

Dec. 21, 1965

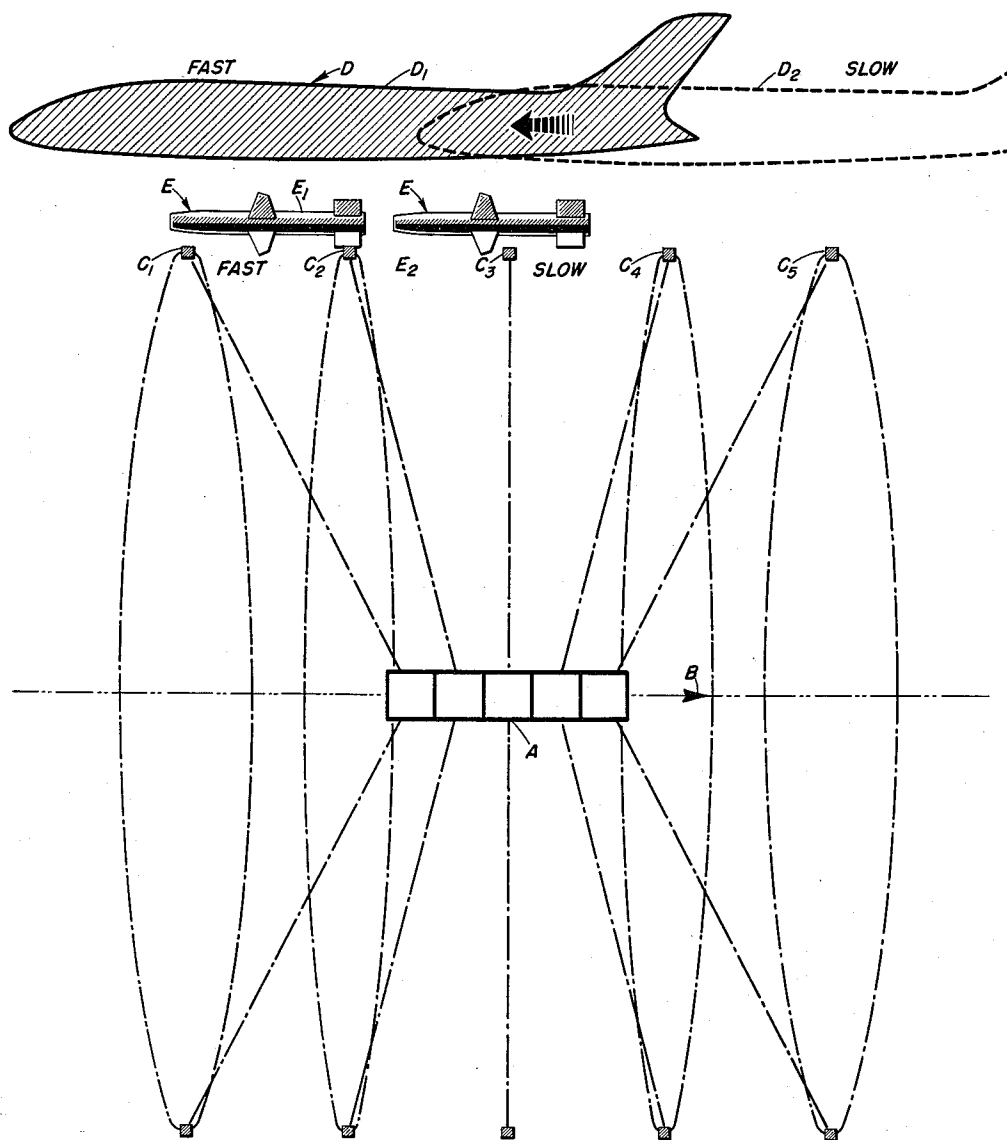
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3,224,372

MULTI-PROJECTILE CONTINUOUS ROD WARHEAD

Filed May 12, 1958

3 Sheets-Sheet 1



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FIG. 2.

