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(54) PRACTICE AMMUNITION FOR MORTARS

(71) We, DYNAMIT NOBEL AKTIENGESELLSCHAFT, a German Company of 521 Troisdorf, Near Cologne, Germany, 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:–

This invention relates to practice ammunition for mortars.

Practice ammunition which is used in mortars is frequently of considerably smaller calibre than the live ammunition to be fired from the mortar and is fired out of a liner providing a sub-calibre barrel within a mortar barrel and referred to hereinafter as such. Practice ammunition for this purpose may be produced in the form of cartridges, whose cases house a practice missile and a propellant charge therefore, possibly together with a signal charge or a marking charge having an associated impact detonator. For firing, these cartrides are placed in the rear portion of the sub-calibre barrel and are held therein by means of a plug. The sub-calibre barrel housing the cartridge is frequently disposed or constructed in a shell dummy simulating an equivalent live shell in shape and dimensions.

In order that the shell dummy should be expelled along with the empty cartridge case out of the mortar tube when projecting the practice missile, an expulsion charge may be provided in a separate plug disposed at the rear end of the shell dummy. Alternatively, such an expulsion charge may be housed in the cartridge case behind the practice missile. It is then necessary to provide an axially disposed ignition channel between the expulsion charge and the propellent charge of the practice missile to enable ignition of the latter to be effected by means of the flame from the ignited expulsion charge. After the loadings of the mortar tube by pushing the practice ammunition up to the base thereof, the expulsion charge is ignited by means of an associated igniter disposed therebehind. The gases produced by the expulsion charge flow *via* gas openings into the rear end of the mortar tube and round the rear end of the shell dummy and effect the expulsion of the shell dummy. In addition, the hot flame gases of the expulsion charge flow forwards in the axial direction *via* the ignition channel and effect detonation of the propellent charge of the practice missile or of an ignition propagation charge which may be located therebehind. A characteristic problem with a system of this type is that the interior ballistics are not sufficiently uniform and this in turn gives rise to variations in the exterior ballistics and in target accuracy.

According to the present invention, there is provided practice ammunition for use in a mortar, comprising a cartridge case, a passage extending through a forward part of the cartridge case and housing a sub-calibre practice missile provided with a propellant charge therefor, and an expulsion charge housed behind the propellant charge and having an ignition flame conduit passing therethrough and housing an igniter at a rear part thereof, the ignition flame conduit having formed therein at least one passage for communicating the interior thereof with the expulsion charge and terminating at an ignition channel for passage of an ignition flame therein to said propellant charge and the cartridge case having at least one bore communicating the expulsion charge with the exterior thereof.

With practice ammunition according to this invention, the aforesaid ballistics problems are largely overcome by ensuring that the ignition conduit comprises a section passing through the expulsion tube so that the ignition flame produced by the detonator can itself pass into the ignition channel and effect ignition of the missile propellant charge or of a propagation charge, posi-

tioned therebehind, in contrast to prior art ammunition of this type wherein the ignition flame acts on the expulsion charge, which thus has a blocking action thereon, and has the supplementary function of supplying a flame to the ignition channel. The expulsion charge for its part is now only ignited by the ignition flame from the igniter when the ignition flame expands laterally through the at least one radial ignition opening. This means that the propellant charge of the practice missile is ignited before the expulsion charge and that the practice missile is already travelling forward in the shell dummy before the latter is set in motion by the expulsion charge. It has been found that this time lapse enables a considerable improvement in the internal ballistics of both the propellant charge of the sub-calibre practice missile and of the expulsion charge of the shell dummy to be achieved, thereby enhancing the external ballistics of the practice missile.

