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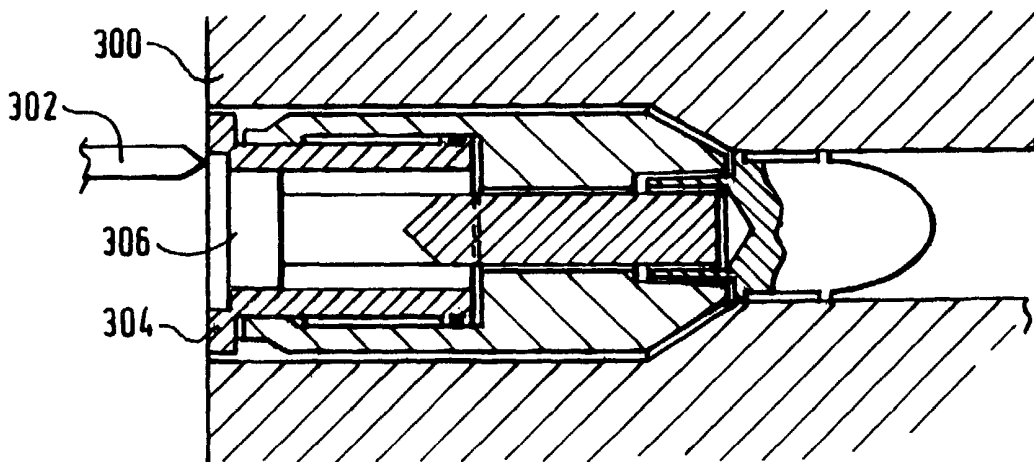
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(54) Title: IMPROVEMENTS IN AND RELATING TO TRAINING AMMUNITION



(57) Abstract: The invention provides a training cartridge (304) having a peripheral fire primer (306) and a gun modified to fire the cartridge. The combination of modified gun and peripheral fire cartridge avoids the potentially adverse consequences that could arise if live ammunition and training ammunition were to become inadvertently confused or mixed up by preventing the firing of live centre fire ammunition.



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IMPROVEMENTS IN AND RELATING TO TRAINING AMMUNITION

5 This invention relates to improved training ammunition and to a method of modifying a gun to fire the training ammunition.

Background of the Invention

10 Low powered training cartridges are known, and examples of such cartridges are disclosed in PCTGB98/00620, PCT/GB99/02859, PCT/GB99/02556, GB 9819928.4 and US 5492063. Training cartridges are characterised in that they impart much less energy to a projectile than a live (“killing”) round. Thus, whereas a live round may impart 800 ft/lbs of energy to a bullet and a shotgun may impart as much as 1000 ft/lbs of energy to the shot, training cartridges are much less energetic. For example, the energy imparted to a projectile
15 by a training cartridge is typically less than 5 ft/lbs and more usually less than 4 ft/lbs. The term “training cartridges” as used herein therefore refers to such low energy cartridges, unless the context indicates otherwise.

20 The aforementioned training cartridges typically contain only a primer and do not contain a conventional amount of propellant. Consequently, they must be carefully designed to ensure that there is sufficient energy both to recycle a weapon and eject a projectile such as a bullet. Many training cartridges, see for example the cartridges disclosed in the patent documents *supra*, are of the expanding type in which the body of the cartridge comprises a “piston and cylinder” arrangement. With such cartridges, part of the energy of the primer
25 is used to force the piston and cylinder apart (i.e. expand the cartridge) and drive the rear end of the cartridge back to recycle the weapon, and part of the energy is used to discharge the projectile from the front end of the cartridge. Careful control of gas flow within the cartridge is required in order to make sure that the projectile is discharged at a consistent and appropriate velocity and that the weapon is recycled at every firing.

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All (so far as the Applicants are aware) current training ammunition, and most live military ammunition, is of the centre fire variety. Exceptions are certain 0.22" (5.56mm) rounds generally used in target shooting (and occasionally in military training) which are of the rimfire type. Live cartridges of the centre fire variety generally have a primer carried in

a cup or "can" set into the rear end of the cartridge. However, with live rounds of the rim fire type (for example the 0.22" rounds referred to above) the primer is not carried in a cup or can but is held in the hollow rim of the cartridge case itself.

5 Figure 1 shows a sectional elevation through the primer for a centre fire cartridge of the type typically used in live military ammunition. The primer comprises a can 2 formed from, for example, nickel plated brass, and containing a suitable pyrotechnic primer material 4. The can is held in a recess in the centre of the rear surface (not shown) of the cartridge. An anvil 6 is set into the front of the can 2 to close the can and retain the primer in place. 10 As the anvil is inserted into the can, the protruding central part 6a of the anvil greatly compresses the primer to create a compressed region 4a which is highly sensitive to shock. The region 4a which is sensitive to shock has an approximate width I, and this represents the impact area for the firing pin of a centre fire weapon. Thus, a centre fire firing pin will impact against the impact area and further compress the primer between the wall of the can and the anvil thereby detonating the primer. However, it will be appreciated that the firing 15 pin of a rimfire weapon would impact against the can outside the impact area I and hence would not detonate the primer.

