

The invention concerns an anti-tank grenade containing a head, a tubular tail extending the head, whereby the head is crossed by an axial bore opening on an axial bore of said tubular tail, a hollow-shaped charge situated symmetrically round the axial bore in the head and a detonator.

Such a grenade corresponding to the preamble of claim 1 is known from patent EP-A-0 030 051 concerning the use of a particular ball-passage in one of the above-mentioned bores.

It is also known that the use of a hollow-shaped charge requires a symmetrical ignition. However, the presence of said central bore does not allow for such a symmetrical ignition if the detonator is in an eccentric position with regard to the longitudinal axis of the grenade.

This is not the case with the grenade according to patent EP-A-0 030 051 which mentions neither an asymmetrical detonator, nor an eccentric percussion point. Instead of a detonator a tubular fuse is mounted symmetrically at the front end of the head.

Thus, the present invention aims to realize a grenade with a hollow-shaped charge meant to be launched by means of a fuse and allowing for a symmetrical ignition of the hollow-shaped charge from an eccentric percussion point.

To this end, means making it possible to obtain a symmetrical ignition with regard to the axis of the above-mentioned hollow-shaped charge have been mounted between the detonator placed asymmetrically with regard to the axis A-A of the grenade and the hollow-shaped charge of the grenade, whereby these means contain means to transfer the shock wave caused by the detonator, said means determining the trajectory followed by this wave between a point adjacent to the detonator and various ignition points which have been placed symmetrically

around the longitudinal axis of the grenade, whereby the length of the trajectories between the initial point and each of the ignition points is such that the waves require the same time to reach all the ignition points from the initial point.

The use of means to transfer the shock wave is known in itself from patents US-A-3 311 055 and US-A-3 561 361, however these two patents do not concern a grenade but detonation systems.

Indeed, patent US-A-3 311 055 concerns a secondary detonator (booster) for the detonation of a warhead. Lengths of explosive surrounded by metal are placed in concentric grooves in the surface of a chamber in which the annular detonation charge is situated. In one groove, lengths of explosive connect an initiation point to T-shaped connections joining one length to two lengths in an adjacent groove, whereby each of these latter lengths is joined by means of T-shaped connections to two other lengths in another groove.

Patent US-A-3 561 361 describes a cylinder-shaped detonator which has been mounted in a symmetrical manner on a shaped charge which is not really hollow-shaped. Conduits filled with explosive connect an initiation point to the chamber composed of two elements, either directly or by means of a round central chamber, such that the detonation of the exterior element is brought about before the detonation of the interior element of the charge.

According to a particular embodiment of the invention, the detonator is part of a security device provided in the head between the hollow-shaped charge and the tail.

According to an efficient embodiment of the invention, the means to transfer the shock wave contain at least one washer placed between the detonator and the hollow-shaped charge, transversally with regard to the longitudinal axis, and

containing grooves filled with an explosive material forming the trajectories.

By way of example only and without being limitative in any way, the following preferred embodiments of the invention are described with reference to the accompanying drawings, where:

figure 1 shows a longitudinal section of an anti-tank grenade according to the invention;

figures 2 and 4 are views according to the lines II-II and IV-IV of figure 1 respectively;

figure 3 shows a section according to line III-III of figure 2;

figure 5 shows a variant of the part indicated by F5 in figure 1;

figures 6 and 8 show sections according to lines IV-IV and VIII-VIII in figure 5;

figure 7 shows a section according to line VII-VII of figure 6;

figure 9 represents a second variant of the part indicated by F5 in figure 1;

figures 10 and 12 show sections according to lines X-X and XII-XII of figure 9;

figure 11 shows a section according to line XI-XI of figure 10;

figure 13 shows, in perspective and in exploded view, a variant according to figure 9.

Figure 1 shows a grenade according to the invention consisting mainly of a head 1 containing a hollow-shaped charge 2, a security device 3 containing the detonator 4 and a percussion point device 5, whereby the grenade is crossed by an axial bore 6, extended by a second axial bore 7 provided in the tail 8 of the grenade.

A ball-passage 9 as described in Belgian patent 880349 of the

applicant has been mounted in this bore 7.

All these elements are known in themselves and therefore will not be described in detail.

In order to realize an ignition of the hollow-shaped charge 2, the grenade according to the invention contains, between the security device 3, more in particular the detonator 4 and the hollow-shaped charge 2 as such, a device 10 to transfer the shock wave resulting from the ignition of the detonator 4 to the hollow-shaped charge 2, for example a washer 10. The latter is realized such that it makes it possible to obtain a symmetrical ignition of the hollow-shaped charge.