Ignition is preferably effected by means of an ignition element having an intensifier charge. Of particular use for this purpose is an igniter of the type described in U.K.Patent Specification No. 1,065,244, the igniter having an intensifier charge arranged to be ignited in use by an initiating charge and being a thermal mixture of oxidising and reducing agents without an initiating substance, the initiating charge containing both a thermal mixture of oxidising and reducing agents and an initiating substance, each thermal mixture producing a great evocution of heat when reacted. An ignition flame is produced which is so powerful that even when a substantial distance exists between the igniter and the propellant charge, the use of a supplementary propagation charge is not necessary. The ignition flame conduit is preferably open at its end remote from the igniter so that the ignition flame produced, in use, can enter the free igniting channel without obstruction. Alternatively, however, a cover made, for example, of paper can be provided where the ignition conduit adjoins the ignition channel as long as this does not undesirably impair the passage of the ignition flame into the ignition channel. In order to achieve that particularly uniform ignition of the expulsion charge, the ignition flame conduit is preferably provided with several ignition openings, *e.g.* four lateral bores in a ring therearound. When relatively large expulsion charges are employed necessitating the use of larger ignition flame conduits two or more rings of ignition openings may be provided at intervals along the length of the ignition flame conduit.

It is preferred that the ignition flame conduit be sufficiently strongly made to withstand the pressure exerted thereon, in use, from inside, by gas produced by the ignition charge undergoing combustion. Otherwise premature destruction of the ignition flame conduit would have a deleterious effect on the ignition of the expulsion charge. It is further preferred that the internal cross-section of the ignition channel for feeding an ignition flame to the propellant charge be smaller than the internal cross-section of ignition flame conduit. This reduction in the available passage cross-section causes blocking of the ignition flame and assists ignition of the expulsion charge. Furthermore, this construction can prevent too much gas from flowing from the igniter to the propellant charge chamber of the practice missile; this could cause an uneven gas pressure for the forward movement of the practice missile to be set up. This cross-section narrowing can be obtained, for instance, by constructing the ignition channel as a cylindrical tube with a diameter over its entire axial length which is less than the inner diameter of the ignition flame conduit. To prevent the ignition ray from fanning out in the region of the transition from ignition flame conduit to the ignition channel, the ignition channel undergoes a reduction in cross-section along a part of its length. More particularly, the ignition channel undergoes said reduction in internal cross-section from a value corresponding to the internal cross-section of the ignition flame conduit to a smaller cross-section which it possesses over a final part of its length, thereby causing the ignition flame to be concentrated in the ignition channel. This concentrating of the ignition flame may be further intensified by providing a section in the ignition channel which is conically narrowing in the direction of ignition flame travel from the igniter to the propellant charge.

In a further preferred form of practice ammunition embodying this invention, at least one radially directed bore in the cartridge case communicates the expulsion charge with the exterior of the cartridge case and said bore(s) is/are staggered with respect to said at least one passage communicating the interior of the ignition flame conduit with the expulsion charge. This can prevent the part of the case housing the expulsion charge in the region of a said bore from being perforated undesirably early under the effect of gas pressure, as could be the case in adverse cirumstances when an ignition passage and a case bore are disposed in alignment with one another.

For a better understanding of this invention and to show how the same can be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, wherein:

Figure 1 shows the rear end of one form of practice cartridge embodying this invention, and

Figure 2 shows a similar view of part of another form of practice cartridge embodying this invention.

Referring to Figure 1 there is shown a cartridge case 1 in which is positioned a sub-calibre practice missile 2 having a tail unit 3. A propellant charge 4 is housed in the practice missile 2 and is provided with thin covers 5 and 6 made of paper so as substantially not to obstruct detonation of the charge 4 which is held in the missile by means of a screw cap 7. A separate expulsion cartridge 9 containing an expulsion charge 10 is fitted with frictional contact closing into the rear end of the cartridge case 1 at which are provided radial gas openings 8. Alternatively, the expulsion charge 10 could also be introduced directly into the cartridge case 1. The expulsion cartridge 9 comprises a double layer outer sleeve 11 made of cardboard, a base plug 12 formed of compressed cardboard, a base cap 13 made of steel or brass, and a front cover plate 14 made of cardboard. Frictionally fitted in the base plug 12 is a case 15, shown in elevation, of an igniter with an intensifier charge. Also frictionally engaging the base plug 12 is an ignition flame which the front end of the igniter case 15 extends. The flame conduit 16 extends the entire axial length of the expulsion charge 10, beyond the section thereof in which a friction fit exists between the case 15 and the base plug 12, its forward end 17, which is open, passing through the cover plate 14. Four radial bores 18 which act as ignition openings are provided in the tube 16 approximately in the centre of the expulsion charge 10. A thin cover sleeve 19, made, for instance, of paper is slipped over the ignition flame conduit 16 and serves to prevent part of the expulsion charge 10 from falling out through the bores 18 prior to ignition thereof. The sleeve 19 has virtually no adverse effect on the ignition of the expulsion charge 10. The cover plate 14, which bears on the inner layer of the sleeve 11 and on the sleeve 19 is held in place by means of a flanged edge 20 of the outer layer of the sleeve 11.

