

[54] CONSUMABLE EXPLOSIVE CARTRIDGES

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102/24

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[57]

ABSTRACT

A consumable explosive cartridge includes an explosive charge defining therewithin a recess. A primer material is disposed within the recess and is of less volume than the volume of the recess to resist premature detonation of the cartridge.

A method for making the cartridge includes the steps of providing a pair of cartridge half sections, each containing an explosive charge and a recess section. A primer material is inserted within one of the recesses and the half sections are secured together with the primer material being disposed within a recess formed by the recess sections.

[56] **References Cited**

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FOREIGN PATENTS OR APPLICATIONS

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11 Claims, 4 Drawing Figures

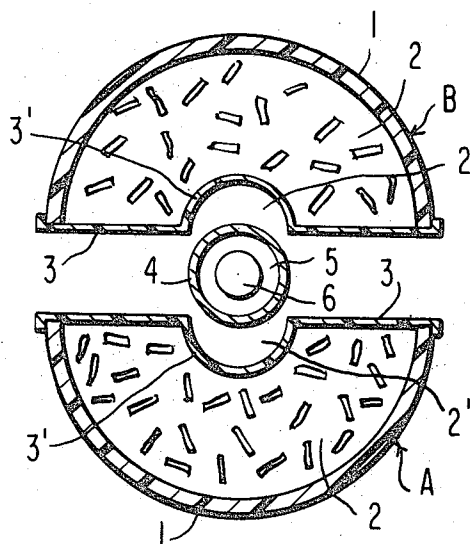


FIG. 1

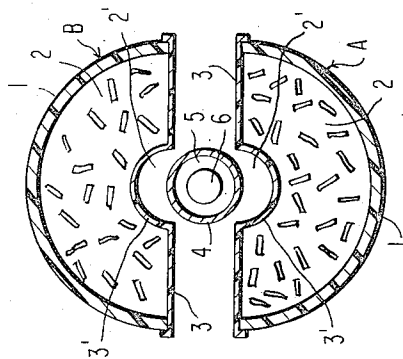


FIG. 2

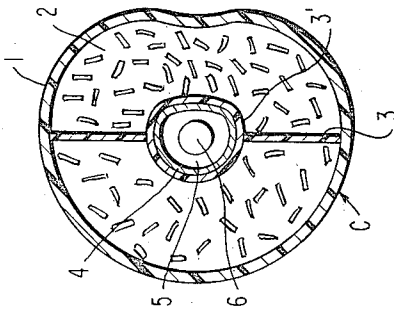


FIG. 3

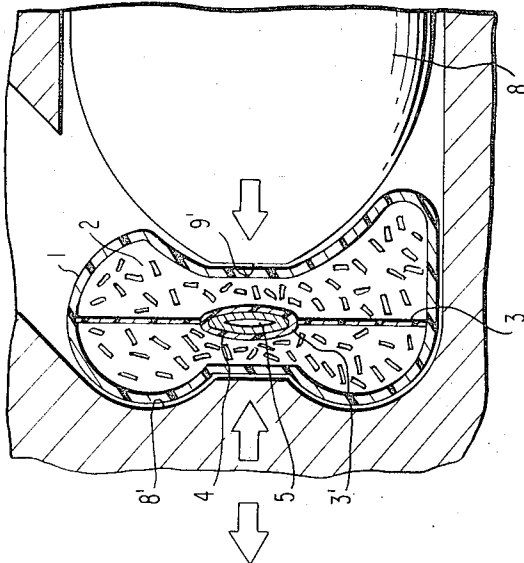
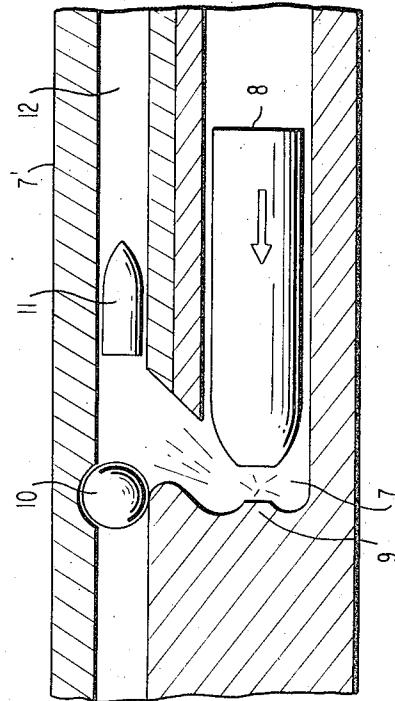


FIG. 4



CONSUMABLE EXPLOSIVE CARTRIDGES

BACKGROUND OF THE INVENTION

The invention relates to a consumable, primer-actuated cartridge suitable for use in explosively actuable devices.

