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Waite et al.

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[54] **FIREBOMB IGNITER DEVICES AND COMPONENTS THEREFOR**

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[52] **U.S. Cl.** ....**102/6,** 102/70 R, 102/90, 149/15, 149/19, 149/44

[51] **Int. Cl.** **F42b 25/14**

[58] **Field of Search** 102/65, 66, 90, 78; 149/87, 149/44, 15, 19, 20

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[57] **ABSTRACT**

Firebomb igniter devices designed to spread hundreds of burning particles over wide areas are constructed from a stack of ring-shaped wafers encased in a canister surrounding an explosive fuse unit. The wafers are compression molded powder mixtures of combustible metal and fluoroalkylene polymer, e.g., magnesium metal and polytetrafluoroethylene compacted to about 70 to 95 percent of ultimate density. Upon detonation of the igniter device, the wafers break into hundreds of small particles that disseminate to distances of 100 feet or more and burn for several seconds providing ignition points for areas of fuel concentration within a firebomb pattern.

5 Claims, 2 Drawing Figures

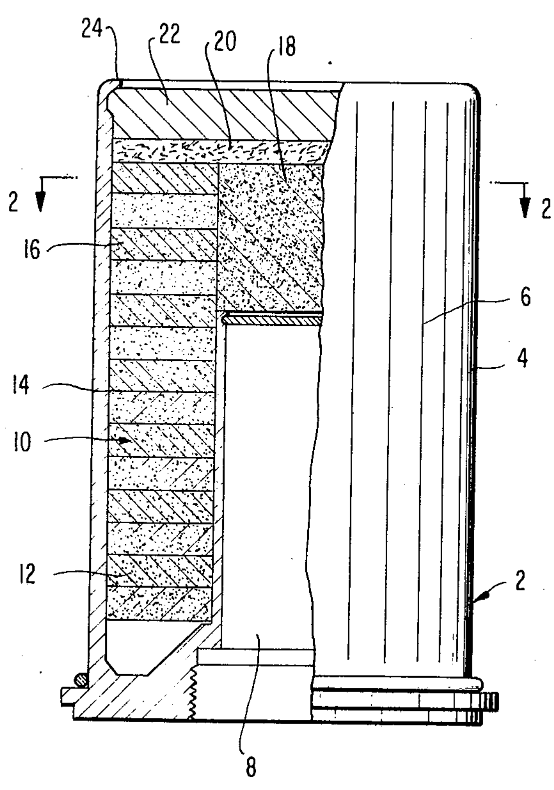


FIG. 1

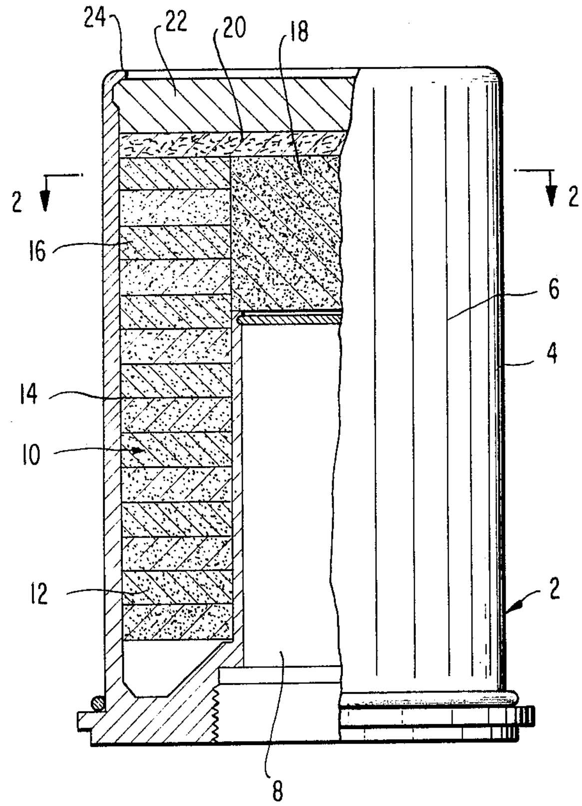
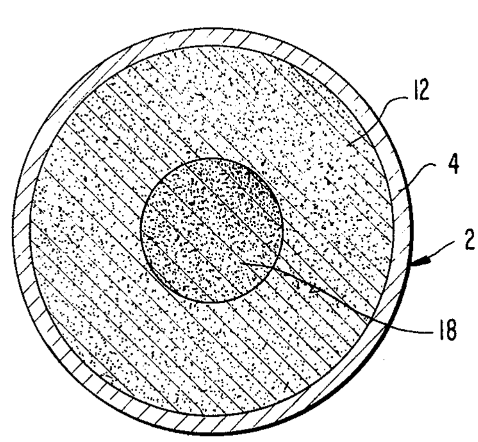


