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LIQUID PROPELLANT CARTRIDGE

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The present invention relates to ammunition and in particular to cartridges utilizing liquid propellant.

It is a particular feature of the invention to provide a simple, primerless cartridge structure which depends upon adiabatic compression of the propellant for ignition.

It is a further feature of the invention to provide a simple cup-like cartridge case including a piston received within the case where the case and the piston cooperate to pressurize a quantity of liquid propellant disposed within the case where the pressure level of the propellant is maintained at a value which is lower than the pressure level at which ignition occurs.

The reason for establishing the initial or pre-compression level of the liquid propellant while packaged within the cartridge is to establish a sensitivity level in the cartridge and to create uniform ignition sensitivity from cartridge to cartridge.

The pressure level created in the liquid propellant by initially compressing the propellant while packaged within the cartridge is a function of the ignition sensitivity of the cartridge. The relationship is generally linear in that the higher the level of pressure created by the initial or pre-compression of the propellant, the less energy required to ignite the cartridge.

A cartridge embracing certain features of the present invention may comprise a cup-shaped case having a generally circular open mouth, a charge of liquid propellant susceptible of ignition by adiabatic compression disposed in the case and a piston received within the mouth of the case a sufficient distance effective to compress the propellant, said case being crimped in the region of said mouth so as to engage and retain the piston within the case and to maintain said pressure level.

A process embracing certain principles of the present invention may comprise the steps of providing a cylindrical case and cooperating piston, disposing a quantity of said propellant within the cylinder and advancing the piston into the cylinder in a direction which tends to pressurize the propellant without igniting the propellant and securing the piston relative to the cylinder so as to establish a seal and to maintain the pressure level and subsequently introducing energy to the piston operative to increase the pressure level of the propellant effective to bring about ignition.

Other features and advantages of the present invention will become more apparent from an examination of the succeeding specification when read in conjunction with the appended drawings in which:

FIG. 1 shows a vertical section of a tool with which the cartridge of the present invention may be utilized;

FIG. 2 shows the cartridge of FIG. 1 enlarged, while,

FIG. 3 discloses an alternative arrangement with which the cartridge may be utilized.

Referring now to the drawings, there is shown a fastener driving tool incorporating a cartridge booster, indicated generally by the reference numeral 10 and which, for purposes of convenience, will be referred to hereinafter as a hammer actuated fastener driving tool.

It is to be particularly noted that although the cartridge and method of firing the cartridge disclosed herein is described by way of its adaptation to a hammer actuated fastener driving tool, obviously the cartridge may be utilized in a variety of tools, including firearms, as condi-

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tions of design and other engineering considerations dictate.

The tool 10 includes a body portion 11 normally grasped manually by an operator and carries a barrel 12 threadedly connected to the body 11. The barrel is formed with a bore 13 of generally uniform cross-section and is operative to receive the driving head 14 of a piston 16 movable axially within a bore 17 formed in the body 11. The piston 16 also carries a striking head 18 which in the operation of the tool is struck by a hammer for a purpose which will become more apparent hereinafter.

The head 14 is shown in contact with a cartridge 19, such as shown in FIG. 2, comprising a cup-shaped container or case 21 and a movable piston or plunger 22 where the void within the container, indicated by the letter P, is filled with liquid propellant susceptible of ignition by adiabatic compression.

Examples of such propellants are propyl nitrate, ethyl nitrate and nitromethane.

The piston 22 is shown in contact with the driving head 14 while the bottom of the cartridge case 21 bears upon the head 23 of a fastener 24 retained centrally in the bore by the frictional engagement of a flanged, generally conic plastic spacer 26.

The tool 10 is shown resting upon a surface into which the fastener is to be driven, such as a concrete slab indicated by the letter S.

The cartridge case 21, the fastener 24 and the piston head 14 are positioned in abutting relationship with the ogival head of the fastener enclosed in the spacer 26, in contact with the concrete slab S. The cartridge 19 is fired by delivering a sharp blow of a hammer upon the striking head 18 while the body of the tool 10 is grasped manually with the result that the piston 16 is depressed or moved downwardly in turn moving the piston 22 relative to the case 21 against the resistance offered by the slab S through the fastener 24 with the result that the propellant P is further compressed adiabatically to the point of ignition.

Upon the occurrence of ignition, propellant gases are developed which tend to drive the piston upwardly in opposition to recoil spring 27 while the case 21 is driven downwardly against the head 23 of the fastener operative to drive the fastener into the slab S.

In the embodiment of the invention shown in FIG. 3, the cartridge 19 is shown housed in an intermediate power element 28 in threaded engagement with a fastener 29.

In this arrangement, the hammer force is applied through driving head 31 and the resistance offered the slab S through the fastener 29 and the member 28 operate to move piston 22 relative to the cartridge case to effect ignition with the result that the main body of ignition gases developed operate upon the annular shoulder 32 effective to drive the element 28 and the fastener 29 into the slab.

Passageway 33 is provided to vent excess gas.

After the fastener 29 is set, the member 28 is merely removed from threaded engagement with the fastener.

The method of charging and firing the cartridges 19 of the present invention includes the steps of introducing liquid propellant into the cartridge case and thereafter inserting the piston.

The piston makes a snug fit with the mouth of the cartridge and is moved into the cartridge a sufficient distance to precompress the propellant by developing a pressure in the propellant ranging from 50 p.s.i. to 750 p.s.i.

The pressure is maintained in the cartridge by crimping the cartridge case to the piston.

Thereafter, upon inserting the cartridge in a tool, such as disclosed in FIG. 1, additional energy is supplied to drive the piston 22 into the cartridge to develop addi-

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tional pressure in the propellant to bring about adiabatic ignition.

Although it is preferred that the cartridge case be fabricated of metal, such as brass or aluminum, appropriate plastics are satisfactory; the piston can be fabricated from metallic or plastic material, such as polyethylene, nylon, aluminum, brass, or the like.

It is anticipated that a wide variety of modifications and variations in the present invention may be devised without departing from the spirit and scope of the invention.

What is claimed is:

1. A method of utilizing potential energy within a liquid propellant susceptible of ignition by adiabatic compression where the propellant is confined within a cartridge comprising the steps of providing a cylindrical case and cooperating piston, disposing a quantity of said propellant within the cylinder and advancing the piston into the cylinder in a direction which tends to pressurize the propellant without igniting the propellant and securing the piston relative to the cylinder so as to maintain the pressure level established and subsequently introducing energy to the piston to drive the piston further into the case operative to increase the pressure level of the propellant effective to bring about ignition.

2. The method of claim 1 wherein the propellant within the case is initially pressurized to a level ranging from 50 to 750 p.s.i.

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3. A primerless liquid propellant cartridge consisting of a cup-shaped case having a generally circular open mouth, a charge of liquid propellant susceptible of ignition by adiabatic compression disposed in the case and a piston closure received within the mouth of the case and disposed above the propellant, said closure having a portion telescoped within the case, and a portion extending beyond the mouth effective to seal the propellant under a pressure substantially above atmospheric pressure, said casing being secured to said piston closure in the region of said mouth so as to retain the piston closure fixed relative to the case and to maintain said pressure, said extending portion having an exposed face operative to receive an impact effective to drive the piston closure into said case whereby the propellant is ignited adiabatically.

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