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3,045,524

BOOSTER CUP AND METHOD OF MAKING SAME

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FIG.1.

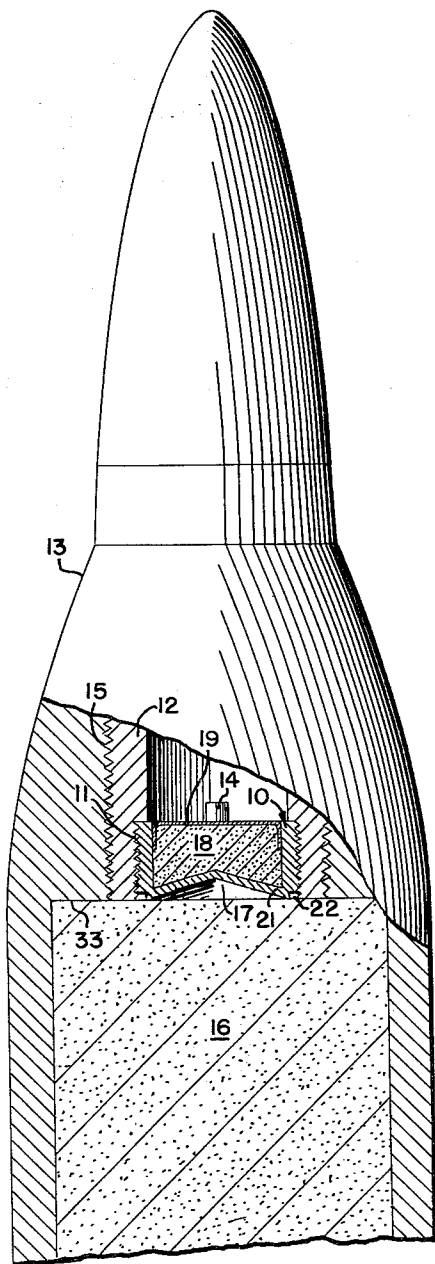


FIG.2.

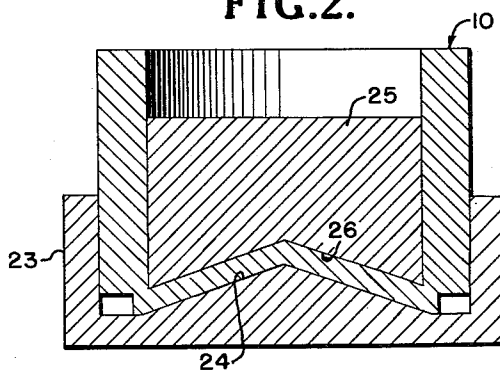


FIG.3.

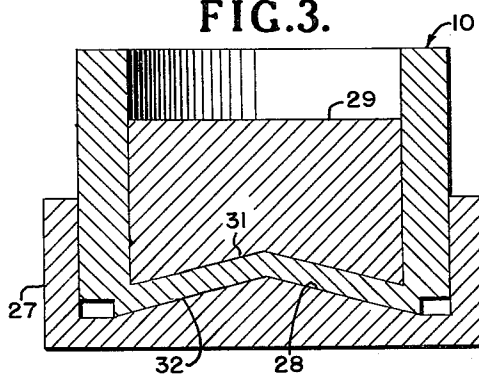
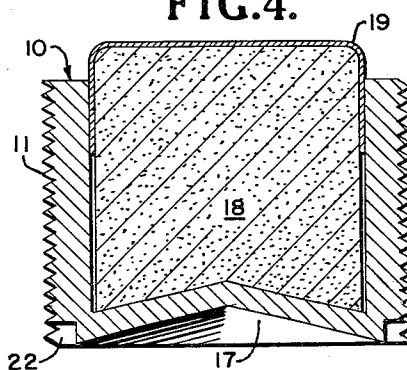


FIG.4.