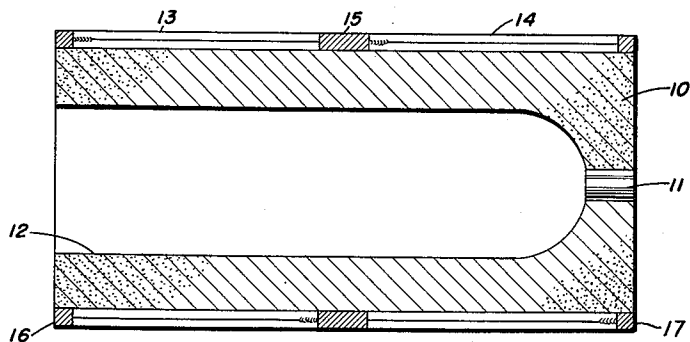


FIG. 3.

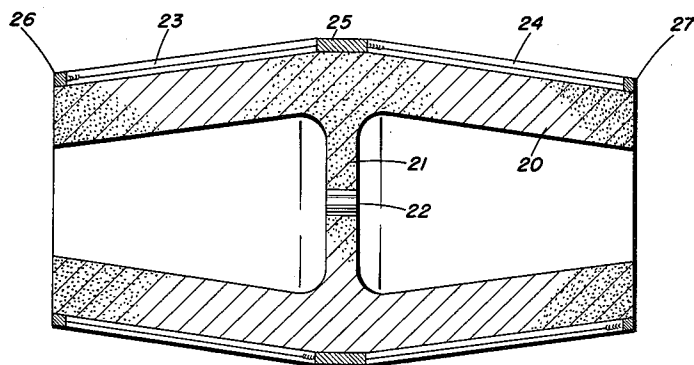
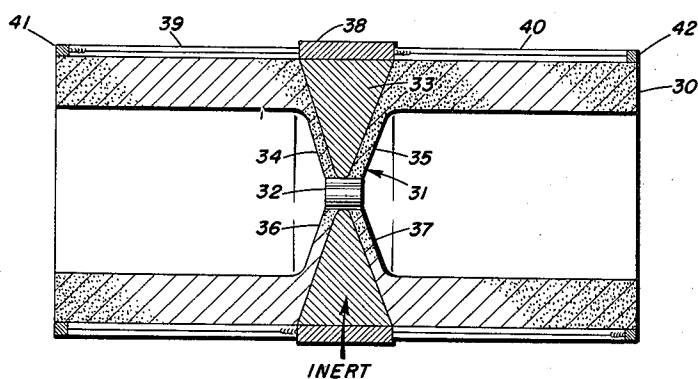


FIG. 4.



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FIG. 5.

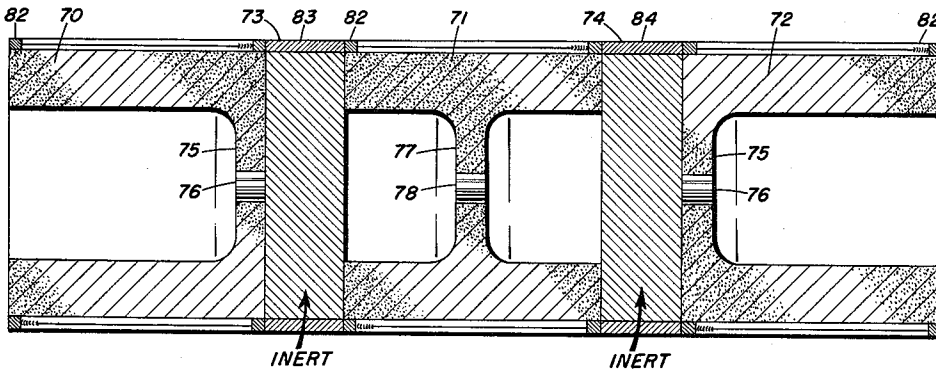
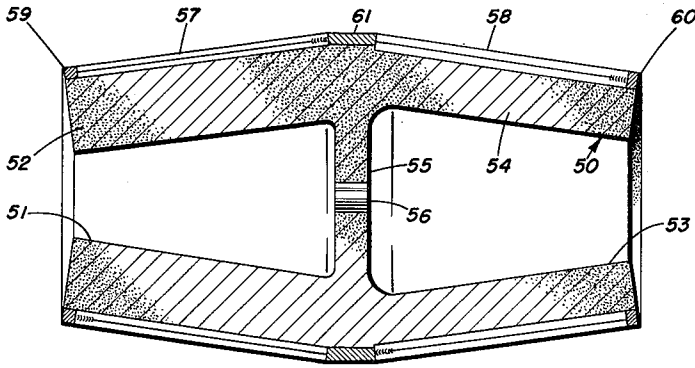


FIG. 6.

