

Dec. 3, 1946.

H. W. ARNOLD
METHOD OF FORMING FRANGIBLE EXPLOSIVE CONTAINERS
AND THE PRODUCT SO PRODUCED
Filed Dec. 17, 1942

2,411,862

Fig. 1

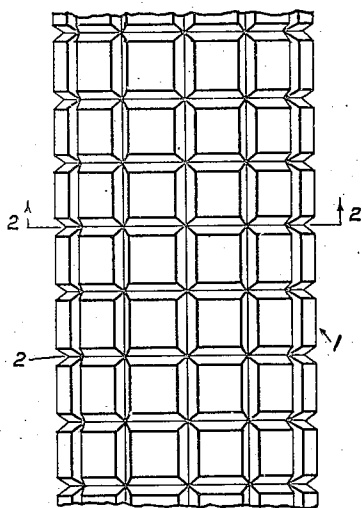


Fig. 2

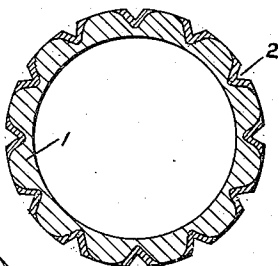


Fig. 3

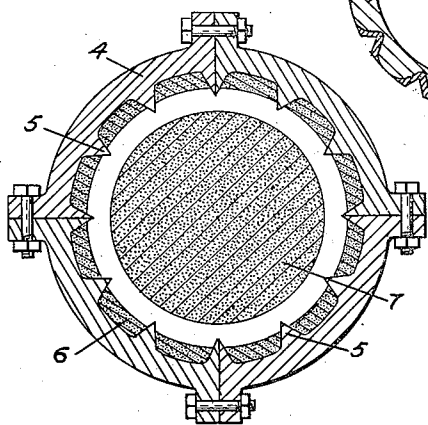
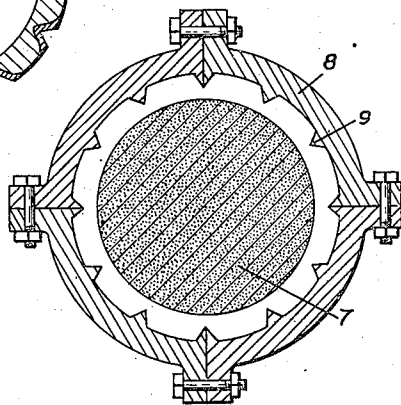


Fig. 4



Inventor
Harmon W. Arnold

By C. E. Hennstrom & H. E. Philocean

Attorneys

UNITED STATES PATENT OFFICE

2,411,862

METHOD OF FORMING FRANGIBLE EXPLOSIVE CONTAINERS AND THE PRODUCT SO PRODUCED

Harmon W. Arnold, South Bend, Ind.

Application December 17, 1942, Serial No. 469,342

6 Claims. (Cl. 102—67)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

The present invention relates to a method of producing fragmentation type of projectiles and frangible explosive containers commonly used as high explosive shells, bombs, grenades, etc. and the product so produced.

It is an object of the present method to produce a projectile in an economical manner and without the use of expensive forging and machining equipment.

It is a further object of the present invention to produce the projectiles expeditiously and without sacrificing the quality or advantageous characteristics.

Further objects will appear from the description.

It has been well recognized in the art that it was desirable that the fragments formed on the explosion of a projectile should be small as such yields the best ballistic properties and the largest and most dense coverage of an unit area. Many expedients have been resorted to, to cause fragmentation of the case, for example in the case of grenades it has been common to score the outside of the case and in high explosive shells the interior of the shell has been proposed to be scored. In each of these cases the scoring of the case involved complicated machining steps and the finished product did not have a structure which aided in the fragmentation of the case. Another expedient used to secure fragmentation was to wind a square or diamond shaped bar of low carbon steel about a steel cylinder of the shape desired and thus form a close packed helix thereon. The case so formed provides two dimensions for fracture of a definite limit but such does not define the third dimension and the fracture in the third dimension is left to chance.

If a projectile is formed of gray cast iron and one surface scored or roughened with the idea of causing fragmentation to take place in a desired pattern the optimum fragmentation is not secured as has been proven in numerous experiments. The reason that fragmentation does not take place in the zones as planned is due in a large degree to the fact that gray cast iron is relatively insensitive to notch effect as compared to steel. This property is particularly noticeable on impact tests when a notched specimen is compared with an unnotched specimen.

White cast iron is very hard and brittle as

2

compared with gray iron and possesses less than half the impact resistance of gray iron. By making the projectile of a composite structure of gray iron and white cast iron it is clear that a readily frangible structure is produced.

By the practice of the present invention a projectile case is formed in an economical manner without the use of a forged, rolled or drawn steel.

