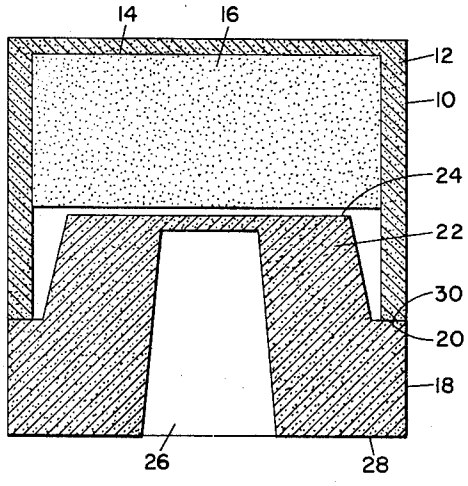
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COMBUSTIBLE PRIMER FOR CASELESS AMMUNITION

Filed March 7, 1968



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United States Patent Office 3,486,453
Patented Dec. 30, 1969

3,486,453

COMBUSTIBLE PRIMER FOR CASELESS AMMUNITION

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Filed Mar. 7, 1968, Ser. No. 711,380
Int. Cl. C06c 7/00
U.S. Cl. 102—86.5 7 Claims

ABSTRACT OF THE DISCLOSURE

A highly reliable combustible primer is provided for caseless ammunition having a configuration similar to that of a conventional metal primer.

This invention relates to a combustible primer for use with caseless ammunition. More particularly, this invention relates to a combustible primer having a configuration similar to that of a conventional metal primer.

Combustible primers employed with caseless ammunition have been prepared consisting of a thin walled heavy bottom propellant cup into which a priming mixture is consolidated. The propellant cup is sealed with a foil of paper with an adhesive coating on the internal side of the paper and a waterproof coating on the external side of the paper. The propellant cup employed in these primers functions as both the cup and anvil of the prior art conventional primers. Combustible primers prepared as described have not been reliable. The poor reliability of these primers is due to failure of the firing pin to initiate the priming mixture, and/or failure of the initiated primer to ignite the caseless ammunition. Attempts to increase the reliability of the combustible primer have centered on utilization of more sensitive priming mixtures and the use of explosive caps to sensitize the primer. While increased reliability is achieved employing the more sensitive priming mixtures other problems have resulted. Manufacture of these primers is more hazardous due to the greater friction and impact sensitivity of the priming mixtures. Damage to firing pins has also been extensive due to direct contact of the firing pins with the priming mixtures.

It is the object of this invention to provide a fully combustible primer having high reliability.

It is another object of this invention to provide a fully combustible primer employing standard priming mixtures used in metal primers.

It is still another object of this invention to provide a combustible primer designed to substantially decrease firing pin wear due to contact with corrosive priming mixtures.

Other objects of this invention will, in part, be obvious and will, in part, appear hereinafter. For a complete understanding of the nature and objects of this invention, reference is made to the following detailed description and drawing.

In accordance with this invention, there is provided a combustible primer comprised of a primer anvil, a primer cup, and a priming mixture secured within the assembled cup and anvil. The primer anvil and primer cup are prepared from molded granules of smokeless powder. The primer anvil provides support for the priming mixture whereby the priming mixture is crushed and thereby initiated when the primer cup is impacted by a firing pin. Reliable functioning of the combustible primer is thereby achieved.

The drawing attached hereto illustrates a longitudinal view of a vertical section of a combustible primer of this invention. As shown in this drawing, a cylindrical

primer cup **10** having a side wall **12** and a base **14** is filled with a priming mixture **16**. A primer anvil **18** having a peripheral surface **20**, an anival projection **22** and a crushing surface **24** is inserted into the primer cup **10**. The primer anvil is inserted into the primer cup **10**. The primer anvil has a centrally disposed flash hole **26** which extends from the forward surface **28** of the anvil **18** into the anvil projection **22** and which is closed by a thin web of propellant which forms a part of the crushing surface **24**.