 Although training cartridges that are constructed to provide consistent low energy 20 discharge of bullets are generally safe *per se*, safety problems can arise when live killing cartridges are inadvertently mixed with or substituted for low powered training cartridges. As stated above, all of the known existing training cartridges use centre fire type of primers which are very similar and often identical to the types of primers used in the equivalent live 25 killing cartridge for a particular gun type. Attempts have been made to prevent confusion between the two types of cartridge by modifying the gun so that it will not fire the cartridge type usually fired from the gun, but will only fire a training cartridge. Unfortunately, this safety feature can sometimes be bypassed by using a different live cartridge type which, when chambered, fits the gun, or by using damaged live cartridges. In such circumstances, 30 firing live cartridges rather than training cartridges can result in serious injury or death.

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 It is an object of the present invention to provide a solution to the aforementioned problems by preventing live killing cartridges from being fired inadvertently in place of training cartridges.

Summary of the Invention

5 The present invention makes use of peripheral fire primers in the training cartridges, and a gun modification which allows the firing pin of the gun to strike the periphery (i.e. rim) of the primer which fires a cartridge. If any type of centre fire cartridge is fitted into the gun whilst the conversion is fitted, the firing pin cannot set off the centre fire primer as the point of impact of the firing pin is beyond the sensitive part of the centre fire primer. Thus, the present invention prevents the standard centre fire military ammunition from being fired inadvertently instead of low velocity training ammunition.

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Accordingly, in one embodiment the invention provides a training cartridge having a peripheral fire primer.

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The primer typically takes the form of a cup or "can" which is set into the rear end of the cartridge. The cup typically has a hollow peripheral rim in which the primer material is located, the primer material being in a compressed state and highly sensitive to shock. The primer material can thus be detonated when the peripheral rim of the can is impacted by a firing pin. This arrangement is in contrast to conventional live rimfire cartridges (i.e. 0.22" calibre) in which the primer material is located in the rim of the cartridge itself rather than the peripheral rim of a cup set into the rear of the cartridge.

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The training cartridges of the invention are preferably expandable upon firing, expansion of the cartridge serving to urge a rear surface of the cartridge rearwardly against a breech block of a gun to initiate recycling of the gun.

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For example, in one embodiment, there is provided an expandable training cartridge configured to enable a projectile (e.g. a bullet) to be mounted in or on a nose portion thereof, a gas passage through the nose portion providing communication between the cartridge interior and the projectile. The cartridge has valve means for controlling propellant gas flow through the gas passage to the projectile, and a movable member which upon firing is propelled rearwardly from the cartridge against a breech block of the firearm by the pressure of propellant gas within the cartridge so as to recycle the firearm. The valve means is preferably arranged to close in order to stop or substantially reduce the flow of propellant gas through the said gas passage after the projectile has been fired from the cartridge,

thereby to facilitate rearwards propulsion of the movable member.

The precise nature of the training cartridge is not critical but, for example, the training cartridge can be of the general type described in any one of PCT98/00620, PCT/GB99/02859, PCT/GB99/02556 and GB 9819928.4, but with an appropriately modified primer. The diameter of the training cartridge is generally greater than the diameter (usually approximately 0.375" (9mm)) of live 0.22" (5.65mm) rounds although the training cartridge may carry a 0.22" (5.65mm) bullet or projectile, and may be provided with a primer of a diameter typically associated with a 0.22" (5.65mm) round.

In general, the primer is the only pyrotechnic material in the cartridge; i.e. there is no propellant other than the primer. The primer is such that the cartridge produces an energy of less than 4 ft/lbs, more preferably less than 3 ft/lbs, for example less than 2.5 ft/lbs, and most preferably 2 ft/lbs or less.

In another aspect, the invention provides a method of modifying a gun to prevent it from firing live ammunition but permit the firing of a rimfire primer training cartridge, which method comprises (i) replacing a centre fire firing pin with a rim fire firing pin and/or (ii) replacing a barrel of the gun such that a centre firing pin is misaligned for centre firing of the cartridge but is aligned for rim firing of the cartridge, but excluding the modification of a gun capable of firing live 0.22" (5.56mm) cartridges by replacing the centre firing pin with a rimfire firing pin..

In a further aspect, the invention provides a method of modifying a gun to prevent it from firing live ammunition but permit the firing of a rimfire primer training cartridge other than a 0.22" (5.56mm) calibre cartridge, which method comprises replacing a centre fire firing pin with a rim fire firing pin.

In another aspect, the invention provides the combination of a training cartridge having a rimfire primer and a gun that has been modified to fire a rimfire primer-containing training cartridge.

In a further aspect, the invention provides a peripheral fire primer for use in a cartridge as hereinbefore defined, the primer comprising a cup for setting into the rear end

of the cartridge, the cup having a hollow peripheral rim containing compressed primer material.

In a further aspect, the invention provides a method of modifying a gun to prevent it from firing live ammunition but permit the firing of a rimfire primer training cartridge, which method comprises selecting a gun having a centre fire firing pin and replacing the barrel of the gun with a barrel in which the breech is offset such that the centre fire firing pin can impact against and fire the rimfire primer training cartridge but not a centre fire cartridge.