A partition 21 is constituted by the part of the cartridge case 1 which separates a cavity 22 therein which the expulsion cartridge 9 is held from a cavity 23 in which the practice missile 2 is housed. An axial ignition channel 24 passes through the partition 21, having a section of relatively large cross-section 25, corresponding to the inside cross-section of the conduit 16, adjacent the conduit 16, a conically narrowing transition section 26, and a section 27 area of smaller cross-section leading into the cavity 23. The base of the practice missile 2 is formed with axial bores 28 and 29 in line with each other and whose cross-section is greater than that of the section 27 of the ignition channel 24, so that the ignition flame from the igniter 15, dammed up in the ignition channel 24, can detonate the propellent charge 4.

Referring next to Figure 2 in which like reference numerals denote like reference numerals denote like parts in Figure 1, there is shown a two part cartridge case in which the cavity 22 for holding the expulsion cartridge 9 is provided in a separate housing 30 connected to a main cartridge case 1 *via* a screw connection 31. Because the expulsion charge 10 is of greater length than that shown in Figure 1, the ignition flame tube 16 is of correspondingly greater axial length and is provided with two rows of ignition openings 18 which are staggered in relation to one another and to the bores 8.

WHAT WE CLAIM IS:–

1. Practice ammunition for use in a mortar, comprising a cartridge case, a passage extending through a forward part of the cartridge case and housing a sub-calibre practice missile provided with a propellant charge therefor, and an expulsion charge housed behind the propellent charge and having an ignition flame conduit passing therethrough and housing an igniter at a rear part thereof, the ignition flame conduit having formed therein at least one passage for communicating the interior thereof, the ignition flame conduit having formed therein at least one passage for communicating the interior thereof with the expulsion charge and terminating at an ignition channel for passage of an ignition flame therein to said propellent charge and the cartridge case having at least one bore communicating the expulsion charge with the exterior thereof.

2. Practice ammunition according to Claim 1, wherein the ignition flame communicates uninterruptedly with the interior of the ignition channel.

3. Practice ammunition according to Claim 1 or 2, wherein the ignition flame conduit is formed with a plurality of passages arranged at regular intervals in a ring therearound for communicating the interior thereof with the expulsion charge.

4. Practice ammunition according to Claim 3, which comprises a plurality of said rings of passages spaced apart over the length of the ignition flame conduit.

5. Practice ammunition according to any one of the preceding claims, wherein the ignition flame conduit is able to withstand the pressure exerted thereon from within, in use, by gas produced by the ignition charge undergoing combustion.

6. Practice ammunition according to any one of the preceding claims, wherein the internal cross-section of the ignition channel for feeding an ignition flame to the propellent charge is smaller than the internal cross-section of the ignition flame conduit.

Figure 2 shows a similar view of part of another form of practice cartridge embodying this invention.