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MULTI-PROJECTILE CONTINUOUS ROD WARHEAD

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11 Claims. (Cl. 102—67)

The present invention relates to warheads for missiles; more particularly it relates to improvements in warhead structures of the types shown in U.S. patent applications Serial Numbers 590,077, 590,078 and 590,079.

In copending patent application Serial Number 590,079 there is shown a warhead including a projectile consisting of rods of rectangular cross-section arranged in layers and with their alternate opposite ends rigidly connected, so that when the warhead is detonated, the projectile will be propelled as a single continuous ring (continuous rod warhead). Notwithstanding best available fuzing the probability of single ring-type projectiles striking moving targets at points of maximum vulnerability is relatively slight, due to variations in target sizes and relative speeds, and to variations in the projectiles themselves, spatial approach conditions and other factors.

It should be understood that there are several basic problems involved in adapting a continuous rod warhead for use with guided missiles, i.e., those associated with the successful performance of the warhead itself and those involved in conforming the warhead to the missile configuration. In the latter group are included ones concerned with fuzing and the variability of target speeds and sizes. That is, a single continuous rod (ring) warhead projectile of zero beam width cannot intersect with optimum damage potential targets of differing sizes under all possible spatial conditions, so long as the warhead is actuated by fuze having either a fixed delay or a variable time delay based on closing rate velocities.

Two avenues of approach are open to yield a better total "kill" probability, assuming that the total "kill" is the product of the warhead "kill" potential times a fuze operation factor. The first avenue is to develop a fuze that will lead the warhead burst by a sufficient time so that the warhead projectile can effect optimum target damage. Such a fuze system should furnish information about and be able to act upon miss-distance, aspect, orientation, angle of attack (there are several such angles for both missile and target), missile velocity and target velocity. Rod velocity is assumed known, as is target size and missile guidance information.

The second avenue of approach, that of modifying the warhead design so that the total "kill" probability can be increased, will now be discussed. Such a modified warhead design must compensate for a less than completely efficient fuzing system and must therefore contemplate a greatly widened destructive beam width. The means for accomplishing this is simply to employ a warhead utilizing a plurality of continuous rod ring-shaped projectiles which, following warhead burst, will be spaced along the trajectory of a target (missile or airplane).

One of the important objects of the present invention, therefore, is to provide a warhead having multiple ring-type projectiles so arranged that the probability of one or more of them striking a vulnerable point on a target will be substantially increased.

Another object of the invention resides in the provision of a warhead which is so designed that it will be capable of destroying targets having varying speeds.

A further object of the invention is to provide a warhead employing means for assuring expulsion of multiple

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projectiles as continuous rings and without breakage of the rods constituting said rings.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a diagrammatic view showing the manner in which a warhead incorporating five projectiles functions to destroy relatively fast and slow and relatively large and small targets;

FIG. 2 is an axial section of a basic form of multi-projectile warhead according to the invention;

FIG. 3 is an axial section showing a modified embodiment of the invention;

FIG. 4 is an axial section showing still another embodiment of the invention;

FIG. 5 is an axial section of a further embodiment of the invention, the same utilizing a pair of warhead projectiles, the rods of one of said projectiles being larger in cross-section and lower in velocity than those of the other said projectile; and

FIG. 6 is an axial section showing a warhead utilizing three spaced rod projectiles isolated by inert barriers, each detonated separately with selectable time delay.

Referring to the drawings in more detail and first to FIG. 1 thereof there is shown diagrammatically at A a warhead which consists of five rod type projectiles arranged on a common axis. The direction of travel of a missile carrying the warhead A is indicated by the arrow B. The continuous rod projectiles in their optimum extended positions after detonation of an explosive charge contained in the warhead is shown at C1, C2, C3, C4 and C5.