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BOOSTER CUP AND METHOD OF MAKING SAME

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4 Claims. (Cl. 86-1)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a booster cup for use with a projectile and more particularly to a booster cup having an explosive charge therein for use with a high velocity projectile such, for example, as a projectile suitable for use with an anti-aircraft gun, and the method of making and filling with an explosive charge.

In the booster cups of this type heretofore devised it has been the usual practice to provide the cup with a flat bottom surface in abutting relation with the main explosive charge which the cup is adapted to fire. Such prior art booster cups have not been altogether satisfactory under the conditions of use for the reason that a considerable quantity of explosive is required within the booster cup to insure reliable firing of the main charge in all cases. As a result of this requirement the booster cup is of necessity of a relatively large size and, when used with a high velocity projectile such as a projectile employed with an anti-aircraft gun, the amount of main explosive charge within the casing of the projectile is reduced by reason of the reduction in the size of the high explosive filled chamber caused by the relatively large size of the booster cup arranged within the projectile. A booster cup in accordance with the present invention, however, will fire an explosive charge with the same degree of reliability as a booster cup of the prior art possessing twice the size of the booster cup of the present invention. This reduction in the size of the booster cup enables the size of the explosive chamber to be increased with a corresponding increase in the quantity of main explosive charge disposed therein, therefore, the explosive force of the projectile may be increased with respect to the explosive force of a projectile of equal size employing a booster cup of the prior art. The manner in which this is achieved will be more clearly apparent as the description proceeds.

One of the objects of the present invention is to provide a booster cup for a main explosive charge having a substantial increase in the efficiency of detonation from the booster pellet to the main charge.

Another object is to provide a booster cup for use with an explosive charge having a conical recess formed in the bottom thereof.

Still another object is the provision of a booster cup for a high velocity projectile in which new and improved means are provided for preventing deformation of the bottom thereof and cracking of the explosive pellet within the cup as the result of set back force as the projectile is fired from a gun.

A still further object resides in the new and improved method for making a booster cup having an explosive pellet in intimate contact with the conical bottom thereof.

Still other objects, advantages and improvements will be apparent from the following description taken in connection with the accompanying drawing in which like numerals of reference are employed to designate like or similar parts about the several views and in which:

FIG. 1 is a view partially broken away and partially in section of a booster cup of the present invention assembled within a projectile;

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FIG. 2 is a view in section somewhat enlarged of the booster cup of FIG. 1 and the means for forming a conical portion in the base thereof during a first step in the fabrication of the cup;

FIG. 3 is a view similar to FIG. 2 on which is shown the means for additionally deforming the bottom of the cup in accordance with a succeeding step in the process of manufacture; and

FIG. 4 is a view in section of the cup of FIG. 3 and the explosive pellet and cap assembled therein prior to applying pressure to the cap sufficient to force the cap into the cup to the position shown on FIG. 1.

Referring now to the drawing for a more complete understanding of the invention and more particularly to FIG. 1 thereof, there is shown thereon a booster cup generally indicated at 10 threaded as at 11 for engagement with a sleeve 12 of the fuze employed with the projectile 13, the fuze being of any type suitable for the purpose such, for example, as the type well known in the art as a proximity fuze in which a tetryl lead 14 carried thereby is fired in response to a firing operation of the fuze. The fuze may be threaded within the body of the projectile as at 15 after the projectile has been filled with a cast explosive charge 16 as illustrated.

The booster cup is composed preferably of aluminum although, if desired, steel may be employed, and is preferably extruded from a sheet of metal and provided with a conical recessed portion 17 formed in the bottom thereof to provide an air space of conical configuration between the booster pellet 18 within the booster cup and the flat surface of the explosive charge 16 adjacent thereto. The pellet is tightly pressed into the booster cup and retained by a cap 19, the outer surface of which has been pressed flush with the adjacent end portion of the booster cup.