In a still further aspect, the invention provides a gun having a centre fire firing pin and a barrel in which the breech is offset such that the centre fire firing pin can impact against and fire a rimfire primer cartridge but not a centre fire primer cartridge.

Which modification is selected will depend upon the nature of the gun. For pistols or other guns which have sliding or removable barrels, a barrel conversion may offer the simplest means of modifying the weapon. On the other hand, if the barrel is fixed, and the breech block is slidable, as with most rifles and machine guns, then the simplest conversion is to modify or change the firing pin to a rimfire firing pin.

In the case of a barrel modification, the centre fire firing pin of a gun prior to modification is arranged such that it strikes at a location which is central with regard to the bore or breech of the barrel, i.e. the centre line of the firing pin is coincident with the centre line of the barrel. After modification in accordance with the invention, the centre line of the bore of the barrel is offset relative to the centre line of the firing pin. This means that a firing mechanism incorporating a centre fire firing pin will not impact against the sensitive central area of a centre fire cartridge but will instead impact against the rim. Thus, the modification to the barrel allows rimfire training cartridges to be fired but prevents the corresponding centre fire live ammunition from being detonated.

A further advantage of the offset of the bore is that the bore can be inclined with respect to the axis of the barrel thereby providing a means of correcting the trajectory of the low velocity projectile without the user of the gun needing to make any changes to his normal sighting.

In cases where it is more appropriate to modify the firing pin, rather than the barrel, the centre line of the firing pin may still be aligned with the centre line of the bore of the barrel but the modified pin typically has a laterally extended leading end portion, the laterally extended leading end portion having a leading surface profiled such that it impacts against the rim of a rimfire primer but not against the centre of a centre fire primer. The laterally extended leading end portion can be laterally extended in one plane or in two planes.

For example, when it is extended in one plane, the end of the pin can take the form of a flat spade-like structure that slides in a slot cut into the breech block. The flat spade-like structure may have one or two (and preferably two for balance) forwardly oriented projections at the edges thereof for impacting against the rim of a rimfire primer but not the central impact area of a centre fire primer..

When the leading end portion of the modified firing pin is laterally extended in two planes, it can, for example, have a cylindrical form. In such a case, the leading surface can have one or more (preferably more than one) discrete projections protruding forwardly therefrom, or the leading surface can be provided with a forwardly projecting annular rim having a diameter such that it impacts against the impact area of a rimfire primer but not the impact area of a centre fire primer.

In order to reduce still further the possibility of a centre fire primer being detonated by the modified pin (for example as a consequence of a piece of particulate matter or debris between the firing pin and cartridge), the region of the leading surface between or inwardly of the projection(s) can be cut away, at least over the area that would overlap with the impact area of a centre fire primer.

Brief Description of the Drawings

The invention will now be illustrated, but not limited, by reference to the particular embodiments shown in the accompanying schematic drawings, Figures 1 to 9.

Figure 1 is a side sectional elevation through a centre fire primer.

Figure 2 is a side sectional elevation through a rimfire primer.

Figure 3 is a schematic elevation of a conventional arrangement of a centre fire primer in a gun fitted with a centre fire firing pin.

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Figure 4 is a schematic elevation of a conventional arrangement of a rimfire primer in a gun fitted with a rimfire firing pin.

Figure 5 illustrates schematically part of a standard centre fire pistol having a barrel containing a centre fire primer cartridge.

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Figure 6 illustrates schematically the centre fire gun of Figure 5 but wherein the barrel has been replaced by a modified barrel.

Figure 7 illustrates a standard rifle fitted with a centre fire firing pin and containing a centre fire primer cartridge.

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Figure 8 illustrates the rifle of Figure 7 but with a modified firing pin.

Figure 9 illustrates an explosive blank cartridge having a peripheral fire primer.

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Detailed Description of the Preferred Embodiments

A peripheral fire primer for use in a cartridge according to the invention is shown in Figure 2 and comprises a can 102, the closed end of which is formed to provide a hollow peripheral rim area 103. A pyrotechnic primer composition 104 is placed in the can and the can is spun thereby forcing the pyrotechnic material into the hollow peripheral rim area 103. With the primer of Figure 2, the impact area I' is annular in shape and extends around the peripheral rim of the primer. As can be seen from Figures 1 and 2 together, for cartridges of the same calibre, there will be a dead zone S between the impact region I of a centre fire primer, and the impact region I' of a peripheral fire region in which any impact will not detonate the primer. When a cartridge containing the primer of Figure 2 is placed in a weapon having an appropriately configured and aligned firing pin and the weapon is fired, the firing pin strikes impact area I' and compresses the pyrotechnic composition between the

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two walls 103a and 103b of the hollow rim region 103, the shock imparted to the pyrotechnic composition causing it to detonate.

Referring now to Figure 3, there is shown a conventional arrangement of a gun 200 having a centre firing pin 202, a training cartridge 204 being inserted into the breech thereof. In this case, in accordance with conventional practice, the cartridge 204 has a centre fire primer 206 fitted into the end thereof, the primer being of the type shown in Figure 1. It will be noticed that the centre line L1 of the firing pin 202 is coincident with the centre line L2 of the barrel of the gun.

