April 9, 1957 E. W. BRANDT 2,787,958

PROJECTILE

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Fig. 1

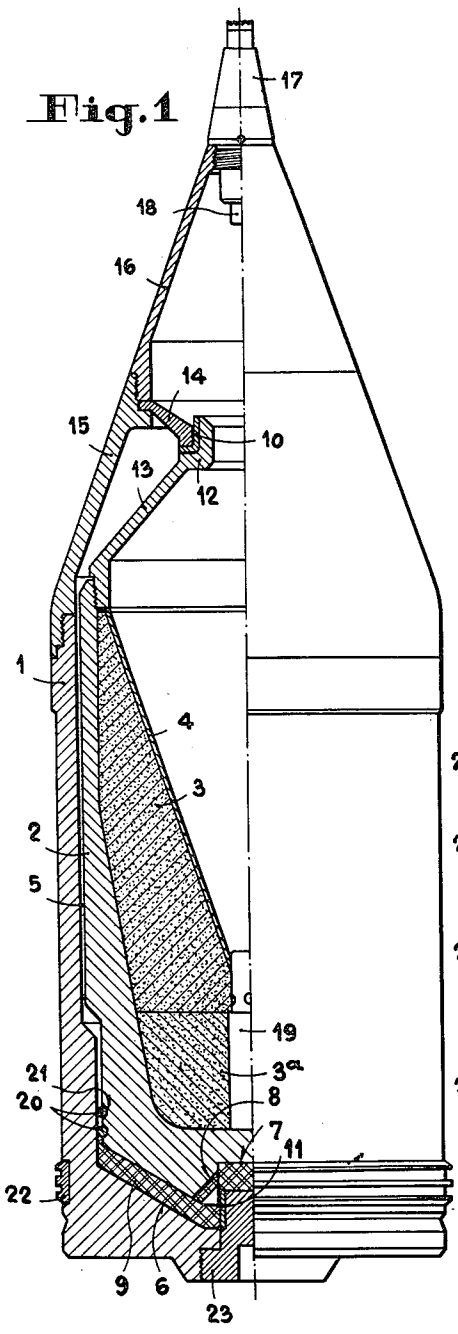
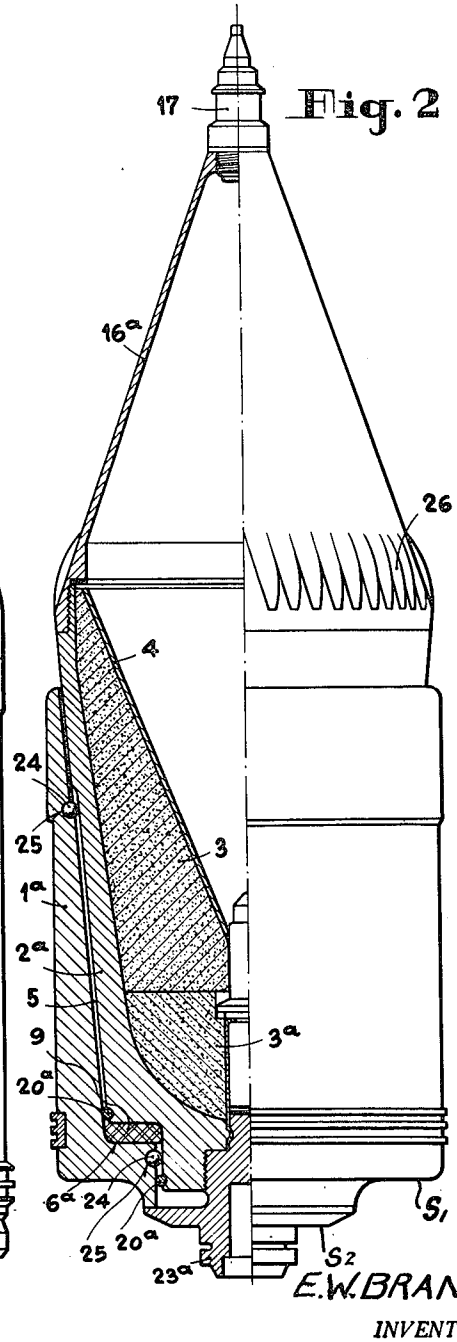


Fig. 2



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PROJECTILE

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1 Claim. (Cl. 102—50)

This invention relates to spin-stabilized projectiles.

