An explosive weapon and a fragmentary element therefor are disclosed. The explosive weapon comprises an explosive charge and a means to combine a plurality of fragmentary elements with the explosive charge to form an explosive assembly. Each of the fragmentary elements comprises a member having the general shape of a sphere. Each of the members has six flat surfaces located along the greatest diameter of the sphere. This greatest diameter occurs along the great circle or equatorial zone of the spherically shaped member. Each of the flat surfaces intersects the next adjacent flat surface at the greatest diameter of the sphere. Therefore, a cross section through the element in a plane including the greatest diameter and the center of the sphere has a regular hexagonal shape. The flat surfaces are adjacent elements adapted to be facially disposed to prevent rotation of the elements with respect to each other. These flat surfaces are further adapted to join other flat surfaces located in the structure of the explosive weapon. The fragmentary element has an air resistance that is only slightly greater than the air resistance of a totally spherical member of corresponding size. In more specific embodiments of the weapon, the fragmentary elements are in flat surface to flat surface contact to form rows adjacent each other. The elements of adjacent rows interlock each other to prevent shifting of the rows with respect to each other.

7 Claims, 7 Drawing Figures
EXPLOSIVE WEAPONS AND FRAGMENTARY ELEMENTS THEREFOR

RELATED INVENTION

This application is a continuation-in-part application of U.S. application Ser. No. 686,189 filed Nov. 28, 1967, which is now abandoned.

BACKGROUND OF THE INVENTION

The use of fragmentary elements or slugs in the construction of explosive shells or other explosive missiles is well known in the prior art. The prior art has used spherical balls and cube shaped members as fragmentary elements or slugs. The spherical balls have a low air resistance but give a very low degree of compaction. That is, the packing density of the balls is very low. On the other hand, cubes have a greater air resistance. It is obvious, however, that these particular shaped elements have a greater degree of compaction.

When fragmentary elements are located adjacent an explosive charge or formed thereof, it is desired to reduce the loss of combustion gases when the charge is ignited. If spaces exist between the fragmentary elements, the full force of the charge will not be transmitted to the elements which are to be thrown outwardly upon ignition. It is desirable to have fragmentary elements which may be located adjacent an explosive charge in such a manner as to prevent an inefficient use of the force produced upon the ignition of the charge. For this reason, a tight seal is required to exist between the various fragmentary elements as well as between the elements and the structure of the weapon itself.

PURPOSE OF THE INVENTION

The primary object of this invention is to provide a fragmentary element which has a low air resistance and therefore greater range and impact quality.

Another object of this invention is to provide a fragmentary element for an explosive shell which will give a great degree of compaction or large packing density.

A further object of this invention is to provide a fragmentary element having a relatively low air resistance and which may be placed together within a shell in combination with an explosive charge in such a manner as to obtain maximum efficiency of force from the charge upon ignition thereof.

A still further object of this invention is to provide an explosive weapon having an explosive charge and means to combine a plurality of fragmentary elements together to form a tight seal and thereby give a low leakage of the combustion gases from the explosive charge upon the ignition thereof.

SUMMARY OF THE INVENTION

A fragmentary element made in accordance with this invention comprises a member having the general shape of a sphere. This member has six flat surfaces located along the greatest diameter of the sphere. Its greatest diameter is located along the great circle or equatorial zone of the spherical member. Each of the flat surfaces intersect the next adjacent flat surface at the great circle or equatorial zone. A cross section taken through the spherical element in a plane including the greatest diameter and the center of the sphere has a regular hexagonal shape due to the relationship of the flat surfaces with respect to each other. These flat surfaces are adapted to join other flat surfaces located in the structure of the explosive shell.

An explosive weapon made in accordance with this invention comprises an explosive charge and means to combine a plurality of fragmentary elements with the explosive charge. The fragmentary elements as described hereinafter have their flat surfaces facing disposed with other flat surfaces to prevent rotation of the elements with respect to each other. The shape of the fragmentary elements and their interlocking relationship when combined with the explosive charge prevents rotation of the elements with respect to the charge and also provides a tight seal to provide a low leakage of combustion gases upon the ignition of the charge.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of this invention will appear in the following description and appended claims, reference being made to the accompanying drawings forming a part of the specification wherein like reference characters designate corresponding parts in the several views.

FIG. 1 is a side elevation view of a fragmentary element made in accordance with this invention.

FIG. 2 is a sectional view along the line II—II of FIG. 1.

FIG. 3 is a sectional view along the line III—III of FIG. 1.

FIG. 4 is a front end view of an explosive shell made in accordance with this invention.

FIG. 5 is a sectional view taken along line V—V of FIG. 4.

FIG. 6 is a top elevation view of another explosive weapon made in accordance with this invention.

FIG. 7 is a sectional view along the line VII—VII of FIG. 6.

DESCRIPTION OF SPECIFIC EMBODIMENTS

A fragmentary element made in accordance with this invention comprises a generally spherically shaped member, generally designated 10. The spherical shape of the element is modified along a great circle or equatorial zone thereof. The member 10 made in accordance with this invention has six flat surfaces 11 located along the greatest diameter of the sphere. Each of the flat surfaces 11 intersects the next adjacent flat surface at the greatest diameter of the sphere. A cross section through the element 10 in a plane including the greatest diameter and the center of the sphere has a regular hexagonal shape as shown in FIG. 3. These flat surfaces are adapted to join other flat surfaces located in the structure of an explosive shell made in accordance with this invention. In this specific embodiment, the flat surfaces 11 are substantially the same size and intersect each other along straight lines. In addition, the fragmentary element 10 is composed of metal.