The need for providing momentary pulses of high energy in the operation of explosively actuable devices such as, for example, firearms, staple guns, flare guns, and various types of impact tools, has resulted in the development of explosive cartridges which, upon detonation, exert sufficiently high amounts of energy to propel elements associated with such devices. Alternatively, the cartridge detonation may be employed merely to create a loud noise, as in the case of a starter's pistol and the like.

A commonly utilized form of explosive cartridge includes an assembly of a non-consumable metallic casing, an explosive charge such as gun powder carried within the casing, and a primer positioned adjacent the charge and held, or restrained, in some manner by the casing. The primer typically consists of a material which detonates in response to percussive impacts exerted thereupon, to ignite the charge. At the moment of detonation, with the charge contained within a confined chamber, burning or deflagration of the charge will progress in a cumulative manner throughout the charge to produce an explosion. The resulting momentary pulse of high energy may be directed in a suitable manner to perform the desired function.

The previously described metal-cased cartridge, due to its non-uniform design, must be employed in a device which is able to orient the cartridge in a specific manner so that the primer may be properly compressed by a percussion member. Additionally, the cartridge itself must be capable of restraining the primer as the latter is being compressed by the percussive member to insure that the primer is subjected to sufficient compression for ignition.

Moreover, this type of cartridge requires that the spent casing, being non-consumable, must be ejected or removed from the firing device. This necessitates a manual operation, or the need for a special ejecting mechanism incorporated within the firing device.

A further drawback exists in that metallic cartridge casings generally weigh at least as much themselves as the remaining portions of the cartridge and thus add considerable weight when the cartridges are carried in bulk.

Furthermore, although metallic-cased cartridges are relatively stable in their assembled state, their assembly involves certain hazards due to the necessity of exerting force on the primer to position it within the casing.

Although widely used, this type of cartridge cannot be considered ideal due to the necessity of alleviating the previously-outlined problems. These problems are reflected in the high fabrication costs, not only of the cartridge itself, but also of the various associated firing devices. This is particularly evident in relation to automatic firearms wherein cartridges are required to be fired in rapid succession and thus require the use of relatively sophisticated feeding, detonating, and ejecting mechanisms.

In an effort to facilitate the manufacture and operation of explosive cartridges, there has been substantial

research performed on the development of a "caseless" cartridge, i.e., a cartridge which is completely consumable when detonated. In certain of these types of cartridges, the charge is fabricated in rigid form, i.e., granular gun powder may be combined with a binder material to produce a solid element which can function to retain a primer and, in the case of firearm rounds, a bullet. While the use of a binder to solidify the charge enables the charge to position the primer as well as restrain it during compression, it also makes the cartridges subject to fragmenting or chipping during handling. This is especially evident in firearms which employ breechblock ramming to position a cartridge for detonation. Moreover, there remains the need for orientating the cartridge in a specified manner within the firing device in order that the primer may be properly detonated by a percussion member.

Another type of caseless cartridge which has been proposed is described in U.S. Pat. No. 3,283,657. This patent describes a cartridge consisting of gun powder which is either pressed together, or mixed with a binder, to form a rigid pellet-like element. The pellet does not feature the convenience of primer-induced ignition, however, but relies on the use of gun powder which is sufficiently sensitive so as to ignite in response to being compressed. It is apparent that due to the relatively sensitive nature of such compression-responsive gun powder, and the lack of protection therefor, a cartridge of the pellet type may be less stable than desired during its manufacture and handling. Additionally, pellet-type cartridges are subject to chipping during shipping and other handling, especially during automatic loading.

OBJECTS OF THE INVENTION

It is therefore a general object of the invention to provide a novel explosive cartridge which overcomes or alleviates problems of the type discussed previously.

It is a further object of the invention to provide an explosive cartridge which eliminates the need for non-consumable components, and yet retains the advantages of primer-induced detonation and a high degree of stability.

It is yet another object of the invention to provide a consumable, primer-detonated cartridge which provides maximum primer stability, while affording omnidirectional detonation.

