

A HOLLOW CHARGE

This invention relates to of a hollow charge which has a projectile-forming insert.

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A device for compensating for the different thermal expansion of the explosive and of the casing of a hollow charge is shown in DE 34 41 693. This device consists of at least rings. The rings have conical contact surfaces, and one ring consists of a material which has a lower coefficient of thermal expansion than the material of the other ring. A funnel-shaped insert of the hollow charge is supported against one surface of one ring, and said surface of the ring lies at a right angle to the axis of the hollow charge. This ring consists of a special steel having a low coefficient of thermal expansion.

In the case of a hollow charge for the production of a projectile, it is important that the projectile is formed coaxially to the axis of the charge. In the event of small deviations from the axis of the charge, an unsymmetrical projectile having a somewhat unstable flight path and deviating from the axis of the hollow charge is formed. An improvement in the aforesaid parameters may be effected upon appropriately large tamping of the casing of the hollow charge.

In DE 34 41 693 C1, the insert is indeed supported in the axial direction against a steel ring, but there is a lack of a suitable tamping at a right angle to the axis of the hollow charge. Upon transformation of the insert
5 6 into a hollow-charge jet, the forces exerted by the insert on the casing - namely at a right angle to the hollow charge - are low, since the angle of the insert with regard to the wall of the hollow charge amounts to about 45°. Therefore, no pointer with regard to the set
10 or problems realised in accordance with the present invention emerges from the said document.

An aim of the present invention is to provide a device which makes possible a projectile formation which
15 is coaxial with the axis of the hollow charge.

According to the present invention there is provided a hollow charge having a casing containing explosive, a projectile-forming insert and rings having conical
20 surfaces, which rings support and secure the insert in the casing, characterised in that one of said rings is a bearing ring consisting of heavy or hard metal guided axially in a recess of the casing, the bearing ring having a conical guide surface butting directly against a
25 conical surface of the insert fastened by wedge effect, and another one of said rings being a supporting ring which supports the insert at the explosive side relative to a shoulder of the recess on the casing side, and a

further fixing ring fastenable in the recess fastens the insert, the supporting ring and the bearing ring.

Upon transformation of the insert into the
5 projectile, an additional tamping with regard to the casing wall is achieved by the heavy-metal ring. In this respect, the transformation and folding or forming of the insert is influenced advantageously. An additional stabilisation of the projectile is effected.

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Different strength portions of the casing in the region supporting the insert are eliminated or largely avoided by the present invention. The projectile is formed in the longitudinal axis of the hollow charge.
15 Thus, at least the first portion of the flight of the projectile is coaxial with the axis of the charge. Also the formation of the projectile is symmetrical to the said charge axis, since all the mass particles of the insert contribute to the formation of the projectile. An
20 eccentric centre of mass (that is to be avoided) of the projectile is therefore avoided.

A further advantage is that, upon securing the insert in the casing, the insert is urged or pressed
25 under pressure against the explosive, i.e. the insert

exerts a pressure on the explosive. This pressure is selected to be so high that, on the one hand, no gap (gap freedom) exists between the explosive and the insert and, on the other hand, the bias force is so great that in the
5 predetermined temperature range of -40°C up to $+76^{\circ}\text{C}$ no gap (gap freedom) exists between the explosive and the insert. A reduction in performance of the hollow charge by reason of an existing gap is, therefore, likewise avoided.

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Advantageous further developments of the present invention will be apparent from the sub-claims.

In accordance with the arrangement provided for in
15 Claim 2, tolerances of the bearing ring with respect to its dimensions in the direction of the main axis of the hollow charge are compensated for by way of the plastics ring.

20 In accordance with the arrangement provided for in Claim 3, there is a durable fastening of the bearing ring in the recess of the casing. The type of fastening is cost-favourable and does not lead to any further weakening of the casing, as would be the case with a
25 threaded connection.

An exemplified embodiment of the present invention is shown with reference to a single Figure of the

drawing.

Referring to the drawing, a hollow charge 10 consists of a casing 11 made of steel with explosive 12 and of a projectile-forming insert 2 made of iron or tantalum.

The casing 11 has a recess 6 with an a shoulder 61. The following rings are arranged in the recess 6. A supporting ring 1 made of plastics material, a bearing ring 3 made of a heavy or hard material or metal (Schwermetall) or metal carbide or the like, namely tungsten carbide or titanium/iron composition, a plastics ring 4 and a fixing ring 5 made of a high-strength steel.

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The fixing ring 5 is, by reason of a press or force fit with respect to the recess 6, pressed into this and by way of the plastics ring 4 presses (urges) the bearing ring 3 against the supporting ring 1. The supporting ring 1 butts against the shoulder 61 of the recess 6. By reason of its elastic deformability - dictated by the compressive forces exerted on it by the bearing ring 3 by way of the insert 2 - the supporting ring 1 butts annularly with the surface 17 against the insert 2. The insert 2 is, therefore, uniformly supported relative to the casing 11. Conical surfaces 15, 16 on the insert 2 and on the bearing ring 3 centre the insert with respect to a hollow-charge axis 13. An angular spacing 31 exists

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between the supporting ring 1 and the bearing ring 3. The insert 2 is therefore fastened or secured by being wedged in the casing 11. An angle of 125° exists between a tangent 21 of the insert 2 and of the surface 16. The
5 plastics ring 4 ensures temperature compensation.