The cup is fabricated in a manner to provide a hardened conical portion in the base thereof of sufficient strength to withstand set back force applied thereto as the shell is fired from a gun without appreciable deformation whereby the booster pellet 18 is not cracked or otherwise injured during the firing of the projectile from the gun and the stand-off conical space between the outer surface of the conical portion of the cup and the adjacent flat surface of the cast explosive charge 16 remains effective to transmit the force of the detonation from the booster pellet to the main explosive charge 16 in a highly efficient manner. This conical section comprises a central portion of the base or bottom of the booster cup encircled by an annular base portion 21 having a pair of notches 22 formed exteriorly therein to receive a tool such as a spanner wrench for screwing the booster cup into the end portion of the fuze sleeve 12 to the position shown on FIG. 1.

The process employed in the fabrication of this conical recess within the base of booster cup 10 will best be understood by reference to FIGS. 2, 3 and 4 in the order named. On FIG. 2 is shown a receiving die 23 having an upstanding conical portion 24 formed centrally therein within which the booster cup 10 having a flat bottom thereon is placed. A complementary die or anvil 25 of circular configuration and of outside diameter sufficient for easy slideable movement within the cup 10 is employed to bring the bottom circular portion of the cup into conformity with the conical upright portion 24 of the die 23, a complementary conical depression 26 being formed in one end of the die 25 for this purpose. The cup 10 is placed between the dies 23 and 25 and sufficient pressure is applied thereto to deform the bottom of the booster cup into conformity with the conical surfaces 24 and 26 of the dies 23 and 25, respectively, the angle of the conical surface of the die and the booster cup when pressed therebetween being at a greater angle

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from the original flat bottom surface of the cup than the final angle of this conical portion of the base with respect to the flat bottom surface when the cup is completely fabricated and the explosive pellet 18 has been pressed into position with the cover 19 thereof flush with the opposite end surface of the cup.

The cup 10 is now removed from the dies 23 and 25 and placed within a second receiving die 27 having a conical surface 28 formed thereon at an angle with respect to a plane surface normal to the axis of the cone less than the angle of the conical portion 24 of die 23, an angle of 6° having been found satisfactory.

The preformed cup 10 is now placed within the die 27 and a second die or anvil 29 generally similar to the die or anvil 25 is placed within the cup. The die 29 differs from the die 25 in the angle of the conical section formed in the end portion thereof adjacent the surface of the bottom of the cup, the angle of the conical section of the die 29 being the same as the angle of the conical section 28 of die 27. Pressure is now brought to bear on the die or anvil 29 sufficient to bring the bottom portion of the cup into conformity with the conical surfaces 28 and 31. The cup is now removed from the dies and has a conical inwardly extending portion 17 in the bottom thereof formed at a 6° angle with respect to the circular planar surface at the end of the cup.

By forming a conical surface in the base of the booster cup in the manner disclosed wherein the surface of the bottom portion is first extruded beyond the final position thereof and thereafter pushed reversely to the final position, the bottom portion of the cup is hardened and particularly at the circular portion thereof indicated generally by the numeral 32 thereby forming a bottom on the booster cup of sufficient strength and rigidity to withstand the set back force applied thereto at the moment of firing the projectile from the gun without appreciable deformation thereof. A conical air space between the bottom of the booster cup and the adjacent surface of the cast explosive charge is thus maintained in predetermined configuration after the projectile has been fired. Since the configuration of the explosive pellet and booster cup therefor is critical and essential to the reliable operation of a detonator of small size as contemplated by the present invention, it is essential that the shape of the bottom of the booster cup will not be changed as the result of set back force. The process or method of extruding the bottom portion of the cap to effect this final conical configuration is essential to the high degree of reliability achieved by the booster in service.