Projectiles fired from a rifled gun barrel have a speed of gyration proportional to their linear speed and inversely proportional to their caliber.

The centrifugal force resulting from such gyration and acting on the internal mechanism of the projectile is such that in certain cases the projectile does not or only inadequately fulfils the function which it is intended to perform.

This disadvantage applies to hollow charge projectiles which, when subjected to rapid rotation, lose a substantial part of their perforating power on impact. It is known that a hollow explosive charge perforates the target by axial and centripetal concentration of a fluid metallic jet issuing from the internal surface of the liner covering its cavity.

Experience has shown that the gyration of the projectile hampers the concentration of the perforating jet and that, for example, a projectile of the hollow charge type of 57 mm. caliber, rotating on its trajectory at the rate of 10,000 revolutions per minute and fired at an initial velocity of 300 to 400 meters per second, loses 20% to 30% of its perforating power.

Heretofore it has not been possible to reduce the speed of a projectile fired from an ordinary gun except with a sacrifice of initial velocity, and consequently of practical range.

It has already been proposed for various purposes, to reduce the gyration of part of a projectile by mounting that part on ball bearings. This solution, which is substantially satisfactory for low accelerations (being applied to illuminating projectiles equipped with a parachute) cannot however be considered for projectiles subjected to very heavy accelerations. In such cases the balls or bearing parts with which such projectiles are in contact undergo permanent deformations which prevent free rotation of one part of the projectile with respect to the other.

The projectile of the present invention is of the type which is stabilized by gyration, fired from a rifled gun barrel and which comprises an internal charge-carrier body housed and centred at its ends in a coaxial external body from which it is separated by a peripheral space.

In the projectile of the present invention, the inner body rests at its base on a liquefiable and lubricating element, adapted under the effect of the propulsive charge to resist and to transmit the thrust from the outer body to the charge-carrier body, while communicating to said latter only a small fraction of the speed of gyration resulting from the engagement of the driving band of the outer body in the rifling.

The aforesaid liquefiable and lubricating element may advantageously consist of thermoplastic material, paraffines or waxes, which in its initial state, retain their normal shape but which liquefy under pressure and rise in temperature. An element of this type forms a hydraulic cushion withstanding the effect of inertia of the

inner charge-carrier body with respect to the outer body, and ensures perfect lubrication of the assembly.

Centring means may be provided having axial play and solid with one of the aforesaid bodies which centring means are adapted to permit axial displacement of one of the bodies with respect to the other, but which themselves are not affected by an axial thrust.

Balls or rings of anti-friction material may advantageously serve as centring means and may be disposed in rear and in front of the inner body. Since said centring means are not subjected to any axial thrust on the firing of the shot, they do not undergo any deformation and the effect of friction which results from the gyration is permissible.

According to one embodiment of the invention, the outer body has a density higher than that of the inner charge-carrier body, which is of light metal of equal resistance to the inertia and internal pressures developed on the firing of the shot.

Since the mass of the outer body is substantially greater than that of the inner body, said outer body stabilizes after the manner of a flywheel, the inner body, the weight and wall thickness of which are reduced to a minimum.

In a modified embodiment, the outer body entirely surrounds the inner body and one of the centring members, preferably the front member, then constitutes a bearing acting as thrust block and serving to prevent the displacement of the inner body in the forward direction with respect to the outer body, which under the influence of the air resistance undergoes a reduction of velocity while the inner body tends to retain its initial velocity.

In said modified embodiment, the liquefiable and lubricating element is housed in at least two compartments of the peripheral space which intercommunicate through orifices serving to balance pressure between said compartments on the firing of the shot.

In order to prevent the liquefiable element from escaping in the forward direction, one or two metallic rings may be inserted in the peripheral space and may be retained in one or two corresponding grooves in the inner body. These rings then act as sealing packings.