The specific nature of the invention as well as other objects and advantages thereof will clearly appear from a description of a preferred embodiment as shown in the accompanying drawing in which:

Fig. 1 is a fragmentary plan view of an explosive container,

Fig. 2 is a cross sectional view of the explosive container taken on the line 2—2 of Figure 1,

Fig. 3 is a cross sectional view of a mold used in the casting of explosive container, and

Fig. 4 is a cross sectional view of a modified mold.

The projectile case 1 is formed by the casting of a cast iron into the form of a projectile case of the desired shape and with zones 2 formed, at the points of desired fracture, of white cast iron that is brittle and readily frangible. The production of the white cast iron at the desired points of fracture may be secured in several ways, for example, the iron may be cast against a chill of such size that the carbon is held in solution or sufficient alloying elements may be incorporated in the iron at the desired points of fracture, so that the carbon is held in solution during solidification of the cast iron.

In Figure 3 is shown one mold 4 by which the required chilling of the iron at the desired points of fracture can be secured. The mold proper may be formed of gray iron with projections 5 that will form the desired grooves in the finished product and the spaces between the projections filled with molding sand 6 or other insulating material. If the article is formed by stationary casting a core 7 would be used and if formed by centrifugal casting it is obvious that the core may be omitted. With the mold of Figure 3 a so called molten gray cast iron would be used for the formation of the cast article having sufficient silicon or other graphitizing element present that the iron cast in contact with the molding sand 6 solidifies as a gray cast iron and the iron in contact with the projections 5 will be a white cast iron. While the zone of white cast iron has been shown spaced from the interior surface of the cast article, it is clear that the

3

zone of white cast iron can be varied in amount by changing the chill or composition of the molten cast iron.

In Figure 4 is shown a mold 8 of the same type as that shown in Figure 3 but the insulating material has been omitted and the projections 9 made shorter. In the use of such a mold, a molten cast iron would be used for the cast article of such chemical composition that due to the difference in cooling rate at the point of the projections and the thinner section of the cast article at the points of the projection that the cast iron would be chilled and a white cast iron formed around the projections and the remainder would be gray cast iron.

The mold of Figure 4 could also be used for producing the same product by using a cast iron for casting that is normally a gray cast iron when cast in such a mold and coating the projections with a carbide stabilizer such as chromium or tellurium.

When the cast iron is poured into such a mold the carbon in the cast iron at the points of the projections is held in solution and a white cast iron is formed at the projections or desired points of fragmentation. It is obvious that the projections could be made with a depression therein and the carbide stabilizer placed in the depressions prior to the casting. With such a procedure the product would have formed therein at points spaced from the outside and inside surface of the finished article zones of white cast iron. In such a case the white cast iron could be so controlled that the white cast iron would not extend out to the surface of the article and the surface portions would be gray cast iron that is readily machinable. In some cases it is desirable to machine the surfaces of a projectile to provide a smooth surface and one that has an even weight distribution. By limiting the extent of the white cast iron formed, a projectile can be produced that has a thin zone on the surface of gray cast iron of a thickness substantially that which is to be removed on machining.

Other expedients may be adopted to produce a white cast iron zone in the interior of the projectile body. For example the mold may be formed of sand and a prefabricated mesh like structure positioned centrally in the casting

4

cavity. The prefabricated mesh like structure may be formed from drawn wire or as a cast structure and should have the openings of a size and shape of the desired fragments of the shell or in other words of the configuration of the projections in Figures 3 and 4.

I claim:

1. A method of producing projectiles comprising pouring a molten cast iron into the shape of the desired projectile and controlling the formation of cementite in narrow intersecting zones of the casting to produce alternating zones of gray cast iron and white cast iron.

2. A method of producing projectiles, comprising pouring a molten cast iron into a mold having projections therein to chill the iron and form white cast iron in areas corresponding to the projections on said mold the carbon content of the iron and the size of the projections being controlled to produce white cast iron in areas forming indentations with the remainder of said projectile formed of a gray iron.

3. As an article of manufacture, a frangible explosive container formed of cast iron with alternating areas of gray cast iron and white cast iron the white cast iron having the configuration of an intersecting gridiron.

4. A projectile in which a wall of the same is formed of cast iron, the wall having intersecting gridiron areas formed of white cast iron whereby the projectile may be readily broken along the intersecting areas and the remainder of said wall having a substantial amount of precipitated carbon therein.

5. A projectile in which a wall of the same is formed of cast iron, the wall having intersecting areas formed of chilled cast iron whereby the projectile may be broken into a finite number of fragments upon detonation of an explosive contained within the projectile and the remainder of the wall being formed of gray cast iron.

6. An explosive container having one wall thereof that is adapted to be broken into a finite number of fragments and being formed of cast iron, said wall being formed of narrow intersecting areas of white cast iron inclosing areas of cast iron having precipitated carbon therein.

HARMON W. ARNOLD.