Referring to Figure 1 there is shown a cartridge case 1 in which is positioned a sub-calibre practice missile 2 having a tail unit 3. A propellant charge 4 is housed in the practice missile 2 and is provided with thin covers 5 and 6 made of paper so as substantially not to obstruct detonation of the charge 4 which is held in the missile by means of a screw cap 7. A separate expulsion cartridge 9 containing an expulsion charge 10 is fitted with frictional contact closing into the rear end of the cartridge case 1 at which are provided radial gas openings 8. Alternatively, the expulsion charge 10 could also be introduced directly into the cartridge case 1. The expulsion cartridge 9 comprises a double layer outer sleeve 11 made of cardboard, a base plug 12 formed of compressed cardboard, a base cap 13 made of steel or brass, and a front cover plate 14 made of cardboard. Frictionally fitted in the base plug 12 is a case 15, shown in elevation, of an igniter with an intensifier charge. Also frictionally engaging the base plug 12 is an ignition flame which the front end of the igniter case 15 extends. The flame conduit 16 extends the entire axial length of the expulsion charge 10, beyond the section thereof in which a friction fit exists between the case 15 and the base plug 12, its forward end 17, which is open, passing through the cover plate 14. Four radial bores 18 which act as ignition openings are provided in the tube 16 approximately in the centre of the expulsion charge 10. A thin cover sleeve 19, made, for instance, of paper is slipped over the ignition flame conduit 16 and serves to prevent part of the expulsion charge 10 from falling out through the bores 18 prior to ignition thereof. The sleeve 19 has virtually no adverse effect on the ignition of the expulsion charge 10. The cover plate 14, which bears on the inner layer of the sleeve 11 and on the sleeve 19 is held in place by means of a flanged edge 20 of the outer layer of the sleeve 11.

A partition 21 is constituted by the part of the cartridge case 1 which separates a cavity 22 therein which the expulsion cartridge 9 is held from a cavity 23 in which the practice missile 2 is housed. An axial ignition channel 24 passes through the partition 21, having a section of relatively large cross-section 25, corresponding to the inside cross-section of the conduit 16, adjacent the conduit 16, a conically narrowing transition section 26, and a section 27 area of smaller cross-section leading into the cavity 23. The base of the practice missile 2 is formed with axial bores 28 and 29 in line with each other and whose cross-section is greater than that of the section 27 of the ignition channel 24, so that the ignition flame from the igniter 15, dammed up in the ignition channel 24, can detonate the propellent charge 4.

Referring next to Figure 2 in which like reference numerals denote like reference numerals denote like parts in Figure 1, there is shown a two part cartridge case in which the cavity 22 for holding the expulsion cartridge 9 is provided in a separate housing 30 connected to a main cartridge case 1 *via* a screw connection 31. Because the expulsion charge 10 is of greater length than that shown in Figure 1, the ignition flame tube 16 is of correspondingly greater axial length and is provided with two rows of ignition openings 18 which are staggered in relation to one another and to the bores 8.

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2. Practice ammunition according to Claim 1, wherein the ignition flame communicates uninterruptedly with the interior of the ignition channel.

3. Practice ammunition according to Claim 1 or 2, wherein the ignition flame conduit is formed with a plurality of passages arranged at regular intervals in a ring therearound for communicating the interior thereof with the expulsion charge.

4. Practice ammunition according to Claim 3, which comprises a plurality of said rings of passages spaced apart over the length of the ignition flame conduit.

5. Practice ammunition according to any one of the preceding claims, wherein the ignition flame conduit is able to withstand the pressure exerted thereon from within, in use, by gas produced by the ignition charge undergoing combustion.

6. Practice ammunition according to any one of the preceding claims, wherein the internal cross-section of the ignition channel for feeding an ignition flame to the propellent charge is smaller than the internal cross-section of the ignition flame conduit.

7. Practice ammunition according to any one of the preceding claims, wherein the ignition channel undergoes a reduction in internal cross-section along a part of its length.

8. Practice ammunition according to Claim 7, wherein the ignition channel undergoes said reduction in internal cross-section from a value corresponding to the internal cross-section of ignition flame conduit to a smaller cross-section which it possesses over a final part of its length.

9. Practice ammunition according to Claim 8, wherein the ignition channel comprises a section which is conically narrowing in the direction of ignition flame travel, in use, from the igniter to the propellent charge.

10. Practice ammunition according to any one of the preceding claims, wherein at least one radially directed bore in the cartridge case communicates the expulsion charge with the exterior of the cartridge case and said bore)s) is/are staggered with respect to said at least one passage communicating the interior of the ignition flame conduit with the expulsion charge.

11. Practice ammunition, substantially as hereinbefore described with reference to, and as shown in, Figure 1 or 2 of the accompanying drawings.

12. A shell dummy for firing from a mortar, which shell dummy houses therein practice ammunition as claimed in any one of the preceding claims.

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