During a firing sequence a firing pin (not shown), having a flat face configuration, strikes the base **14** of the primer cup **10**. A portion of the base **14** of the primer cup **10** breaks away from the base **14** and crushes and shears the priming mixture **16** against the crushing surface **24** of the anvil **18**. The resulting heat and compression initiates the priming mixture **16**, which in turn ruptures the crushing surface **24** of the anvil **18** directly above the flash hole **26**. Flames from the initiated priming mixture **16** immediately pass through the flash hole **26** igniting the caseless round of ammunition which is to be fired.

The primer anvil **18** and the primer cup **10** are assembled by wetting the peripheral surface **20** of the anvil **18** and the mating surface **30** of the primer cup **10** with a solvent. The solvent wet surfaces are pressed together and a strong bond is formed between these components.

The primer cup is prepared in the form of a hollow cylinder open at one end, and closed at the opposite end by a wall of propellant referred to as the base of the primer cup. The primer cup can be prepared in other shapes, if desired. The base of the primer cup is generally from about ½ to about ¾ of the thickness of the side wall of the cup. This ratio can vary, depending on the overall size of the combustible primer as well as the formulation of the molded propellant and its strength characteristics which vary depending on molding conditions.

The primer anvil functions as both an anvil or support for the priming mixture and as a seal for the primer cup. The anvil projection is sized so that it can be inserted into the cup freely while limiting the free volume of the assembled primer to less than about 10%. The part of the anvil crushing surface which closes the flash hole extending from the forward surface of the primer anvil into the anvil projection is a thin web of propellant. This thin web of propellant is sized so as to provide the support necessary for crushing of the priming mixture. This web of propellant ruptures upon ignition of the priming mixture providing a path for flames from the initiated primer to the propellant charge. For most applications of the combustible primer in caseless ammunition, this web can be from about 0.010 inch to about 0.030 inch thick. The thickness required will vary, depending on the strength of the molded propellant and on the striking force and configuration of the firing pin.

The following examples illustrate the high reliability of the combustible primers of this invention. All parts and percentages are by weight unless otherwise specified.

EXAMPLE 1

A combustible primer cup and primer anvil are prepared by molding granules of double base smokeless powder comprised of 84.15% nitrocellulose, 15% nitroglycerine and 0.85% potassium nitrate.

The smokeless powder granules are admixed with a solvent mixture comprised of 40% acetone and 60% alcohol for about a minute. The weight ratio of solvent mixture to smokeless powder granules is about 1/1. The solvent wet granules are then molded at about 1500 p.s.i. to

form primer cups and primer anvils. Solvent is driven from the mold during compression.

The primer cup and primer anvil each have an outside diameter of 0.325 inch, and when assembled have a combined length of 0.325 inch. The primer cup side wall is about 0.055 inch thick and the primer base is about 0.045 inch thick. The primer cup is loaded with 1.5 grains of a priming mixture having the following formula:

	Percent
Lead styphnate	36
Tetracene	12
Antimony sulfide	7
Barium nitrate	22
Pentaerythritol tetranitrate	5
Zirconium	9
Lead dioxide	9

The priming mixture is pressed into the primer cup with a ram at a pressure of about 8000 p.s.i. The resulting loaded primer cup is sealed by wetting the peripheral surface of the primer anvil and the mating surface of the primer cup with acetone, and pressing these components together.

The primer anvil has a flash hole having a diameter of 0.09 inch. The thickness of the propellant web directly above the primer flash hole is about 0.010 inch.

Sensitivity tests are conducted on 35 primers previously described. The test method employed (Bruceton Sensitivity Tests) is described in detail in NAVORD Report 2101 prepared by the Naval Ordnance Laboratory and dated Oct. 13, 1953. In the tests conducted, a firing pin having a flat face configuration is employed. The firing pin has a diameter of 0.10 inch. The combustible primers are struck by the firing pin when a 6-ounce steel ball is dropped on the firing pin. Results from this test indicate that the 99.9% reliable all fire force required to initiate these primers at a 95% confidence level is 0.43 foot-pounds.