FIG. 2



FIREBOMB IGNITER DEVICES AND COMPONENTS THEREFOR

BACKGROUND OF THE INVENTION

Firebomb weapon systems require ignition sources which will provide points of ignition across a wide area representing the spread of fuel within a firebomb pattern. A representative firebomb pattern will encompass a relatively circular area having a radius of 100 feet or more extending from the point of detonation of the weapon system. In order to obtain effective ignition of the firebomb fuel pattern, it is necessary to disseminate across the area of the fuel pattern hundreds of small particles of ignition material which have a burning time of sufficient length to cause ignition of the fuel within the firebomb pattern. Good performance characteristics for an ignition device of a firebomb weapon system would require the spread of hundreds of burning particles having a burning duration of at least 1 second across an area having a radius of at least 100 feet from the point of dissemination of the ignition particles.

In addition to good performance characteristics, ignition sources for firebomb weapons should possess good safety features. The standard military item used as an ignition source for firebomb weapons is white phosphorous. This is deficient, however, both with respect to good performance characteristics and safety. In addition, it requires elaborate loading facilities for production.

The deficiencies of white phosphorous as an ignition source for firebomb weapons has led to the development of combustible metal-fluorocarbon polymer igniters. The ignition composition comprising the mixture of combustible metal, such as magnesium, and fluorocarbon polymer are relatively safe and further offer improved ignition characteristics as compared with white phosphorous. The pyrotechnic reaction between magnesium metal and similar combustible metals and fluorocarbons, particularly polytetrafluoroethylene polymers is well known and has been described extensively in patents and published literature.

An important requirement in the use of an ignition composition comprising a combustible metal and a fluorocarbon polymer is to obtain burning particles of the composition which can be spread by an explosive force over a wide area as mentioned above and which at the same time will be of sufficient mass as to provide a burning time of the order of one second or more. A known firebomb igniter employing a mixture of magnesium metal and polytetrafluoroethylene polymer comprises a group of closely nested pellets of the composition in a matrix of a powder mixture of magnesium metal and polytetrafluoroethylene polymer. Alternate layers of powder and closely packed pellets are pressed into a cylindrical case surrounding a fuse well. This is covered with a pressure pad and the case is sealed. The completed igniter unit holds more than 150 of the pellets within the interstitial powder. The steps of pressing pellets and the method of final assembly, while not as hazardous in production as the handling of white phosphorous, nevertheless, constitute costly, extended operations which are subject to variations because of the nature of the operation and hence variations in performance characteristics.

There is a need for new improved ignition sources for firebomb weapons which can be made at low cost by high rate of production techniques and which will at the same time exhibit improved performance characteristics coupled with increased safety of manufacture and handling.

OBJECTS

A principal object of this invention is the provision of new ignition sources for firebomb weapon systems that exhibit both improved performance characteristics and safety. Further object include the provision of:

1. Firebomb igniter devices of improved construction capable of manufacture at low cost and high rates of production.

2. Improved igniter devices of this type which inherently possess high reliability and performance characteristics, in part due to simplicity of construction eliminating variables which can occur in manufacture of the devices.