There is diagrammatically represented in FIG. 1, at D, a relatively large target such as a bomber type airplane. The position of the target D along its course is represented in full lines at D1, assuming that the target is moving rapidly. The position of the target D, assuming that it is moving relatively slowly, is shown in broken lines at D2. Beneath the target D on FIG. 1 is shown a relatively small target E, such as a guided missile. The position of a relatively fast moving target E is shown at E1 whereas a relatively slow moving target E is shown at E2. From a scrutiny of FIG. 1 it will be clearly seen that a warhead utilizing five continuous rod type projectiles would, if detonated at a point parallel to the trajectory of the target D or the target E, intersect either of said targets, either fast or slow moving, with at least one of the projectiles C1-C5.

From the foregoing it will be clearly understood that at least some of the limitations of a continuous rod warhead utilizing but one continuous rod projectile are avoided.

Attention is now directed to FIG. 2 of the drawings, wherein there is shown a simple embodiment of a multi-projectile warhead. The warhead of FIG. 2 comprises a detonating high explosive charge 10 which is initiated by an axially positioned detonator 11 which may be of any suitable type. The charge 10 is of the shaped type, having a hollow interior 12.

Surrounding the charge 10 are continuous rod type projectiles 13 and 14 which are of the kind disclosed in patent application Serial Number 590,079, filed June 7, 1956, titled, Double Layer Warhead. The projectiles 13 and 14 are spaced from each other medially of the warhead by an annular band 15 of inert material, which band also serves to anchor the corresponding inner ends of the said projectiles 13 and 14. The corresponding outer ends of the projectiles 13 and 14 are retained in position by hoops 16 and 17, of rectangular cross-section. It should be understood that the band 15 and the hoops 16

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and 17 are welded or otherwise suitably connected to the confronting end faces of the rod elements of the projectiles 13 and 14, and that said hoops and band cooperate to control the rod end portions so that tumbling or twisting of the said rod elements will be largely prevented and continuity of the projectiles thus usually maintained.

The warhead is assembled in a missile (not shown) on the axis thereof and the detonator 11 is connected to a firing circuit in the missile, which firing circuit of course incorporates a suitable influence fuze. Upon initiation of the detonator the charge 10 will be detonated for propelling the projectiles 13 and 14 outwardly as a continuous ring, substantially as indicated at C1, C5 in FIG. 1. The detonation of the charge 10 will, of course, break the ends of the rod elements of the projectiles 13 and 14 from the band 15 and the hoops 16 and 17. The charge 10 is so designed and shaped that the propelling explosive forces will be applied to the rod elements of the projectiles 13 and 14 at such times that said elements will be projected at a slight angle with respect to each other.

In the modification of FIG. 3 a generally bi-conical warhead is shown. In this embodiment the detonating explosive charge is shown at 20 and includes a central web 21 which carries, axially thereof, the detonator 22. The projectiles, of the continuous rod type similar to the projectiles 13 and 14, are shown at 23 and 24 and are spaced from each other medially of the warhead by an annular band 25. End hoops 26 and 27, similar to the hoops 16 and 17, retain the projectiles 23 and 24 against displacement and also control the explosive end effects which take place upon detonation of the charge 20. It will be understood that the bi-conical shape of the warhead of FIG. 3 will have the effect of causing the projectiles 23 and 24 to project at slight angles with respect to each other and thus cover a greater target area.

The embodiment of FIG. 4 comprises a cylindrical detonating charge 30 having a bi-conical centrally located web 31 on the axis of which is positioned a detonator 32. A wedge-shape annular barrier is shown at 33, said barrier extending from the outer surface of the charge 30, medially thereof, to the surface of the detonator 32. The barrier 33 is of inert material and functions to define lead-in annular explosive sections 34, 35, 36 and 37. Surrounding the barrier 33 is a band 38, the purpose for which will be described in more detail hereinafter.

Continuous rod projectiles 39 and 40, similar in every respect to the projectiles 13 and 14, surround the charge 30 between the band 38 and points near the ends of the said charge. End hoops 41 and 42 cooperate with the band 38 for retaining the projectiles in place on the charge and for controlling explosive end-effects upon detonation of the charge. More specifically, the opposite end faces of the rod elements of the projectile 39 are welded to the hoop 41 and to the adjacent face of the band 38. Similarly, the end faces of the rod elements of the projectile 40 are welded to the opposite face of the band 38 and to the end hoop 42.