In Figure 4, there is shown an arrangement in which a gun 300 has been modified to provide it with a peripheral fire firing pin 302 which is offset from the centre line of the barrel so that it can fire a training cartridge 304 having a peripheral fire primer 306 of the type shown in Figure 2.

As indicated above, a problem with centre fire training cartridges is that on occasions training cartridges and live killing ammunition can become confused. In order to avoid this problem the invention provides a training cartridge which is detonated by impact on the peripheral rim of the primer, and makes use of a gun which is specially modified to allow use of the peripheral fire primer.

Figure 5 shows a standard centre fire pistol into which has been inserted a cartridge having a centre fire primer. The arrangement shown in this Figure corresponds to Figure 3 except that the barrel of the pistol is removable. Figure 6 shows a modification of the gun shown in Figure 5. As demonstrated in Figure 6, the gun is still provided with a centre fire firing pin 410 which, with a normal gun barrel, would allow the firing of centre fire cartridges. However, in order to prevent centre fire cartridges from being fired, the gun is converted by replacing the normal gun barrel with a gun barrel 412 in which the bore 414 is offset. As can be seen from Figure 6, the bore 414 is inclined at an angle α with regard to the axis 16 of the barrel. The centre line of the bore 414 is also inclined with respect to the centre line of the firing pin 410.

If a training cartridge having a peripheral fire primer is inserted into the breech, the relative geometry of the gun barrel and firing pin are such that the firing pin can fire the

cartridge. On the other hand, if a centre fire cartridge (for example a live killing cartridge) is inserted into the gun barrel, the firing pin 410 will fail to strike the centre fire impact area 318, and hence the cartridge will not detonate. Thus, the modification of the invention greatly enhances the safety in that it prevents live killing ammunition from being inadvertently mixed with training ammunition.

A further advantage of the arrangement shown in Figure 6 is that it can enable training ammunition to be used more accurately. One of the problems with training ammunition is that the low velocity means that the bullet will often fall away before it reaches a target, and consequently there will be a tendency for the user to compensate for this by aiming above the target. Thus shooting at targets using low velocity ammunition can be less realistic than is desirable. With the gun barrel arrangement shown in Figure 6, the user of the gun can fix his sights on the target in the normal way, and the angle of the bore, rather than the angle of the barrel, provides the necessary correction to enable the projectile to reach its target. Thus, the range of the training ammunition is much closer to the range of normal live killing ammunition.

The modification shown in Figure 6 is particularly suited to pistols since in many cases the barrel of a pistol can be removed fairly easily. However, the barrels of rifles are typically fixed and hence a barrel modification of the type shown in Figure 6 would involve somewhat more complex alterations to the gun and would not be a practical proposition.

Therefore, with rifles and machine guns and other firearms with fixed non-sliding barrels, it is easier to modify the firing pin and this is demonstrated in Figures 7 and 8.

Figure 7 shows a part of a conventional rifle equipped with a centre firing pin and having a centre fire training bullet inserted in the breech thereof. Figure 8 illustrates the same rifle but wherein the firing pin has been modified. Thus the firing pin is no longer pin-shaped but instead has a leading end which is extended laterally to give a spade-like shape. The leading surface of the leading end has forwardly oriented projections 512 at either edge thereof, the projections being aligned with the impact region 514 of the peripheral fire primer 513 of the cartridge. The central part 516 of the leading end is recessed, the width of the recess being at least as great as the width of the impact area of the centre fire primer 318. In use, when the weapon is fired, the projections 512 on the edges of the leading end

of the modified firing pin impact against the sensitive impact region of the peripheral fire primer to detonate the primer. However, if a cartridge (e.g. a live killing round) having a centre fire primer is inadvertently inserted into the gun, it will not be detonated. The safety of the modified firing pin arrangement shown in Figure 8 is further enhanced by virtue of the recessed central region 516 which ensures that centre fire primers cannot accidentally be detonated as a result of the presence of particles of debris between the firing pin and cartridge.

The modified firing pin of Figure 8 can be fitted, for example, by shortening an existing firing pin, cutting a thread on the end thereof, and fixing the threaded end into a suitably profiled end piece. The circular channel or opening in which the firing pin normally slides is machined out to form a slot to accommodate the spade-like shape of the end piece.

Figure 9 illustrates an explosive blank cartridge that can be fired in the modified gun of Figure 8. The blank cartridge comprises a casing 602 closed at its nose 604 and containing an explosive material 606. The rear end of the blank cartridge has a flange 608 to enable the spent cartridge to be extracted from the breech in the usual manner. Thus far, the blank cartridge is of conventional construction. However, the cartridge differs from conventional blank cartridges in that the primer 610 set into the centre of the rear of the cartridge is a peripheral fire primer. The primer 610, which can be of the form shown in Figure 2 or an appropriate modification thereof, comprises a cup or can 612 having a hollow peripheral rim 614 containing compressed primer material. In use, the off centre firing pin 616 of the gun impacts against the peripheral rim 614 thereby detonating the primer material which in turn detonates the explosive material 606. Expanding gases created by the detonation of the primer and explosive material burst through the nose 604 in the usual manner to give a realistic bang.

