall of the guide sabot.

29. The method as claimed in claim 28, wherein the material includes fibers, and the fibers are aligned parallel to an injection direction during injection molding.

30. A method for production of a projectile having a sub-caliber projectile core and a sabot provided as a guide sabot, according to claim 12, comprising the steps of:

- (a) provisionally detachably connecting a drive element and the projectile core with each other,
- (b) inserting and over-molding the drive element and the projectile core as an inlay unit in an injection molding tool;
- (c) producing a contour of the guide sabot; and

(d) after de-molding the inlay unit, removing the provisional connection formed in step (a) between the projectile core and the drive element.

31. A method according to claim 30, wherein predetermined weak points are also injection molded.

32. A method according to claim 31, wherein guide sabot elements are simultaneously injection-molded by a segment-corresponding number of gates so that material flowing into segment-forming molding areas meets at the predetermined weak points.

33. A method according to claim 30, wherein guide segments of the guide sabot are injection molded with the aid of gates.

34. A method according to claim 30, wherein a tracer set is screwed into an appropriate recess of a rear sided part of the projectile core.

35. A method according to claim 30, wherein the provisional connection is attained by clamping.