In the example shown in figures 2 to 4 the transfer washer 10 is made such that it contains four transfer points 11, 12, 13 and 14 respectively, arranged in a concentric manner and under equal angles with regard to the longitudinal axis A-A of the grenade.

To this end, the washer 10 contains grooves filled with an explosive material 15.

A first groove 16 has been applied on the arc of a circle of 180 degrees and whose median part 17 is situated opposite to said percussion point and detonator 4.

This groove 16 is extended at each free end by aligned grooves 18-19 directed one towards to the other. Each groove 18-19 ends in a groove 20-21 respectively situated in a concentric way with regard to the groove 16 and extending over 90 degrees, more in particular over two times 45 degrees on both sides of the grooves 18-19. Each free end of these two grooves 20 and 21 is extended by radial grooves 22, 23, 24 and 25 respectively directed towards the axis A-A of the grenade, each of these grooves 22 to 25 being connected to any of the

holes 26, 27, 28 and 29 forming said transfer or ignition points 11 to 14.

In order to situate the exact position of the washer 10 with regard to the detonator 4, said washer is in this case provided with a notch 30 which can cooperate with an inwardly protruding part 31 of the body of the grenade. It is clear that the lengths of the constituent elements of the above-mentioned grooves should all be perfectly identical and should have the same lengths so as to obtain a symmetrical ignition, i.e. an ignition of the hollow-shaped charge 2 at all four points 11 to 14 at once.

The washer 10, in particular the mutual distance of the grooves and the depth of these grooves with regard to the thickness of the washer 10 are made such that short-circuits are avoided between the adjoining grooves 16, 20 and 21 on the one hand, and between the explosive material 15 and the hollow-shaped charge 2 at the height of the grooves on the other hand.

The working of the grenade equipped with a washer 10 as described above is very simple and as following.

When the point 5 strikes the detonator 4, the thus produced shock wave is transferred to the material 15 contained in the groove 16 of the washer 10. The shock wave is thus carried to both the grooves 18-19, then to the grooves 20-21 and then to the grooves 22 to 25 to end up, through the explosive material contained in the passages 26 to 29, in the hollow-shaped charge 2, if required via a traditional relay.

It should be noted that the ignition of the hollow-shaped charge 2 is thus realized in a symmetrical manner, namely at all four points 11 to 14 at once situated at equal angles one with regard to the other.

In the example shown in figure 5 the washer 10 has been split up by a second washer 32, made in such a way that the shock waves coming from the four points 11 to 14 are transferred to explosive materials 33 contained in circular grooves 34, 35, 36 and 37 respectively provided in the washer 32.

Said grooves 34 to 37 are each, at each free end, extended by radial grooves 38-39, 40-41, 42-43 and 44-45 respectively, directed towards the outside. The free ends of the grooves 38 to 45 are each connected to holes 46 to 53 so as to obtain a multiplication of the ignition points 54 to 61. It is clear that a better symmetrical distribution of the ignition points is thus obtained with regard to the hollow-shaped charge 2. The above-mentioned second washer also has a positioning groove 62.

The working of the grenade equipped with the washers 10 and 32 is similar to that described above. According to this embodiment the shock waves coming from the points 11 to 14 are transferred to the explosive material 33 contained in the grooves 34 to 37. The shock waves are carried to all the grooves 38 to 45 at once and then to the explosive material contained in the passages 46 to 53 so as to be transferred, at eight points at once, to the explosive charge 2.

According to the invention, the dimensions of the different grooves are always determined such that the shock waves are simultaneously transferred at all eight points 54 to 61 to the hollow-shaped charge.

In order to multiply said number of ignition points it is possible, as shown in figure 9, to further increase the number of washers. Thus, a third washer 63 represents a groove, respectively 64 to 71, in front of each ignition point 54 to 61, concentric with regard to the axis A-A of the grenade and extending over 22 degrees 30 minutes. These grooves are

filled with an explosive material 72. Each free end of these grooves is connected to holes 73 to 88, provided in the washer 63, so as to obtain in this case sixteen ignition points, 89 to 104 respectively.

It is clear that a perfectly symmetrical ignition is obtained in this way, i.e. at a considerable number of points at once situated concentrically and at equal distances.

This washer 63 is provided with a positioning notch 105 working in conjunction with the above-mentioned protrusion 31 of the grenade.

In this example, the shock waves coming from the points 54 to 61 are transferred to the explosive material 72 contained in the grooves 64 to 71 of the washer 63. These waves move via the passages 73 to 88 so as to be transferred, at sixteen points, to the hollow-shaped charge 2.