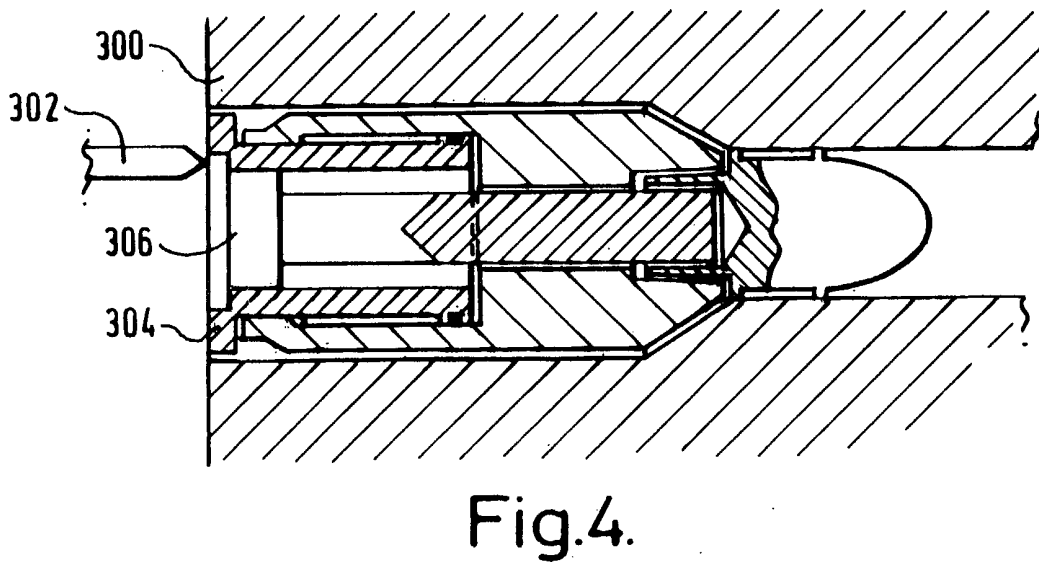
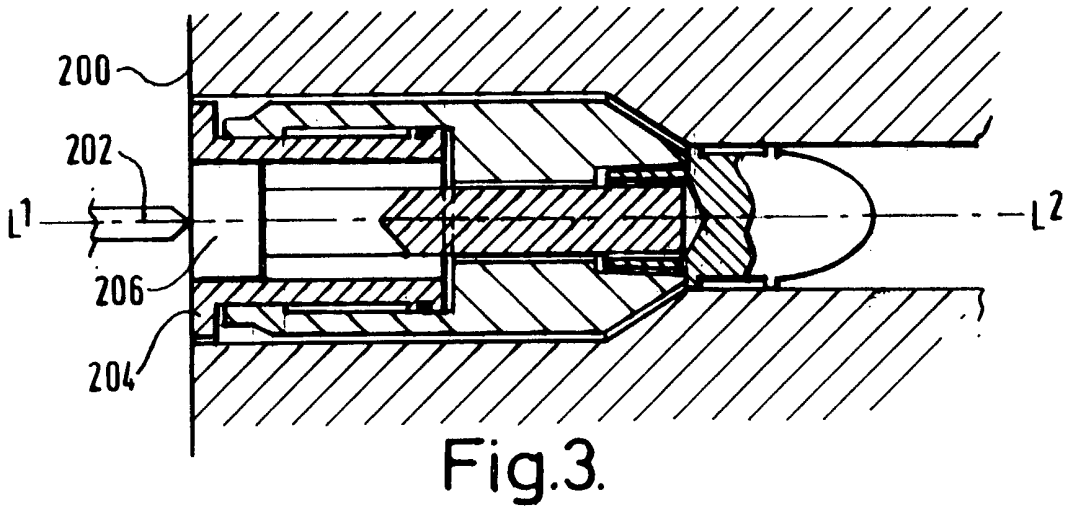
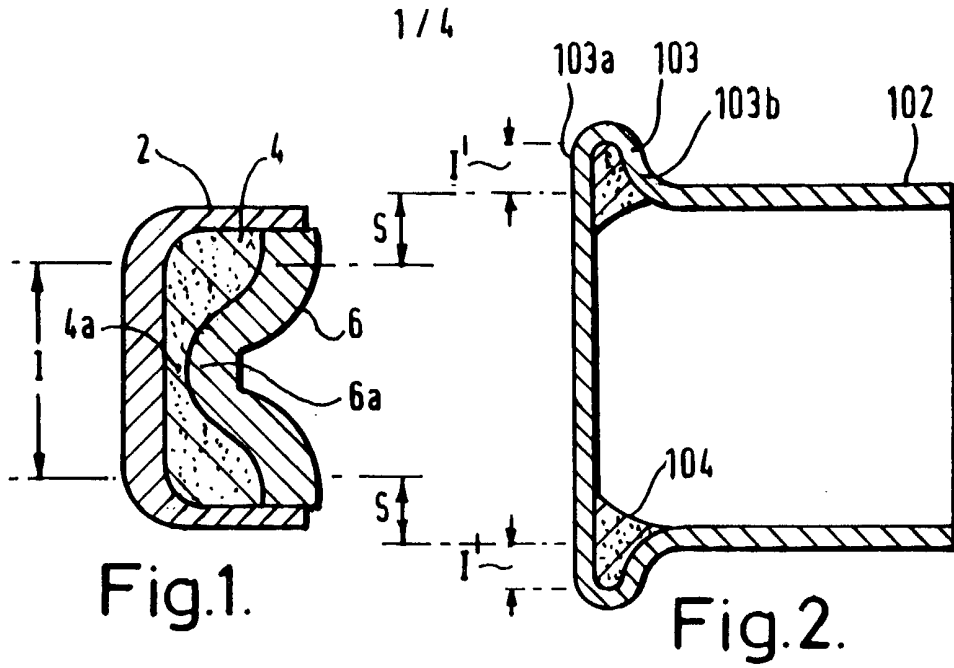
The foregoing examples illustrate merely some of the ways in which the invention can be put into effect, and it will readily be apparent that numerous modifications and alterations can be made to the arrangements shown in the accompanying drawings without departing from the principles underlying the invention. All such modifications and alterations are intended to be embraced by this application.