3. Improved construction for firebomb igniter devices which are based upon ignition compositions comprising a combustible metal and a fluorocarbon polymer.

4. Firebomb igniter devices capable of dispersing a multitude of burning particles having a burning time of at least 1 second over an area extending a distance of at least 100 feet from the point of dispersion.

Other objects and further scope of applicability of the present invention will become apparent from the detailed description given hereinafter; it should be understood, however, that the detailed description, while indicating preferred embodiments of the invention, is given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description. It should also be understood the foregoing abstract of the disclosure is for the purpose of providing a non-legal brief statement to serve as a searching-scanning tool for scientists, engineers and researchers and is not intended to limit the scope of the invention as disclosed herein nor is it intended it should be used in interpreting or in any way limiting the scope or fair meaning of the appended claims.

SUMMARY OF THE INVENTION

These objects are accomplished in accordance with the present invention by forming a firebomb igniter device having a cylindrical canister which encloses a centrally positioned explosive fuse means to include the improvement which comprises a stack of ring-shaped wafers in face-to-face contact and with at least part of the stack of wafers surrounding said explosive fuse means, said wafers being formed of a mixture of combustible metal and fluoroalkylene polymer that has been compacted to a density less than the ultimate density. Advantageously, the wafers are made of a compacted powder mixture of 50 to 80 percent magnesium metal powder and 20 to 50 percent powdered polytetrafluoroethylene polymer. The mixture from which the wafers are compacted may additionally contain a minor percentage, e.g., 0.1 to 10 percent, of chlorinated hydrocarbon burning rate accelerator.

In the preferred embodiments of the invention, the powder mixture in forming the wafers is compacted to between about 70 to 95 percent of ultimate density. With the preferred combination of 50 to 80 percent metal powder and 20 to 50 percent powdered polytetrafluoroethylene, the wafers have a compacted density between about 1.6 and 1.9, and exhibit a hardness between about 85 and 95 on the Shore hardness C scale.

In use of the new igniter devices, detonation of the explosive fuse means generates heat and pressure which simultaneously ruptures the canister wall in scored areas, ignites the pyrotechnic composition of which the wafers are formed and breaks them into hundreds of small particles which are disseminated over an area having a radius of 100 feet or more and which burn for several seconds providing ignition points for areas of fuel concentration within a firebomb pattern.

BRIEF DESCRIPTION OF DRAWINGS

For a more detailed description of the invention, reference is made to the accompanying drawings in which:

FIG. 1 is a partially broken away side sectional view of a firebomb igniter device in accordance with the invention.

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

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring in detail to the drawings, the firebomb igniter device 2 comprises a cylindrical metal canister 4 which may be provided with score lines 6 along which the metal container 4 will shear or part upon detonation of the device.

Centrally positioned within the device is a well **8** for explosive fuse. The fuse means is a standard military item and is not shown in detail. It and the cylindrical canister **4** constitute known items for which the present invention provides new improvements. Any suitable known units of this type may be used in conjunction with the improvement provided by this present invention to be described in more detail hereinafter.

The improvement in firebomb igniter devices provided by the invention comprises a stack **10** of ring-shaped wafers **12** which have their faces **14** in contact with one another. Part of the stack surrounds the explosive fuse well **8** while the upper section **16** of the wafer stack **10** extends above it providing a cylindrical volume which may be filled with uncompacted combustible powder mixture **18**. Advantageously, this powder mixture is made of the same or equivalent powder mixture from which the wafers **12** are pressed, e.g., 50 to 80 percent magnesium metal powder and 20 to 50 percent powdered polytetrafluoroethylene. This assembly is covered by the sealing disc **22** and the compression pad **20**. The assembly is closed by crimping over the upper edge **24** of the metal canister **4**.

EXAMPLES

In further explanation of the invention, there is presented below a specific example of the preparation of wafers used as essential units in the new igniter devices of the invention. In this example and throughout the remaining specification and claims, all parts or percentages are by weight unless otherwise specified.

