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5 Diehl Munitionssysteme GmbH & Co KG, 90552 Röthenbach

Method of trajectory correction of ballistically fired
spin-stabilised artillery ammunition

10 The invention concerns a method as set forth in the classifying
portion of claim 1, as is known from DE 198 45 611 A1. There, the fuse tip
which can be screwed on to the ammunition body has a component which,
for spin reduction purposes, is rotatable with respect to the spin-stabilised
ammunition body and from which two braking surfaces which are held
15 rigidly at the same angle of incidence can be extended in the manner of
canard wings transversely with respect to the spin axis in order to exert a
directed braking action on the current trajectory of the ammunition in order
to increase the level of target accuracy of the predetermined hitting point,
depending on the respective instantaneous roll position in space. For the
20 same purpose, by means of such a reduction in trajectory, by an increase
in the braking action, it was already known from WO 98/01719 for two
discs without incidence to be extended in diametrically mutually opposite
relationship radially out of the ogive of a projectile.

It will be appreciated however that the installation space available in
25 the projectile tip is required for the major part for the safety and fuse
devices, and the additional installation of a receiver circuit for for example
radar distance measurement or satellite navigation also already gives rise
to serious difficulties. Therefore the necessary installation space for braking
surfaces which are to be retracted here and for the mechanisms for moving
30 and holding same in opposition to the dynamic loading produced by the
afflux flow pressure is scarcely adequately available. Moreover, a point of
fundamental disadvantage in regard to those previously known structures is
that the directionally selective braking measure means that the trajectory

can only be shortened and that therefore the degree of scatter in terms of target hit plotting can only be narrowed in one direction.

In consideration of those aspects the object of the present invention is to make the error disposition of ammunition ballistically fired over a
5 target area overall more advantageous.

In accordance with the invention that object is attained in that, in accordance with the essential features of the combination as recited in the main claim and in accordance with the modifications and developments characterised in the appendant claims, the longitudinal and transverse
10 scatter effects are now no longer compensated only in the direction of shorter ranges but, besides the directed reduction, a deliberate increase in the current trajectory is now also made possible.

For that purpose, mounted laterally at the tapered front part of the ammunition, more specifically in the fuse which is decoupled in respect of
15 rolling from the body of the ammunition, at the tip of the ogive, by means of control shafts which are oriented radially with respect to the spin axis, in radially mutually opposite relationship, are two identical-calibre canard wing surfaces which cannot be retracted but which can be set in a condition of incidence thereof with respect to the neutral position by rotation about
20 their control shafts in both directions and with which, depending on the respective instantaneous position in space, it is possible deliberately to produce a pitching movement for influencing longitudinal scatter or a yawing movement for influencing transverse scatter. The pitching or yawing incidence adjustment which is in phase-correct relationship in relation to
25 the instantaneous roll position in space is effected under the management of a roll position sensor in the fuse tip, which specifies how the control shafts of the two canard surfaces are oriented at that time in relation to the horizon of the Earth and in which direction in space therefore the trajectory is lengthened or reduced by a current incidence setting of the canard
30 surfaces.

To provide for such controlled incidence setting of the canard surfaces, because of the small amount of installation space, the self-locking action of a strong transmission step-down arrangement and its low-cost

availability, the preference is for a high-speed low-voltage dc motor, preferably in the coaxial configuration of a shaft transmission motor unit. In that case it is possible to provide a rotationally rigid coupling between the two control shafts in order to manage with a single drive system; or the
5 two canard surfaces can be adjustable independently of each other by their own respective drives and then if necessary can also be adjusted in opposition directions, in the interests of highly dynamic control.

The expenditure in terms of electrical circuitry can be still further reduced if, instead of continuous incidence control, for alternately adjusting
10 the canard surfaces, for that purpose the procedure involves using a three-point control system which is only ever deliberately temporarily switched in the active condition, for the duration of a maximum of a quarter of a revolution of the ammunition body about its spin axis in each case, or indeed it uses a two-point control system which always switches over in
15 correct relationship with the roll phase.

The electrical power for incidence control can be afforded by batteries or still better can be produced by generator means in the fuse tip itself, namely making use of the relative movement between the ammunition body which is stabilised by faster rolling motion and the rotary
20 speed, which is reduced in relation thereto, of the fuse tip which is decoupled in respect of rotation from the ammunition body by way of a rotary bearing.

For the purposes of determining the position of the fuse tip in space, the preference is for a magnetic sensor which responds to the magnetic
25 field of the Earth, because in comparison with optronic horizon sensors it is all-weather-serviceable and in comparison with inertial platforms is less expensive and more compact.

Thus, at very low apparatus expenditure, namely with a canard system which is adjustable in a single-axis mode, as a consequence of the
30 additional degree of freedom in respect of trajectory extension, it is possible to achieve a spatial trajectory correction in respect of the artillery ammunition which in itself is unguided, and thus an extraordinary increase in the precision of delivery in relation to the predetermined target point.

CLAIMS

1. A method of trajectory correction, which is effected in dependence on the instantaneous roll position in space, in respect of ballistically
5 launched spin-stabilised artillery ammunition by means of canard surfaces which are oriented radially in a single-axis configuration at the fuse tip which is tapered in relation to the ammunition body thereof and which is roll-decoupled,
characterised in that
10 canard surfaces which fixedly project substantially in full-calibre mode from the fuse tip which is tapered with respect to the ammunition body and which are adjustable in incidence about control shafts oriented radially with respect to the spin axis are adjusted in respect of incidence in both directions about the neutral position.
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2. A method according to claim 1 characterised in that the control shafts are rotated by electric motor means powered from the difference in rotary speed, used as generator means, between the fuse tip and the ammunition body.
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3. A method according to claim 1 or claim 2 characterised in that the control shafts are rotated discontinuously.
4. A method according to one of the preceding claims characterised
25 in that the control shafts are rotated differently.