CLAIMS

1. A training cartridge having a peripheral fire primer.
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2. A training cartridge having a peripheral fire primer cup set into the rear end thereof.
3. A training cartridge according to claim 1 or claim 2 wherein the cartridge is expandable upon firing, expansion of the cartridge serving to urge a rear surface of the cartridge rearwardly against a breech block of a gun to initiate recycling of the gun.
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4. A training cartridge according to any one of the preceding claims which contains no propellant other than the primer.
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5. A blank cartridge having a peripheral fire primer cup set into the rear end thereof.
6. A blank cartridge according to claim 5 which contains explosive material other than the primer.
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7. A combination of a training cartridge or blank cartridge having a peripheral fire primer as defined in any one of claims 1 to 6 and a gun that has been modified to fire a peripheral fire primer-containing training cartridge or blank cartridge.
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8. A combination according to claim 7 wherein the gun has been modified to prevent it from firing live ammunition but permit the firing of the training cartridge or blank cartridge by replacing the barrel of a gun having a centre fire firing pin gun with a barrel in which the breech is offset such that the centre fire firing pin can impact against and fire the peripheral fire primer but not a centre fire primer.
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9. A combination according to claim 8 wherein the bore of the barrel is inclined relative to the barrel axis.
10. A method of modifying a gun to prevent it from firing live ammunition of a centre

fire type but permit the firing of a training cartridge or blank cartridge as defined in any one of claims 1 to 6, which method comprises (i) replacing a centre fire firing pin with a firing pin configured to impact against the peripheral fire primer of the said training cartridge or blank and/or (ii) replacing a barrel of the gun such that a
5 centre firing pin is misaligned for centre firing of the cartridge but is aligned for peripheral firing of the primer, but excluding the modification of a gun capable of firing live 0.22" (5.56mm) cartridges by replacing the centre firing pin with a rimfire firing pin.

- 10 11. A peripheral fire primer for use in a cartridge as defined in any one of claims 1 to 6, the primer comprising a cup for setting into the rear end of the cartridge, the cup having a hollow peripheral rim containing compressed primer material.



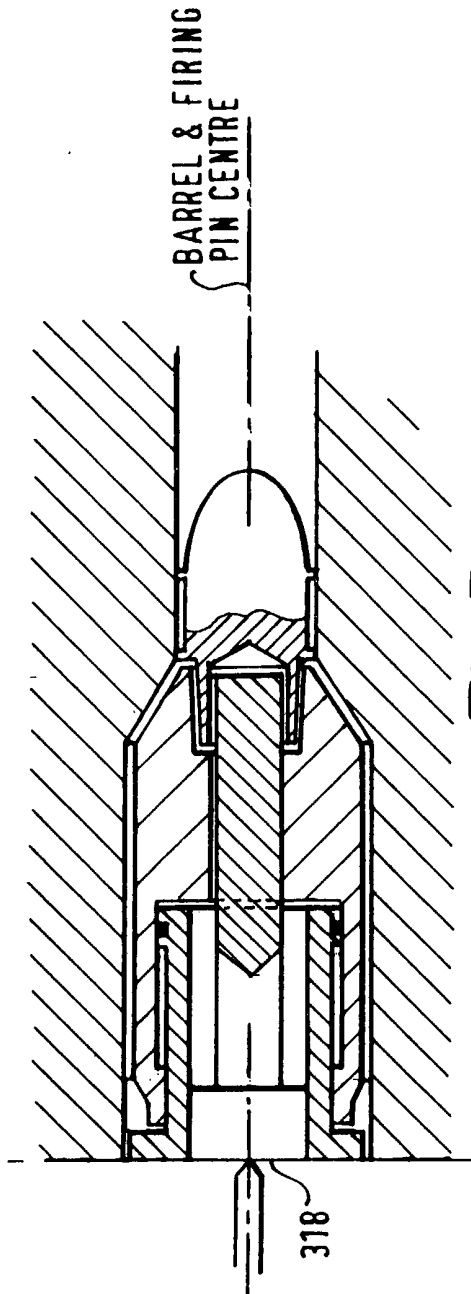


Fig. 5.

