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1331119

DRAWINGS ATTACHED

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(19)

(54) MORTAR SHELL

(71) We, ETABLISSEMENT SALGAD, a Liechtenstein Company of Vaduz, Liechtenstein, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a mortar shell.

Various constructions of fin-stabilised shells are known. The shape and dimensions of the shell body and of the tail portion play an important part in the ballistic properties of a mortar shell. The range of travel and scatter are dependent on a number of factors, each of which have little effect in themselves, yet which together will influence, either favourably or unfavourably the performance of the shell. The diameter of the shell is linked to the calibre, and the shell's weight is also function of this calibre, even though there are differences between shells of the same calibre but of different external shapes.

Thus, for a certain design of mortar shell there exists a certain specific relationship between the position of the centre of gravity and the point of attack of the air-resistance, in relation to the overall length of the shell.

In previously known shells, ranges have been obtained for a given calibre which, on the whole, are of the same order of magnitude, although the shape of the shells varied greatly from one to another. This means that the previously selected combination of the various factors which influence the performance of the shells, have resulted in no notable improvement which would lead the range for one shell of a given calibre being considerably more than that of other shells. The increase for a certain average range with different constructions of known mortar shells is not particularly great, and does not exceed 5—6%.

The aim of the invention is to provide a mortar shell of considerably improved performance, as regards both range and accuracy.

According to the invention there is provided a mortar shell, comprising a body portion having a gas-sealing band at the largest diameter of the body portion of the shell, and a tail portion provided with fins, wherein the profile of the body portion of the shell between the tip of the shell and the centre line of the said band tapers forward and is substantially formed as a Karmann profile which is determined by the formula defined at (1) hereinbelow, and the profile of at least part of the body portion of the shell from the centre line of the band backwards is substantially formed as a Karmann profile which tapers backwards and which is also determined by the formula as defined hereinbelow, and wherein the ratio of the overall length of the shell to the largest diameter D of the body portion of the shell lies within the range 5.2 to 5.5.

Such a combination of the various factors in the formation of a mortar shell has the result that the shell with a stable flight path, has a range which exceeds by about 15% the range of previously known shells with identical calibres, in the present case a calibre of 140 mm. It can further be mentioned that this type of shell, with a range of about 8 km, has a scatter which does not exceed a strike circle with a radius of 20 m.

The term "sealing-band" as used in this specification and the appended claims relates to the zone of the mortar shell having the largest diameter, said diameter remaining substantially constant over the band.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawing, which shows schematically a mortar shell in part section.

Referring to the drawing, an embodiment of a mortar shell according to the present invention is shown generally at 1. The shell is provided with a tail assembly 2 having stabilising fins 3.

The sealing-band 5 of the shell is provided with a number of annular grooves 6 which serve to seal the propulsive gases at the circumference of the shell while the shell is being fired.

The shape of the mortar shell, between the

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tip and the centre line of the band and from the centre line of the band rearwards substantially coincides with a so-called Karmann profile, whose mathematical formula is given by

$$r=\frac{1}{\sqrt{\pi}}\sqrt{\phi-\tfrac{1}{2}\sin 2\phi\ C\sin 3\phi} \quad \ldots (1)$$

wherein

r is the cross-sectional radius of the shell at a distance X along the longitudinal axis of the shell from the top of the shell

C=Haak's gravitational constant, and

$\phi=\mathrm{Cos}^{-1}(1-2x)$

Haak's gravitational constant C lies in the range 0.31 to 0.35 and has a median value of 1/3. If each value of the constant C lies within the values of 0.31 and 0.35, then Karmann shaping of the profile is achieved.

The largest diameter of the grenade is shown by D, and the overall length L lies within the range 5.2D—5.5D. At a distance of about 2D back from the centre line of the band, the diameter of the shell lies within the range 0.38—0.45 D. At a point at a distance greater than 2D back from the centre line of the band, due to the taper profile of this part of the shell, the diameter at a point in front of the tail assembly is about 0.35D. From this point backwards, a straight, non-tapering portion is formed, which has a diameter of less than

$$\frac{D}{2.8},$$

and which carries the tail assembly 2 of the shell. The tip of the shell is preferably cut off, so that the impact surface of the shell has the form of a circle whose diameter is less than

$$0.3\frac{D}{2}.$$

Further, the distance from the centre line of the band 5 towards the tip of the shell lies within the range 2.2D—2.6D.

A conventional additional charge unit 4 is mounted on the tail assembly 2 in front of fins 3 of the assembly. This additional charge unit serves to increase the propulsive force with which the shell is fired.

WHAT WE CLAIM IS:—

1. A mortar shell comprising a body portion having a gas-sealing band at the largest diameter of the body portion of the shell, and a tail portion provided with fins, wherein the profile of the body portion of the shell between the tip of the shell and the centre line of the said band tapers forward and is substantially formed as a Karmann profile which is determined by the formula defined at (1) hereinabove, and the profile of at least part of the body portion of the shell from the centre line of the band backwards is substantially formed as a Karmann profile, which tapers backwards and which is also determined by the formula as defined at (1) hereinabove, and wherein the ratio of the overall length of the shell to the largest diameter D of the body portion of the shell lies within the range 5.2 to 5.5.

2. A shell as claimed in Claim 1 wherein the value of C is 1/3.

3. A shell as claimed in Claim 1 or 2, wherein the diameter of the shell at a point at a distance of about 2D from the centre line of the said band backwards lies within the range 0.38D to 0.45D.

4. A shell as claimed in any preceding claim, wherein at a point at a distance greater than 2D backwards from the centre line of the band, the diameter of the shell is 0.35D and wherein from this point backwards, a non-tapering portion is formed, the diameter of the non-tapering portion being less than

$$\frac{D}{2.8},$$

and said non-tapering portion carrying the tail assembly.

5. A shell as claimed in any preceding claim wherein the tip of the shell is cut-off so that the impact surface forms a circle whose diameter is less than

$$0.3\frac{D}{2}.$$

6. A shell as claimed in any preceding claim wherein the distance from the centre line of the band to the nose of the shell is between 2.2D and 2.6D.

7. A mortar shell substantially as hereinbefore described with reference to the accompanying drawing.

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