Upon detonation of the explosive 12, the detonation waves produced by the explosive form (from the insert 2) a projectile, not shown, lying in the hollow-charge axis
10 13. During the transformation of the insert 2 into the projectile, compressive and tensile stresses are superimposed (on one another) in the insert 2, in which respect the compressive stresses are reflected by the heavy-metal ring 3 until it fractures. By reason of its
15 comparatively large mass with small dimensions, the bearing ring 3 has a good reflection behaviour for the compressive stresses and ensures, compared with the prior art, a comparatively long intact existence of a casing portion 14 during the transformation procedure. Thus,
20 the heavy-metal ring 3 has, upon detonation of the explosive 12, the function of reflecting the compressive stresses, whereby a complete transformation of the insert into a projectile is ensured. The good reflection ability is provided by a large specific density. Thus,
25 tungsten carbide is better suited than a titanium ferroalloy although both have been found to be successful in practice.

The projectile is, therefore, formed symmetrically, i.e. all the mass particles of the insert 2 contribute to a centre of mass lying on the hollow-charge axis 13. An angle of departure 33 of the projectile is avoided.

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The press or push fit of the fixing ring 5 in the casing 11 could also be replaced by a threaded connection, not shown. This has, however, the disadvantage that the cross-section of the casing is weakened by the thread and therefore premature breakage of the casing in this region may occur.

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The weight of the hollow charge being greater than in accordance with the prior art, caused by the bearing ring 3 consisting of heavy metal, is more than balanced by the advantage of the centric projectile formation and of the error-free departure flight of the projectile.

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The term "conical surface" as used throughout the specification and claims is meant to include part-conical surfaces.

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Therefore, further according to the present invention there is provided a hollow charge comprising a casing in which is located a projectile-forming insert and an explosive, said hollow charge having a plurality of rings in a recess in the casing, a first one of said rings having a conical surface matching a conical surface

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of said insert and being a bearing ring for said insert,
a second one of said rings supporting the insert against
movement in the axial direction of the hollow charge, the
insert being wedged between the bearing ring and the
5 supporting ring, the bearing ring acting to ensure a
symmetrical projectile formation coaxial with said axis
or a complete transformation of the insert into a
projectile. Said bearing ring may be of a heavy metal
and a further fastening ring or rings may be provided in
10 said recess. The supporting ring may be of plastics.
The angle of said matching conical surfaces of the insert
and bearing ring is, preferably, $33^{\circ} \pm 5^{\circ}$ (or $\pm 10^{\circ}$) to
the axis of the hollow charge.

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CLAIMS

1. A hollow charge having a casing containing explosive, a projectile-forming insert and rings having
5 conical surfaces, which rings support and secure the insert in the casing, characterised in that one of said rings is a bearing ring consisting of heavy or hard metal guided axially in a recess of the casing, the bearing ring having a conical guide surface butting directly
10 against a conical surface of the insert fastened by wedge effect, and another one of said rings being a supporting ring which supports the insert at the explosive side relative to a shoulder of the recess on the casing side, and a further fixing ring fastenable in the recess
15 fastens the insert, the supporting ring and the bearing ring.

2. A hollow charge according to Claim 1, in which a plastics ring is provided between the bearing ring and
20 the fixing ring.

3. A hollow charge according to Claim 1 or Claim 2, in which the fixing ring is pressed or is a force fit into the recess.

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4. A hollow charge substantially as herein described with reference to the FIGURE of the accompanying drawing.



5. A hollow charge comprising a casing in which is located a projectile-forming insert and an explosive, said hollow charge having a plurality of rings in a recess in the casing, a first one of said rings having a conical surface matching a conical surface of said insert and being a bearing ring for said insert, a second one of said rings supporting the insert against movement in the axial direction of the hollow charge, the insert being wedged between the bearing ring and the supporting ring, the bearing ring acting to ensure a symmetrical projectile formation coaxial with said axis or a complete transformation of the insert into a projectile.

6. A hollow charge as claimed in Claim 5 in which said bearing ring is of a heavy or hard metal or metal carbide.

7. A hollow charge as claimed in Claim 5 or Claim 6 in which a further fastening ring or rings are provided in said recess.

8. A hollow charge as claimed in any one of Claims 5 to 7 in which the supporting ring is of plastics.

9. A hollow charge as claimed in any one of Claims 5 to 8 in which the angle of said matching conical surfaces of the insert and bearing ring is $33^\circ \pm 5^\circ$ (or $\pm 10^\circ$) to the axis of the hollow charge.