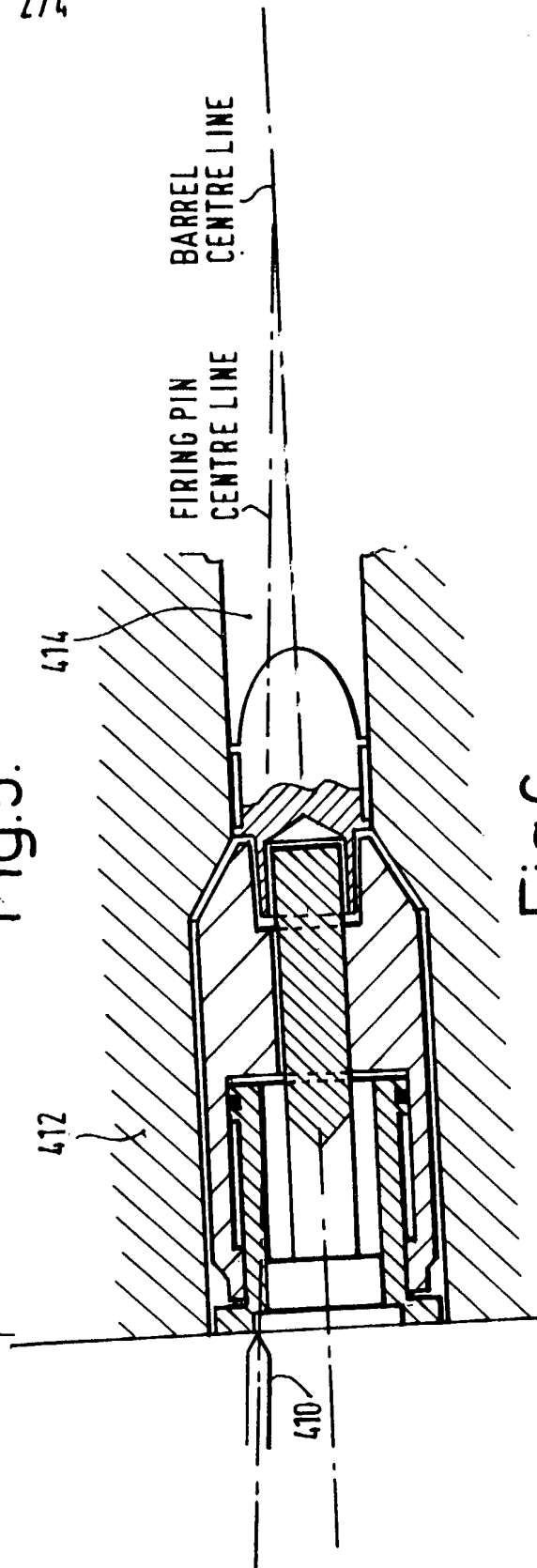


Fig. 6.

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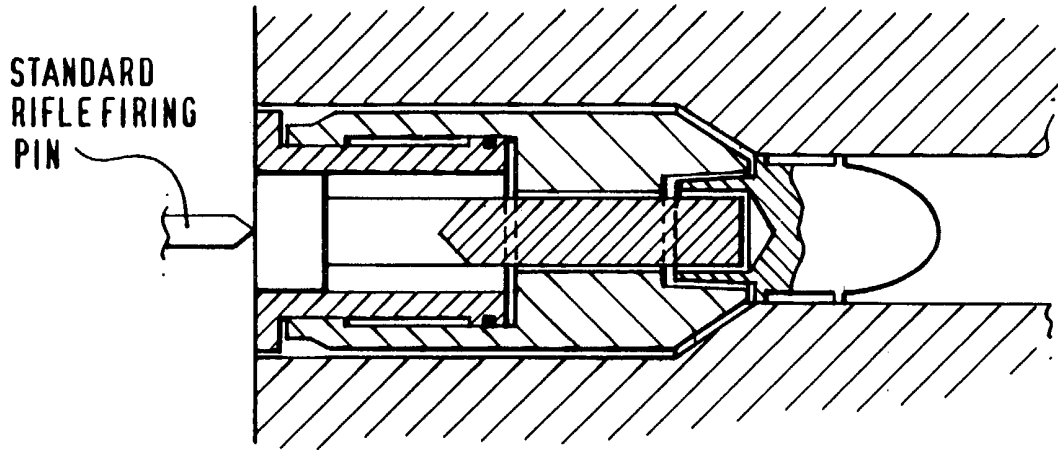


Fig.7.