A mixture of 60 parts of atomized magnesium powder and 40 parts of polytetrafluoroethylene (commercially available under the trade name "Teflon 7") was prepared by mixing together the two separate powdered materials in a rotating drum mixer until a homogeneous mixture had been obtained. This powder mixture was then charged into a compression mold of ring-shaped configuration having an outside diameter of approximately 76 mm. and an inside diameter of 26 mm. to create a ring having a width of 25 mm. The powder mixture was compressed at 7,000 psi, sufficient of the powder mixture being charged into the compression mold so that when compressed at this pressure, the resulting wafer would have a thickness of 5 mm. The resulting wafers had a density of 1.7 g/cc. and a Shore hardness of 87–93 on the C scale.

In other cases, wafers are made from the same powder mixture at compression pressures between 3,000 and 11,000 psi. In each case, sufficient of the powder mixture was charged into the compression mold to provide wafers having a thickness of 5 mm. The resulting wafers are found to possess a density of between 1.65 and 1.85 g/cc. and a hardness of 85–95 on the Shore hardness C scale.

The calculated ultimate density for a mixture of 60 parts of magnesium metal powder and 40 parts of polytetrafluoroethylene is 2.1 g/cc.

A stack of 14 wafers compressed to a density of 1.7 were enclosed in a metal canister as previously described, the cylindrical volume over the fuse well in the canister was filled with a loose powder mixture of 60 parts magnesium metal and 40 parts polytetrafluoroethylene "Teflon 7" and the assembly was sealed with a disc and compression pad as previously described. When tested on a firing range, detonation of a standard explosive ignition fuse positioned in the fuse well of the canister caused the compressed wafers to be broken into hundreds of small burning particles which were explosively disseminated to a distance of approximately 100 feet in all directions from the point of detonation. The burning particles had an average burning time in excess of 2 seconds.

Comparable results were obtained in the firing of other igniter devices using stacks of wafers compressed at pressures between 3,000 to 11,000 psi producing densities between 1.65 and 1.85 g/cc.

DISCUSSION OF DETAILS

Magnesium metal is the preferred combustible metal for use in making the igniter devices of this invention. Use of other known combustible metals is contemplated within the scope of the invention, e.g., aluminum, magnesium-aluminum alloys, Mischmetal or mixtures of these or equivalent combustible metals. In forming the powder mixtures from which the essential compressed wafers are formed, the combustible metal should be in a finely divided state. So-called "atomized" metal powder is preferred, but metal powder subdivided in any suitable fashion to an average particle size between about 0.1 to 150 microns will give satisfactory results.

A variety of fluoroalkylene polymers are available which when mixed with a combustible metal such as magnesium metal, will produce a pyrotechnic composition which upon ignition by a suitable fuse device or the like will produce self-contained combustion. Polytetrafluoroethylene is a preferred fluoroalkylene polymer to be used in accordance with the invention, but other equivalent polymers which are known to produce pyrotechnic reaction with magnesium or equivalent combustible metals may be used. Additionally, such pyrotechnic composition may include small amounts, e.g., 1—10 percent of burning rate accelerators such as polychlorinated benzene, perchlorinated naphthalene or the like.

Examples of fluoroalkylene polymers contemplated for use in the invention, other than the preferred polytetrafluoroethylene, include copolymers of tetrafluoroethylene and perfluoropropylene (commercially available as "Teflon 100"), chlorotrifluoroethylene homopolymers (commercially available as "Kel-F wax"), or copolymers such as with vinylidene fluoride (commercially available as "Kel-F elastomer"), homopolymers of perfluoropropylene and copolymers such as with vinylidene fluoride (commercially available as "Viton A," "Viton A-HV" and "Fluorel") and equivalent homopolymers and copolymers. Mixtures of 2 or more such polymers may be used as the polymer oxidizer-binder for the pyrotechnic.

The powder mixture of metal and polymer may include up to 20 percent, particularly 1–10 percent, of other oxidizer material, e.g., barium nitrate, potassium chlorate, ammonium nitrate, potassium perchlorate, sodium chromate and the like.