It should be noted that the distances to be covered by the shock waves in the different grooves of a washer 10, 32, 63 starting from the point of departure of the shock wave to the ignition points 11 to 14, 54 to 61 and 89 to 104 respectively are all exactly the same so as to obtain under all circumstances a simultaneous ignition at all ignition points.

It is clear that one could consider using even more washers and that the form and arrangement of the grooves may vary as a function of the position of the ignition point and the available surface. Thus, another variant according to the invention is illustrated in figure 13.

In this embodiment, three washers 106, 107 and 108 are applied in the same way as in the previous examples, separately or combined.

Each washer is preceded by a ring 109, 110 and 111 made in explosive material. The washers 106 to 108 thus form barriers so to say for the shock waves and are provided, in order to transfer the shock waves in a symmetrical manner and at equal angles, with passages 112-113, 114 to 117 and 118 to 125 respectively to the hollow-shaped charge 2.

The different washers can be exactly positioned one with regard to the other by means of notches or grooves 126, 127 and 128.

The working of this variant is identical to that described above.

Claims

1. Anti-tank grenade containing a head (1), a tubular tail (8) extending the head, whereby the head (1) is crossed by an axial bore (6) opening on an axial bore (7) of said tubular tail (9) a hollow-shaped charge (2) situated symmetrically round the axial bore (6) in the head (1) and a detonator (4), characterized in that means making it possible to obtain a symmetrical ignition with regard to the axis of said hollow-shaped charge (2) have been mounted between the detonator (4), placed asymmetrically with regard to the axis A-A of the grenade, and the hollow-shaped charge (2) of the grenade, whereby these means contain means to transfer the shock wave caused by the detonator (4), said means determining the trajectories followed by this wave between a point adjacent to the detonator (4) and various ignition points (11 to 14, 54 to 61 and 89 to 104) which have been placed symmetrically around the longitudinal axis of the grenade, whereby the length of the trajectories between the initial point and each of the ignition points is such that the waves require the same time to reach all the ignition points (11 to 14, 54 to 61, 89 to 104) from the initial point.

2. Anti-tank grenade according to claim 1, characterized in that the detonator (4) is part of a security device (5) provided in the head (1) between the hollow-shaped charge (2) and the tail (8).

3. Anti-tank grenade according to any of claims 1 to 2, characterized in that the means to transfer the shock wave contain at least one washer (10-32-63-106-107-108) provided between the detonator (4) and the hollow-shaped charge (2), transversally with regard to the longitudinal axis and containing grooves filled with an explosive material (15-33-



72) forming the trajectories.

4. Anti-tank grenade according to the preceding claim, characterized in that the washer (106) (107) (108) is preceded by a ring (109) (110) (111) of explosive material, the washer (106) (107) (108) being provided with passages (112-113) (114 to 117) (118 to 125) which make it possible for the shock wave to be transferred to the following ring or to the explosive of the hollow-shaped charge.

5. Anti-tank grenade according to claim 3, characterized in that the transfer means contain a single washer (10) provided with a first groove (16) extending over the arc of a circle of 180 degrees whose free ends are extended by aligned grooves (18-19) directed one towards the other, whereby the latter grooves are each connected to a curved groove (20-21) respectively extending over the arc of a circle of 90 degrees, the free ends of each of these grooves (20-21) being connected to radial grooves (22-23-24-25) whose ends are in turn connected to holes (26-27-28-29) provided in the washer (10) so as to realize ignition points (11 to 14) in the surface opposite to it containing said grooves (16-18-19-20-21-22-23-24-25).

6. Anti-tank grenade according to claim 5, characterized in that the first groove (16) is placed in such a manner with regard to the detonator (4) that the detonator is situated opposite to the median part of said groove (16).

7. Anti-tank grenade according to claim 4, characterized in that the means to transfer the shock wave contain a single washer (106) preceded by a ring (109) in explosive material and in that said washer (106) has diametrically opposed passages (112-113).

8. Anti-tank grenade according to claim 7, characterized in



that the passages (112-113) are formed by notches or grooves provided in the circumference of the washer (106).

9. Anti-tank grenade according to any of claims 7 or 8, characterized in that the passages (112-113) in the washer (106) are situated opposite to the ring (109) preceding the washer (106).

10. Anti-tank grenade according to claim 3, characterized in that the means to transfer the shock wave contain two washers (10-32) (106-107) placed between the detonator and the hollow-shaped charge (2), transversally with regard to the longitudinal axis and containing grooves filled with explosive material (15-33-72) forming the trajectories.