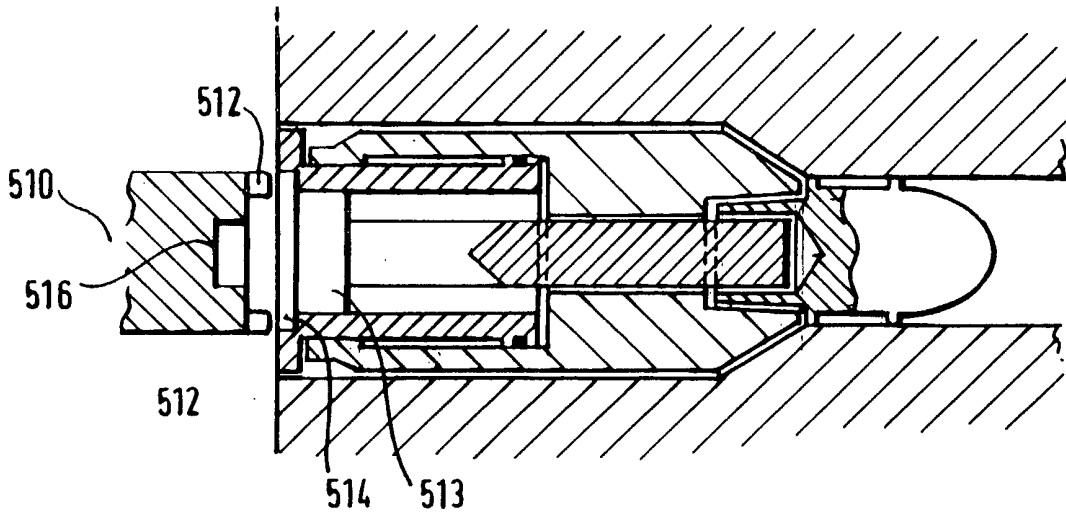


Fig.8.

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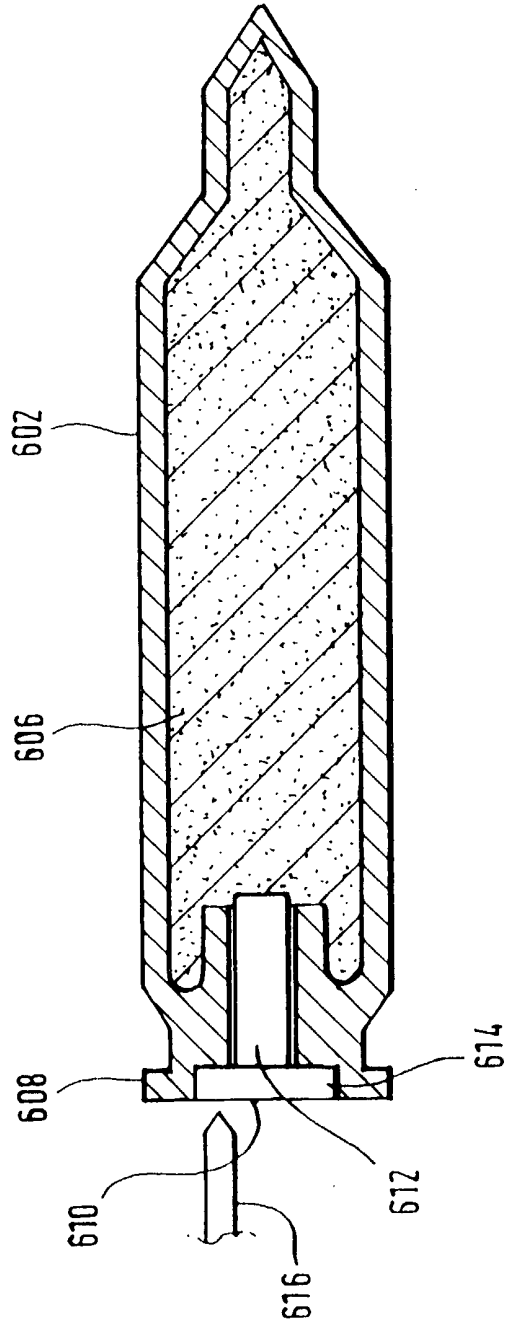


Fig.9.

INTERNATIONAL SEARCH REPORT

International Application No

PC1/GB 01/00515

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 F42B8/02 F42B8/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 F42B F41A

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 144 064 A (DYNAMIT NOBEL) 5 March 1969 (1969-03-05) page 4, line 75-96 figure 2	1,2,11
Y	---	3
Y	WO 98 41810 A (SAXBY MICHAEL ERNEST ;DEFENSE TECHNOLOGY CORP OF AME (US)) 24 September 1998 (1998-09-24) cited in the application abstract	3
X	US 4 442 777 A (GREENE EDWARD) 17 April 1984 (1984-04-17) claim 1 figures 1-8	1,7-10

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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
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- *&* document member of the same patent family

Date of the actual completion of the international search

16 May 2001

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/00515

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 377 924 A (BOWMAN E W) 18 July 1990 (1990-07-18) abstract figures 3,4 -----	5,6,11
A	US 3 598 053 A (GLATER IRVING W) 10 August 1971 (1971-08-10) abstract; figures 1,2 -----	10

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Information on patent family members

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