The booster cup is now removed from the dies and threaded exteriorly at 11 for engagement with the complementary threaded portion of the fuze 12. The notches 22 having been formed therein, the cup is ready for loading with an explosive. An explosive suitable for the purpose may be composed of explosive material known in the art as RDX preferably desensitized and formed into a pellet such as shown on FIG. 4 of slightly less diameter than the inside diameter of the booster cup and somewhat greater in length than the depth of the cup substantially as shown. A cap 19 composed of metal, such, for example, as sheet brass is placed over the explosive pellet, the cylindrical portion thereof being arranged between the outer cylindrical surface of the pellet and the inner cylindrical surface of the cup.

The cup assembly is now placed within a press and pressure in the order of 10,000–15,000 p.s.i. is applied thereto whereby the upper surface of the cap 19 as viewed in FIG. 4 of the drawing is forced downwardly until the upper surface of the cap coincides with the upper surface of the cup in a single plane as shown on FIG. 1. As the cap moves inwardly into the final position thereof shown on FIG. 1, the explosive pellet 18 is compressed and expanded radially into intimate contact with the inner surface of the cup and the inner surface of the cap. The cylindrical portion of the cap is thus expanded into

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tight fitting relation with the inner surface of the cup concurrently with the application of pressure to the pellet. The assembly of the booster cup with the explosive pellet and cap thereof is now complete.

The cup is screwed into the sleeve 12 of the fuze by an appropriate tool such as a spanner wrench engaging the slots 22. When the cup has been screwed tightly into the fuze, the lower planar surface thereof is in alignment with the upper planar surface of the explosive chamber 33 and the flat upper surface of the main explosive charge 16 disposed therein.

When the tetryl lead 14 is ignited in response to the operation of fuze 12, the explosive pellet 18 is fired, the shock wave therein being substantially spherical and emanating from that portion of the pellet opposite the center portion of the cap 19 abutting the tetryl lead 14. The shock wave thus impinges the apex of the conical portion of the bottom of the booster cup causing the conical surface thereof to be moved forcibly and suddenly downward into engagement with the upper flat surface of the main explosive charge 16.

By reason of the inertia of the material of which the conical portion of the cup is formed, the pressure wave at the central apex portion of the bottom of the cup is delayed momentarily such that the pressure wave at the outer hardened portion 32 of the conical base of the cup is applied to the main explosive charge at the same instant as the pressure wave at the apex portion of the bottom of the cup. The pressure wave from the booster cup is thus applied to the main explosive charge in such manner that it possesses the characteristics of a substantially plane wave corresponding generally to the area of the bottom of the booster cup whereby the efficiency of transmission of the explosive shock from the booster cup to the main explosive charge is increased sufficiently such that the reliability of operation of the booster cup 10 of the present invention to fire the main explosive charge is at least equal to that of a booster cup of twice the size having a flat bottom, as is the case with the prior art devices.

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 as new and desired to be secured by Letters Patent of the United States is:

1. The method of making a booster cup having an explosive pellet therein which comprises the steps of extruding a cup-like member having a bottom portion from a flat piece of metal, forcing the bottom portion of the cup inwardly to a predetermined distance to form a conical configuration thereof, forcing said bottom portion in an outward direction sufficiently to form a conical configuration of less conical height than said predetermined distance, forming a continuous thread on the external cylindrical portion of said cup, placing an explosive pellet within the cup of slightly less diameter than the inside diameter of the cup and of greater axial length than the depth of the interior portion of the cup, placing a cup-like cap over the end portion of the pellet extending beyond the upper surface of the cup, said cap having a cylindrical portion formed integrally therewith for snug fitting with the inner cylindrical surface of the cup and the outer cylindrical surface of the pellet throughout a substantial portion of the axial length thereof, and pressing the cap into the cup sufficiently to bring the outer flat surface thereof into coplanar relation with the adjacent flat surface of the cup.

2. The method of claim 1 in which the cup is composed of aluminum.

3. The method of claim 1 in which the cap is composed of thin sheet brass.

4. The method of claim 1 in which the pressing operation is continued at least until a pressure of 10,000–15,000

p.s.i. is reached to force the flat surface of the cap into coplanar relation with respect to the flat surface of the cup adjacent thereto.

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