It is still a further object of the invention to provide a novel method of making an explosive cartridge which features maximum safety.

SUMMARY OF THE INVENTION

At least some of these objects are accomplished according to this invention by the provision of a consumable, caseless cartridge which comprises a charge of explosive material having a recess therewithin. A compression-responsive primer material is contained within the recess and is of less volume than the volume defined by the recess. Such an arrangement tends to isolate the primer from compressive forces which might otherwise cause premature detonation of the cartridge.

The charge is preferably in granular form and is surrounded and encased by a consumable, flexible jacket. An internally disposed, consumable, flexible retainer such as a transverse wall arrangement may be provided

to retain the primer material in a generally fixed position within the cartridge. The granular charge serves to further isolate the primer material from compressive forces acting upon the cartridge.

The flexible jacket preferably comprises a pair of semi-spherical members which carry the charge. The transverse wall arrangement desirably comprises a pair of disc-shaped walls which extend transversely across the ends of the semi-spherical members to define a pair of identical charge-containing cartridge half-sections. The primer-receiving recess within the cartridge may be defined by indentations located centrally in each of the transverse walls. With the cartridge half-sections being bonded together, the primer material will be enclosed within the recess defined by the indentations. Preferably the primer material is disposed within a shell situated within the recess.

Objects of the invention are further accomplished by the combination of a substantially spherically-shaped cartridge having a flexible, consumable outer jacket which surrounds a granulated charge. A primer is disposed centrally within the sphere, thereby affording omni-directional detonation. Additionally, the primer is insulated against minor shock by the granular charge.

Some of the objects of the invention are accomplished by a method of making a consumable explosive cartridge which includes the steps of providing a pair of charge-containing cartridge half-sections, each half-section including a recess section; inserting a primer material into one of the recess sections; and securing the half-sections together, with the primer material being confined within a recess defined by the recess sections.

DRAWINGS

In disclosing the invention, reference will be made to a preferred embodiment shown in the appended drawings.

In the drawings:

FIG. 1 is an exploded, sectional view of a consumable cartridge according to the invention.

FIG. 2 is a sectional view of the cartridge in a partially depressed condition taken along a line transverse to the disc-shaped partition walls.

FIG. 3 is a sectional view of the cartridge being compressed within the firing chamber of a firearm.

FIG. 4 is a partial showing, in section, of a firearm in which a cartridge has been detonated.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

As is illustrated in FIG. 1, a preferred form of consumable cartridge includes an explosive charge material 2 having an inner recess 2' suitable for carrying a primer material 6 therein. The explosive charge 2 may comprise any suitable material, such as gun powder, which is subject to ignition, or deflagration, in response to detonation of an adjacent primer.

The preferred cartridge comprises a pair of semi-spherical half-sections A and B which are bonded together to form a unitary cartridge having a centrally-disposed primer 6.

Each half-section is designed so as to be completely consumable upon detonation and includes an outer jacket portion 1 and a selected amount of charge material 2 carried therein. The outer jacket portion 1 is

comprised of a flexible, i.e., resilient consumable material, such as flexible nitrocellulose for example.

The explosive charge 2 is in a granular state, i.e., in loose powder form, and is confined within the jacket portions 1 by means of transverse disc-shaped partition walls 3. These walls 3 are bonded to the respective jacket portions 1 and extend across the open ends thereof. The walls 3 preferably comprise a flexible consumable material, such as flexible nitrocellulose.

An indentation 3' is provided in each wall. In the assembled state of the cartridge, wherein the walls 3 are bonded together by a suitable bonding material, these indentations function as an inner lining for the recess 2' and provide a chamber for retaining the primer 6 in its centrally-disposed location within the cartridge.

The primer 6 may be comprised of any suitable substance which detonates in response to sufficient compression. In the preferred embodiment the primer is in the form of solid pellet and consists of a primer compound, such as lead styphnate for example.

The volume defined by the primer 6 is less than the volume of the recess 2' and is freely displaceably arranged within the recess. Consequently, the recess 2' is capable of undergoing a certain amount of deformation, in response to external shocks, before the primer is subjected to any significant compression.

For example, assuming an instance wherein the cartridge is accidentally dropped or struck, thereby being acted upon by an external compressive force in the direction of the arrow in FIG. 2, the outer jacket 1 is deformed inwardly. If great enough, the compressive forces are transmitted to the charge 2 and thence to the indentations 3. The indentations are thus deformed, but since the primer is of less volume than the recess defined by the indentations, the deformation may not be sufficient to affect the primer, or may merely cause the primer to shift within the larger space defined by the recess. When the external compressive forces diminish, the flexible jacket 1 and the flexible indentations 3 will tend to return the cartridge to the initial configuration.