The oxidizer-binder polymer for the pyrotechnic compositions of the invention, plus any other oxidizer material or additives, should be in subdivided form for admixture with the powdered combustible metal. Desirable fluoroalkylene polymers can be obtained commercially in finely subdivided form and are useable directly as purchased. On the other hand, if not available in a suitable state of subdivision, advantageously with an average particle size between about 0.1 to 650 microns, such polymers may be powdered or otherwise subdivided using any suitable method of comminution known to the art. The subdivided materials which constitute the components for the pyrotechnic compositions, primarily the combustible metal and the fluoroalkylene polymer, should be homogeneously mixed prior to being compressed into wafers as described herein. Tumbling barrels, paddle mixers or any other form of equipment known to be useful in mixing together 2 or more powdered materials to form a uniform mixture may be used for this purpose.

The compression of the uniform powder mixture into wafers can be accomplished with any suitable pressing or molding equipment. Compression of the powder mixture in molds of suitable size to form individual ring-shaped wafers is a preferred method since this can be adapted to high speed fully automated operation. Alternative procedures are available and will be apparent to those knowledgeable on the subject of powder pressing and molding. For example, a large cylinder of the pyrotechnic composition could be formed from which individual wafers would be cut or sliced.

The size of the ring-shaped wafers made in accordance with the invention may be varied although certain preferred sizes provide the most effective results. Preferably, the wafers will have an outside diameter of 50 to 90 mm., an inside diameter of 20 to 50 mm., a ring width of 20 to 70 mm. and a thickness of 2 to 10 mm. Satisfactory results have been obtained with ring-shaped wafers made in accordance with the invention, compressed to a density between about 70 to 95 percent ultimate density with an outer diameter of the ring between about 1.5 to 3 times the inner diameter and a thickness of the ring between about 0.2 to 0.4 times the inner diameter. In the case of wafers made from a preferred mixture of 50 to 80 percent magnesium metal and 20 to 50 percent polytetrafluoroethylene, most advantageous results are obtained where the powdered composition has been compressed to a density between about 1.6 and 1.9. Preferred wafers are also characterized by a hardness of between about 85 and 95 on the Shore hardness C scale. While it may be possible using certain types of equipment and molding procedures to obtain densities and hardness within these values using other pressures, it has been found that pressures between 3,000 and 11,000 psi are particularly useful in obtaining the required degree of compactness in the pyrotechnic compositions to form wafers which are sufficiently coherent to permit handling and assembly in low cost, high rate of production operations but which will disintegrate upon detonation into individual particles of suitable size and provide a burning rate of at least 1 second and preferably about 2 to 4 seconds average burning time.

What is claimed is:

1. In a firebomb igniter device capable of dispersing a multitude of burning particles having a burning time of at least 1 second over an area extending a distance of at least about 100 feet from the point of dispersion including a cylindrical canister enclosing centrally positioned explosive fuse means, the improvement which comprises a stack of ring-shaped wafers in face-to-face contact at least part of which surround said explosive fuse means, said wafers being formed of a mixture of 50 to 80 percent combustible metal and 50 to 20 percent fluoroalkylene polymer that has been compacted to a density between about 1.6 and 1.9.

2. The device claimed in claim 1 wherein said wafers are made of a mixture of magnesium metal powder and powdered polytetrafluoroethylene.

3. The device of claim 2 wherein said stack of wafers extends above the surrounded explosive fuse means and the cylindrical volume within such extension of the stack is filled with substantially uncompacted powder mixture of 50–80 percent magnesium metal powder and 20 to 50 percent powdered polytetrafluoroethylene.

4. The device of claim 1 wherein said wafers have a hardness of between about 85 and 95 on the Shore hardness C scale.

5. The device of claim 1 wherein the outer diameter of said wafers is between about 1.5 to 3 times the inner diameter and the thickness of the wafers is between about 0.2 to 0.4 times said inner diameter.

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