Twenty-five additional tests are conducted on identical primers while increasing the striking energy to 0.47 foot-pounds force. This force is equivalent to the force resulting from a drop of the six-ounce steel ball onto the firing pin from a height of 14.75 inches. The 0.47 foot-pound striking force of the firing pin employed in these tests is the mean equivalent force between the predicted all fire energy level for these primers based on Bruceton Sensitivity Tests and the maximum striking force available from the test gun. There are no failures of the primers in the 25 tests conducted at 0.47 foot-pounds striking force.

EXAMPLE 2

Sixteen rounds of caseless ammunition are loaded with combustible primers as described. Firing tests are conducted in a test gun. The calculated impact energy of the test gun firing pin on the combustible primer is 0.52 foot-pounds. All of the caseless rounds are fired successfully. Firing pin wear during these tests is undetectable.

The primer cup and primer anvil of this invention are prepared by molding of smokeless powder granules. The smokeless powder granules can be of the single base, double base, or triple base type formulation. The molding process can be done with or without the use of a binder. In preparing the molded primer cup and anvil, it is necessary that the individual granules of smokeless powder maintain their identity in the molded propellant. This is required so that the propellant breaks up into granules during firing and completely burns, leaving no residue in the firing chamber of the weapon.

The priming mixtures which can be employed with the combustible primers of this invention include any of the percussion type formulations employed with metal primers. Typical primer ingredients and compositional ranges for the priming ingredients in a priming mixture include lead styphnate (35–37%), tetracene (3–12%), barium nitrate (22–38%), lead dioxide (0–10%), antimony sulfide (0–15%), zirconium (0–10%), pentaerythritol tetranitrate (0–5%), calcium silicide (0–13%), and aluminum (0–7%). The priming mixtures can be satisfactorily loaded into the primer cup in either the wet or dry state. In loading of the primer cup, a predetermined amount of priming mixture is first charged into the cup. The priming mixture is then compressed in the cup by any suitable means, such as a ram at a pressure of from about 800 p.s.i. to about 8000 p.s.i. When a wet primer mix is employed, the pressed charge is dried for about 12 to about 20 hours at about 120° F.

The solvents which can be employed to wet the peripheral anvil surface and the mating surface of the primer cup for assembling the primer anvil and primer cup include any liquid solvent for nitrocellulose containing propellants. Suitable solvents include acetone, methyl ethyl ketone, dioxane, ethylene glycol, dimethyl ether, diethylene glycol and the like. A preferred solvent is acetone.

For optimum reliability of most combustible primers of this invention, it is preferred that the firing pin employed have a flat face configuration. A flat face configuration provides for better distribution of the striking force of the firing pin on the base of the propellant cup which results in breaking away of a portion of the base with subsequent initiation of the priming mixture.

What I claim and desire to protect by Letters Patent is:

1. A combustible primer for caseless ammunition having in combination a primer cup, a primer anvil, and a priming mixture, said primer cup and primer anvil being prepared from molded smokeless powder granules, said priming mixture being contained within the primer cup, said primer anvil being secured to said primer cup, said primer anvil providing support for said priming mixture whereby the priming mixture is crushed and initiated when the primer cup is impacted by a firing pin.

2. The combustible primer of claim **1** wherein the primer anvil has a centrally disposed flash hole extending from the forward surface of the primer anvil into the anvil projection, said flash hole being closed by a thin web of propellant which forms a part of the anvil crushing surface.

3. The combustible primer of claim **2** wherein the base of the primer cup is thin in relation to the side wall of the primer cup, a portion of the base of the primer cup breaking away from said base, and crushing and shearing the priming mixture when the base of the primer cup is impacted with a firing pin.

4. The combustible primer of claim **3** wherein the free volume of the primer is less than about 10%.

5. The combustible primer of claim **4** wherein the priming mixture is a percussion type of priming mixture used in metal primers.

6. The combustible primer of claim **5** wherein the priming mixture is comprised of lead styphnate, tetracene, antimony sulfide, barium nitrate, pentaerythritol tetranitrate, zirconium and lead dioxide.

7. The combustible primer of claim **6** wherein the primer cup and primer anvil are prepared from molded double base smokeless powder granules.

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U.S. Cl. X.R.

102—45