It is apparent that at least some of the compressive forces tending to deform the cartridge will be absorbed by the flexible jacket 1 and the flexible indentations 3. To even a greater extent, the granular charge will absorb forces as it is being compacted by the forces. The major force absorption, however, occurs in the expenditure of energy in deforming the recess inwardly toward the shiftable primer.

Although the primer 6 may be inserted individually into the recess 2', it is preferred that the primer be encased within a spherical shell, or capsule, 4. The shell comprises a consumable material, such as flexible nitrocellulose, and defines a chamber of greater volume than the volume of the primer material 6, thereby defining a space 5 between the primer and shell. This arrangement of the shell and primer facilitates safe handling of the primer, especially during assembly, in that only the capsule is handled, i.e., no pressure is exerted directly on the primer.

Instead of employing a shell comprised of a flexible nitrocellulose, a more brittle form of nitrocellulose could be used. In this fashion, when the compressive forces deform the shell sufficiently enough to rupture it, the shell will collapse with a splintering, or fracturing, action. The splintered particles will abrasively

strike the primer, thus further tending to induce detonation thereof.

In lieu of providing a free air space in which the primer may be displaced, an easily compressible substance may be disposed in this space to further insulate the primer from sudden shocks, while allowing the primer to be displaced within the recess.

Although the cartridge according to the invention is rendered substantially stable in regard to most premature blows it is likely to receive, it is arranged so as to be subject to instant detonation when compressed within an appropriate firing chamber.

Such a firing chamber is illustrated in FIGS. 3 and 4 and comprises a portion of a firearm. Reference may be made to U.S. Pat. No. 3,641,867, the disclosure of which being hereby incorporated by reference, for a detailed description of the principles of such a firearm.

The firearm includes a barrel 7' in which may be inserted a bullet 11. A firing chamber 7 is located adjacent the barrel and communicates therewith by an appropriate passage. The firing chamber includes a sliding piston 8 which is urged by a spring (not shown) toward an end wall 8' of the chamber. The end wall 8' is provided with a protruding abutment 9 projecting toward the piston 8.

The firing chamber 7 is arranged to receive a cartridge, such as spherical cartridge 1, as shown in FIG. 3. The abutment 9 is positioned at the same general height as the location of both the primer 6 and a flattened nose portion 9' of the piston 8. In this fashion, as the cartridge is compressed between the piston 8 and the end wall 7, the primer will be correspondingly flattened between the abutment 9 and the piston nose 9'. By arranging the piston 8 to exert a sufficiently high compressive force on the cartridge, it is assured that the primer will detonate and thereby ignite the confined charge 2. The ensuing explosive forces are directed against the rear of the bullet 11 to propel the bullet from the barrel. A gas check ball valve 10 may be provided at the rearward end of the barrel to seal the explosion gases within the barrel 12 and away from the action and the shooter.

In assembling the cartridge, the half-sections are individually assembled wherein the semi-spherical jackets 1 are provided with a desired amount of charge and are closed by bonding the partition walls 3 to the jacket portions. The capsule 4 containing the primer material 6 is then inserted into one of the indented portions 3'. Subsequently, the walls 3 are bonded together in face-to-face relationship to define a substantially spherically configured jacket 1 containing a generally spherical charge 2 which envelopes a primer 6.

It is apparent that during this assembling process, i.e., wherein the charge is built around the primer, there will be minimal, if any, pressure exerted on the primer 6. In this manner, the manufacturing process will be rendered less hazardous than that associated with conventional metal-cased cartridges wherein the primer must be pressed into position within the casing at the time of manufacture.

Although the preferred form of the cartridge described previously utilizes a charge which is in granular form, it will be apparent that a charge which is in solid form (e.g., mixed with a binder or compressed into a rigid state) could be employed to carry out the teachings of the invention. Such a cartridge would, of course, contain a central recess which is of greater volume than

the primer to provide a shock-insulating feature. In this case, however, there is no additional shock absorbing feature as would be otherwise provided by a charge which is in granular form. It is preferable, in the event that a rigid charge is employed, that a flexible jacket be used in conjunction therewith to minimize the dangers of cartridge chipping.