Upon initiation of the detonator 32, the portions of the charge 30 at each side of the barrier 33 will be detonated, with the result that the projectiles 39 and 40 will be propelled as spaced continuous rod rings. The wedge shape barrier 33 and the lead-in explosive sections will control the detonation waves produced at each side of the barrier so that the projectiles will be propelled at an angle with respect to each other, thus increasing the target area that may be covered by the exploding warhead.

The modification of the invention shown in FIG. 5 of the drawings will now be described. In this embodiment of the invention a bi-conical explosive charge

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is employed, the same being shown generally at 50. The charge 50 has a relatively small generally conical recess 51, defining a relatively thick annular explosive section 52, and a relatively large recess 53 which defines a relatively thin explosive section 54. The recesses 51 and 53 cooperate to define a central web 55 which carries, axially thereof, a detonator 56.

Surrounding the explosive section 52 is a continuous rod ring projectile 57 which is similar to the projectile 13. However, the rod elements of the projectile 57 are relatively small in cross-section, say three-sixteenths inch square. A projectile 58 surrounds the explosive section 54 and is of the same construction as the projectile 57 except that the individual rod elements are of larger cross-section, say one-fourth of an inch. At the free end of the section 52 the projectile 57 is retained in place by an end hoop 59 of relatively small cross-section which is welded to the end faces of the rod elements of said projectile. An end hoop 60 of relatively large cross-section secures the projectile 58 at the free end of the explosive section 54. A band 61 surrounds the charge 50 medially of its length and serves to connect, by welding, the confronting inner ends of the projectiles 57 and 58.

Upon initiation of the detonator 56 the sections 52 and 54 will be detonated, for propelling the projectiles 57 and 58 outwardly as continuous rod rings. The bi-conical configuration of the warhead of FIG. 5 will result in the propulsion of the projectiles at a diverging angle. Moreover, since the projectile 57 is of lighter weight and is propelled by a heavier charge, it will move at a higher rate of speed than will the projectile 58. Thus, the angle of separation of the two projectiles will be widened, for achieving a greater coverage of target area.

Referring now to FIG. 6 of the drawings, which depicts still another modified embodiment of the invention, there is disclosed a warhead utilizing three continuous rod ring projectiles. More specifically, the warhead of FIG. 6 comprises three detonating explosive charges 70, 71 and 72 which are arranged in tandem on the same axis. A barrier plate 73 is interposed between the charges 70 and 71 and a barrier plate 74 is placed between the charges 71 and 72, the barrier plates being of inert material. Each of the charges 70 and 72 has a web 75 at its inner end and each of said webs carries an axially positioned detonator 76. The charge 71 has a centrally disposed web 77 which has an axially located detonator 78 therein.

Surrounding the charges 70, 71 and 72 are, respectively, continuous rod projectiles 79, 80 and 81. These projectiles are similar to the projectile 13 and are held in place by end hoops 82, a pair of said hoops being used for each projectile. As in the previously described modifications, the end hoops are welded to the end faces of the rod elements of the projectiles. Cylindrical bands 83 and 84 surround the barrier plates 73 and 74, respectively, and are welded to the adjacent end hoops. It will thus be seen that the end hoops and bands cooperate to retain the warhead parts (charges and projectiles) in assembled relation.

The detonators 76 and 78 are arranged for selectable controlled time delay initiation, and upon such initiation the charges 70, 71 and 72 will be detonated for propelling the projectiles outwardly as spaced continuous rod rings. The spacing of the rings will be increased by the barrier plates 73 and 74 and by the time delayed initiation of the detonators coupled with missile travel during such time delay, and will result in greater target area coverage than would be possible with one or two spaced projectiles. It will be obvious, of course, that a warhead comprising as many as seven charges (and associated projectiles) may be made for achieving even greater target area coverage.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within

the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A multi-projectile continuous rod warhead comprising a detonating high explosive projectile-propelling charge, a detonator for the charge, a plurality of structurally independent continuous rod projectiles surrounding the charge in tandem and engaging the outer surface of said charge, means connecting confronting ends of the independent projectiles, and means retaining the free ends of the projectiles in place on the charge, each of said independent continuous rod projectiles comprising a plurality of generally parallel rod elements rigidly connected at their opposite corresponding ends and distributed uniformly about said charge.