According to a further modification of the invention, the outer body is closed at its base by a plug solid with the inner body. By virtue of this construction the pressure of the propulsion gases can then be applied simultaneously on the outer body and on the inner body, and the surfaces of the two bodies on which the propulsion is applied can be so selected that, taking into account the ratio of the masses of said bodies, the thrust applied to the liquefiable element is low or nil.

In order to enable the invention to be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example two embodiments thereof, and in which:

Figure 1 is an axial half-section of one embodiment; and

Figure 2 shows, in axial half-section, a modification of the projectile illustrated in Figure 1.

The projectile illustrated in Figure 1 comprises an outer body 1, a coaxial inner charge-carrier body 2 and a hollow explosive charge 3, the cavity of which is covered with a metal liner 4. A peripheral space 5 separates the bodies 1 and 2 and at its bottom part comprises two compartments 6 and 7 intercommunicating through passages 8 and filled with a liquefiable substance 9, for example paraffine wax.

Two bearing rings 10 and 11, of an anti-friction alloy or of graphite, are interposed between the bodies 1 and 2; the first 10 is mounted on the neck 12 of the piece 13 forming the cap of the charge-carrier body 2 and is coaxial with an annular centring element 14, which in

turn is retained between the two parts **15** and **16** constituting the ogive of the projectile.

The bearing ring **11** acts as a rear centring of the inner body **2** and is mounted on a base plug **23**.

A percussion fuze **17** is screwed to the end of the substantially conical cap **15, 16**. The primer-detonator **18** of fuze **17** transmits the fire on impact to the main detonator **19**, which in turn ignites a relay charge **3***a* which induces the explosion of the hollow charge **3**.

The compartment **6** containing the paraffine wax is sealed peripherally by two annular rings **20** retained respectively in grooves **21** provided in the wall of the inner body **2**.

The outer body **1** is provided with the usual driving band **22** adapted to engage the rifling of the barrel.

Figure 2 illustrates an embodiment in which the outer body **1***a* is open at the front, the ogival part **16***a* of the projectile being integral with the inner body **2***a* which it is desired to free from the effect of gyration. Moreover, in contradistinction to the construction illustrated in Figure 1, the base plug **23***a* is also rigidly connected to the body **2***a*. Thus the base of the projectile has two concentric surfaces S_1 and S_2 belonging respectively to the outer and inner bodies. If said surfaces bear to one another the ratio of the masses M_1 and M_2 of the bodies **1***a* and **2***a* and of the elements of the assembly which are integral therewith, the propulsive forces and hence the accelerations applied of the firing of the shot to the two bodies, will be the same.

The construction illustrated in Figure 2 therefore permits the reduction or even the elimination of the force applied to the liquefiable element.

In the embodiment shown in Figure 2, the bearing rings **10** and **11** shown in Figure 1, which act as centring means, are replaced by balls **24** disposed at the front and rear of the body **1***a* in two grooves **25** formed in the inner wall of the outer body **1***a*. Finally, two

rings **20***a* close the compartment **6***a* and retain the liquefiable and lubricating element **9**. The cap **16***a* may, in addition, be provided at its periphery with vanes **26** inclined in relation to the axis of the projectile, for the purpose of braking the residual effect of gyration transmitted by the outer body **1***a*.

What is claimed is:

A spin stabilized projectile fired from a rifled gun comprising an inner charge carrier body, an outer coaxial body in which said inner charge carrier body is housed and centred, a driving band around said outer body, a peripheral space between said inner and outer bodies, a circular aperture in the bottom of said outer body and a plug closing said aperture, said plug being fixed in the bottom of said inner body and independent from movement of said outer body, a deformable lubricating element lodged rearwardly of said inner body, between said inner and said outer bodies, said element being liquefiable at firing under the thrust of said outer body on said inner body, an annular sealing means between said inner and outer bodies, in front of said element, to retain said element, when liquefied, in the rear part of said peripheral space, said element preventing rolling friction between the rear corresponding parts of said inner body and said outer body.

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