In light of the foregoing description, it is apparent that the present invention provides an explosive cartridge which exhibits novel force-absorbing features. One such feature relates to the arrangement of a primer disposed within a recess of larger volume wherein the primer is isolated from premature impacts. A further feature involves the provision of a granular charge which surrounds, or envelopes, a primer and serves to absorb compressive forces which might otherwise be transmitted to the primer.

The outer, flexible jacket provides, in the case of a granular charge, a biasing force tending to absorb shocks and maintain the cartridge in its initial spherical form. In the case of a rigid charge such a jacket serves to prevent chipping and fragmenting thereof.

The transverse walls 3 aid in defining the recess 2' in the granular charge 2 and also define a chamber for confining the primer material therein.

By enclosing the primer within a shell 4, handling of the primer itself becomes safer since compressive forces will not be imposed directly on the primer. During the occurrence of premature impacts on the cartridge the flexible shell 4 tends to absorb shocks. Conversely, the use of a brittle shell at detonation, produces splintered fragments which abrasively contact the primer, thereby aiding in the detonation thereof.

The provision of a cartridge which may be manufactured by assembling together a pair of half-sections around the primer facilitates safe manufacture of the cartridge, since the primer need not be pressed into the cartridge.

By providing a spherically shaped cartridge with a primer disposed centrally therewithin, the primer is capable of being detonated omnidirectional, i.e., by forces imposed in any direction on the cartridge.

Although the invention has been described in connection with a preferred embodiment thereof, it will be appreciated by those skilled in the art that additions, modifications, substitutions and deletions not specifically described may be made without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A consumable explosive cartridge comprising:

an outer jacket of consumable material;

a charge of explosive material contained within said outer jacket;

a recess disposed within said charge of explosive material so as to be surrounded thereby on all sides;

pressure-sensitive primer material disposed within said recess and being of less volume than said recess;

said primer material being freely displaceable within said recess in a manner tending to resist unintentional detonation by external forces.

2. A consumable explosive cartridge according to claim 1 wherein said jacket is comprised of nitrocellulose.

3. A consumable explosive cartridge according to claim 2 wherein said outer jacket is comprised of flexible nitrocellulose; said charge of explosive material being in loose granular form; and said recess being defined by wall means comprised of flexible nitrocellulose.

4. A consumable explosive cartridge according to claim 3 wherein said outer jacket is substantially spherical; and said recess-defining wall means comprising a shell located centrally within said charge for omnidirectional detonation.

5. A consumable explosive cartridge in accordance with claim 4 wherein said jacket comprises a pair of semi-spherical jacket sections, each section defining an opening; a wall of nitrocellulose being disposed transversely across each opening to define a charge-containing chamber; each wall including a central indentation; said sections being bonded together, with said walls and their respective indentations being disposed in facing relationship to define a shell-containing housing.

6. A consumable explosive cartridge in accordance with claim 3 wherein said outer jacket is substantially spherical; said recess-defining wall means comprising a shell disposed centrally within said charge; said shell being sufficiently brittle to produce, upon collapse, abrasive fragments for contacting and detonating said primer material.

7. A consumable explosive cartridge for use in a firearm having a percussive detonation element, said cartridge comprising a spherical outer jacket of consumable material; a charge of explosive material contained

within said outer jacket; a spherical primer-containing recess disposed centrally within said explosive material so as to be spaced uniformly inwardly from said jacket and surrounded by said explosive material on all sides; pressure-sensitive primer material disposed within said central recess for omni-directional detonation by the percussive detonation element.

8. A consumable explosive cartridge according to claim 7 wherein said outer jacket is flexible; said charge being in loose granular form; and said recess being of larger volume than said primer material, which is freely displaceable therein so as to resist unintentional detonation by external forces.

9. A consumable explosive cartridge according to claim 8 wherein said recess is defined by flexible wall means of consumable material.

10. A consumable explosive cartridge according to claim 9 wherein said jacket and said wall means comprise flexible nitrocellulose; and said primer material being in pellet form.

11. A consumable explosive cartridge according to claim 10 wherein said wall means comprises a flexible shell; said jacket comprising semi-spherical jacket sections, each section defining an opening; a wall of nitrocellulose being disposed transversely across each opening to define a charge-containing chamber; each wall including a central indentation; said sections being bonded together, with said walls and their respective indentations being disposed in facing relationship to define a shell-containing housing.

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