2. A multi-projectile continuous rod warhead as recited in claim 1, wherein the first mentioned means is constituted by an annular band, and said second mentioned means consists of end hoops.

3. A multi-projectile continuous rod warhead comprising a detonating high explosive projectile-propelling charge, a detonator for the charge, and a plurality of structurally independent continuous rod projectiles surrounding the charge in tandem thereon, each of said continuous rod projectiles including a plurality of generally parallel rods arranged in layers and with corresponding end portions of the rod elements of one layer rigidly connected to corresponding end portions of the rod elements of another layer, said rods being distributed uniformly about said charge.

4. A multi-projectile continuous rod warhead comprising a detonating high explosive projectile-propelling charge, said charge having a transverse web, a detonator in the web, and a plurality of continuous rod projectiles surrounding the charge in tandem thereon and in contact with the outer surface thereof, each of said continuous rod projectiles being structurally independent and comprising a plurality of generally parallel rod elements rigidly connected at their opposite corresponding ends and distributed uniformly about said charge, said projectiles being propelled as spaced continuous rod rings along predetermined paths upon initiation of the detonator and bursting of the charge.

5. A multi-projectile continuous rod warhead comprising a substantially bi-conical in external configuration detonating high explosive projectile-propelling charge having a central, transverse web, a detonator positioned in the web, and a continuous rod-type projectile fitting about each of the conical surfaces of the charge, each of said continuous rod projectiles being structurally independent and comprising a plurality of generally parallel rod elements rigidly connected at their opposite corresponding ends and distributed uniformly about said charge.

6. A warhead as recited in claim 5, including additionally an annular band surrounding the mid-portion of the charge and connecting the confronting ends of the projectiles.

7. A warhead as recited in claim 6, including additionally an end hoop surrounding each end portion of the charge and secured to the free end of the projectile extending in close proximity to said end.

8. A multi-projectile continuous rod warhead comprising a detonating high explosive projectile-propelling charge having a central, transverse web, a detonator in the web, a wedge shape annular barrier extending into

the web and defining lead-in annular explosive sections, and a continuous rod projectile on the external surface of the charge at each side of the barrier, each of said continuous rod projectiles being structurally independent and comprising a plurality of generally parallel rod elements rigidly connected at their opposite ends and distributed uniformly about said charge, initiation of the detonator initially detonating the lead-in annular explosive sections and subsequently detonating the charge for propelling the projectiles along predetermined spaced paths as continuous rod rings, the barrier and lead-in sections directing the explosive forces upon detonation so that the projectiles will be propelled at an angle with respect to each other.

9. A multi-projectile continuous rod warhead as recited in claim 5, wherein one of the continuous rod-type projectiles comprises rod elements of relatively small rectangular cross-section and the other of said projectiles comprises rod elements of relatively large rectangular cross-section, said projectiles being propelled at differing velocities upon detonation of the explosive charge, whereby increased separation of the projectiles in flight, with increased target area coverage, will be effected.

10. A multi-projectile continuous rod warhead as recited in claim 9, wherein said charge is formed with relatively large and relatively small recesses, said recesses defining said central web, said relatively small recess defining a relatively thick explosive section inwardly of the projectile having rod elements of relatively small cross-section and the relatively large recess defining a relatively thin explosive section inwardly of the projectile having rod elements of relatively large cross-section.

11. A multi-projectile continuous rod warhead comprising a plurality of detonating high explosive projectile-propelling charges arranged in tandem on a common axis, a detonator for each of the charges, a barrier plate between adjacent charges, a structurally independent continuous rod projectile surrounding each of the charges, said independent continuous rod projectiles each comprising a plurality of generally parallel rod elements rigidly connected at their opposite ends and distributed uniformly about their respective charge, and means engaging the barrier plates and connected to the projectiles for retaining the charges, barrier plates, projectiles and said means in assembled relation, said detonators being arranged for controlled selective initiation, whereby delayed propulsion of the projectiles, with increased spacing thereof one from another, may be effected.

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