In another embodiment of this invention, an explosive weapon may comprise an explosive charge and a means to combine a plurality of the fragmentary elements 10. The explosive weapon 12 as shown in FIGS. 4 and 5 includes an explosive charge 13 and a plurality of the members 10 as discussed hereinafter. The flat surfaces 11 on adjacent elements 10 are facially disposed to prevent rotation of the elements with respect to each other. In addition, the structure of the weapon 12 includes flat surfaces (not numbered) which are facially disposed to the flat surface located on fragmentary elements 10 juxtaposed thereto. The shell 12 includes a bottom portion 14 having projections 15 that are juxtaposed elements 10 located in the annular row of elements 10 immediately adjacent thereto. The shell 12 further includes a front cone 19 that is attached to an annular ring 16. A top layer 17 of fragmentary elements 10 is formed over the top end of explosive charge 13.

A plurality of annular rows 18 of the fragmentary elements 10 is placed on top of each other around the periphery of the explosive charge 13. The fragmentary elements 11 are contiguous and in flat surface to flat surface contact to form adjacent rows 18 which interlock with each other. This interlocking relationship prevents shifting of the rows 18 with respect to each other and with respect to the explosive charge 13. This interlocking relationship thereby prevents rotation of each of the rows 18 around the axis of the missile.

Another specific embodiment of an explosive made in accordance with this invention is shown in FIGS. 6 and 7. Here a layer 22 composed of elements 10 is located adjacent an explosive charge 20. The elements 10 and explosive charge 20 are disposed in a container 21.

In each of the explosive weapons described hereinafter, the flat surfaces 11 of the fragmentary elements 10 may be kept together either by using an adhesive such as glue or by sintering them together so that a substantially solid cake of the
elements 10 is formed. When either of the explosive charges 13 or 20 is ignited, the fragmentary elements 10 are separated and thrown out in all directions. Due to the structural configuration of the fragmentary elements 10, a very tight seal is formed over the explosive charges 13 and 20. This seal prevents the escape of the combustion gases and the explosive force developed inside the weapons will be much greater than explosive weapons using fragmentary elements available heretofore in the prior art. The air resistance of each of the individual elements 11 is only slightly greater than the air resistance of a spherically shaped member of corresponding size.

In the explosive weapons as described hereinabove, the elements 10 are located so that their cross-sections through the center thereof will be substantially parallel to the outer surface of the explosive charges 13 and 20. In this way, a very great degree of compaction of the fragmentary elements 11 will be obtained. Furthermore, the leakage of the combustion gases between the elements 10 would be substantially eliminated as described hereinabove.

**ADVANTAGES OF THE INVENTION**

When compared to cubed shaped fragmentary elements heretofore known in the prior art, the elements 10 made in accordance with this invention have an air resistance that is much lower. On the other hand, the air resistance and penetration force of the elements 10 are only slightly higher than the air resistance of ordinary spherically shaped elements of a corresponding size heretofore known in the prior art.

In prior art explosive shells, there has been a risk of rotation of a layer of fragmentary elements with respect to other portions of the shell structure. This relative rotation or movement is started by the rapid rotational acceleration of the shell during the first moments after firing. If such a rotation takes place, there will be a certain heating due to frictional losses. This heating may cause the explosive charge to detonate before or shortly after the shell has left the firing tube of the firearm.

This problem is clearly overcome through the use of the fragmentary elements made in accordance with this invention. The interlocking of the elements 10 with respect to each other and with respect to the structure of the shell, such as the bottom part 14, will prevent the specific problem of this relational movement. It has been found that such interlocking of fragmentary elements of adjacent rows will not be obtained if the fragmentary elements are of cubical shape and oriented with one side of each cube parallel to the bottom surface of the shell.

While the explosive weapons and fragmentary elements therefor have been shown and described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed, and that changes in detail and construction may be made therein within the scope of the invention, without departing from the spirit thereof.

We claim:
1. An explosive weapon comprising:
a. an explosive charge and
b. at least one tightly sealed outer layer around the explosive charge,
c. said outer layer including a plurality of fragmentary elements and means to combine said plurality of fragmentary elements with the explosive charge to form an explosive assembly,
d. each said fragmentary element comprising a metal member having the general shape of a sphere,
e. said member having six flat surfaces located along the greatest diameter of the sphere,
f. each said flat surface intersecting the next adjacent flat surface at the greatest diameter of the sphere so that a cross section through the element in a plane including said greatest diameter and the center of the sphere has a regular hexagonal shape,
g. each fragmentary element being contiguous to another fragmentary element,
h. said combining means connecting the fragmentary elements only along the flat surfaces thereof,
i. said flat surfaces on adjacent contiguous elements being facially disposed with respect to each other to prevent rotation of the elements with respect to each other.
2. An explosive weapon as defined in claim 1 wherein the structure of the weapon includes flat surfaces which are facially disposed to a flat surface located on fragmentary elements juxtaposed thereto.
3. An explosive weapon as defined in claim 1 wherein said fragmentary elements are in flat surface to surface contact to form rows of elements located adjacent to each other,
   the elements of adjacent rows interlock each other to prevent shifting of the rows with respect to each other,
   said rows of elements being juxtaposed the explosive charge.
4. An explosive weapon as defined in claim 3 wherein said combining means include adhesive material located only between adjacent flat surfaces.
5. An explosive weapon as defined in claim 3 wherein the elements are sintered together along the flat surfaces thereof.
6. An explosive weapon as defined in claim 3 wherein said rows of elements are annularly disposed around the explosive charge and are coaxial with respect to each other.
7. An explosive weapon as defined in claim 6 including a bottom portion having integral projections, said projections having a structural configuration juxtaposed the fragmentary elements of the row adjacent said bottom portion to prevent shifting between the bottom portion and fragmentary elements.