11. Anti-tank grenade according to claim 10, characterized in that the first washer is provided with a first groove (16) extending over the arc of a circle of 180 degrees whose free ends are extended by aligned grooves (18-19) directed one towards the other, whereby the latter grooves are each connected to a curved groove (20-21) respectively extending over the arc of a circle of 90 degrees, the free ends of each of these grooves (20-21) being connected to radial grooves (22-23-24-25) whose ends are in turn connected to holes (26-27-28-29) provided in the washer (10) so as to realize ignition points (11 to 14) in the surface opposite to it containing said grooves (16-18-19-20-21-22-23-24-25), whereas the second washer (32) has four curved grooves (34 to 37) whose free ends are each extended by radial grooves (38-39), (40-41), (42-43) and (44-45) respectively directed towards the outside, the free ends of each of the latter being connected to holes (46 to 53) respectively provided in the washer (32) so as to realize ignition points (54 to 61).

12. Anti-tank grenade according to claim 11, characterized in that the median parts of the curved grooves (34 to 37) are



placed such that they are aligned with the holes (26 to 29) of the washer (10).

13. Anti-tank grenade according to claim 10, characterized in that according to an embodiment of the grenade with two washers (106-107) each preceded by a ring (109-110) in explosive material, the first washer (106) has diametrically opposed passages (112-113), whereas the second washer (107) has four passages (114 to 117) respectively.

14. Anti-tank grenade according to claim 13, characterized in that the passages (114 to 117) are formed by notches or grooves provided in the washer.

15. Anti-tank grenade according to claim 14, characterized in that the passages (112-113) respectively on the one hand and (114 to 117) on the other hand are situated opposite to the ring (109) (110) in explosive material preceding the washers.

16. Anti-tank grenade according to any of claims 13 to 15, characterized in that the passages (112-113) are situated at an angle of 90 degrees with regard to the detonator (4).

17. Anti-tank grenade according to any of claims 13 to 16, characterized in that the passages (114 to 117) in the washer (107) are situated at an angle of 45 degrees with regard to the passages (112-113) in the washer (106).

18. Anti-tank grenade according to claim 3, characterized in that the means to transfer the shock wave contain three washers (10-32-63), (106-107-108) placed between the detonator and the hollow-shaped charge (2), transversally with regard to the longitudinal axis and containing grooves filled with explosive material (15,33,72) forming the trajectories.

19. Anti-tank grenade according to claim 18, characterized in



that the first washer (10) is provided with a first groove (16) extending over the arc of a circle of 180 degrees whose free ends are extended by aligned grooves (18-19) directed one towards the other, whereby the latter grooves are each connected to a curved groove (20-21) respectively extending over the arc of a circle of 90 degrees, the free ends of each of these grooves (20-21) being connected to radial grooves (22-23-24-25) whose ends are in turn connected to holes (26-27-28-29) provided in the washer (10) so as to realize ignition points (11 to 14) in the surface opposite to it containing said grooves (16-18-19-20-21-22-23-24-25), whereas the second washer (32) has four curved grooves (34 to 37) whose free ends are each extended by radial grooves (38-39), (40-41), (42-43) and (44-45) respectively directed towards the outside, the free ends of each of the latter being connected to holes (46 to 53) respectively provided in the washer (32) so as to realize ignition points (54 to 61), and in that the third washer (63) has been provided with curved grooves (64 to 71) whose free ends are each connected with a hole (73 to 88) provided in the washer (63) so as to realize ignition points (89 to 104).

20. Anti-tank grenade according to claim 19, characterized in that the median parts of the grooves (64 to 71) are situated such that they coincide with the holes (46 to 53) of the washer (32).

21. Anti-tank grenade according to claim 18, characterized in that the means to transfer the shock wave contain three washers (106-107 and 108) each preceded by a ring (109-110-111) in explosive material, whereby the first ring (106) has diametrically opposed passages (112-113), whereas the second ring (107) has four passages (114 to 117) respectively and the third ring (108) has eight passages (118 to 125) respectively.

22. Anti-tank grenade according to any of claims 3 to 21,



characterized in that each washer has been provided with a positioning means with regard to the detonator (4) and with regard to another washer respectively.

23. Anti-tank grenade according to claim 22, characterized in that said means consist of a notch or groove (30-62-105) provided in the exterior part of the washer (10-32-63).

24. Anti-tank grenade according to claim 22, characterized in that said means consist of a notch or groove (119-120-124) provided in the interior part of the washer (106-107-108).

25. Anti-tank grenade according to any of claims 3 to 24, characterized in that the distances to be covered by the shock wave in the different grooves of a washer (10) (32) (63) starting from the point of departure of the shock wave to the ignition points (11 to 14) (54 to 61) (89 to 104) respectively are all the same.

