Nov. 11, 1969 I. R. BARR 3,477,374

FIXED PRIMER SET-BACK CARTRIDGE

Filed April 11, 1968 2 Sheets-Sheet 1

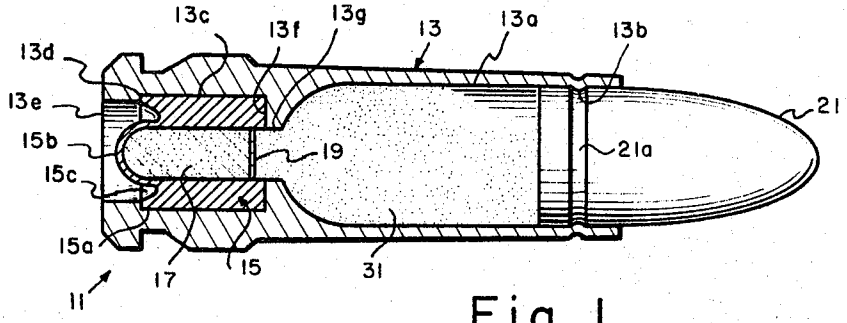

Fig. 1

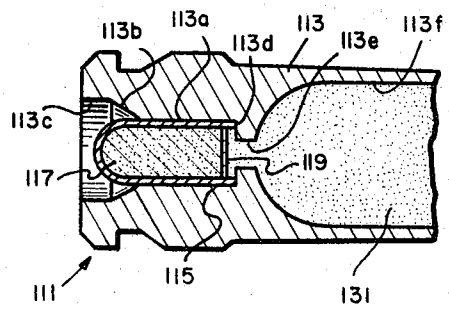

Fig. 5

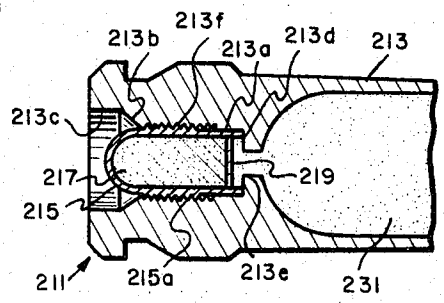

Fig. 6

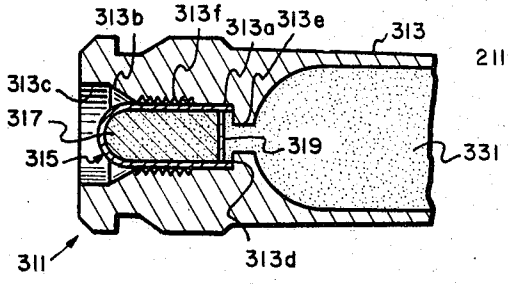

Fig. 7

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FIXED PRIMER SET-BACK CARTRIDGE

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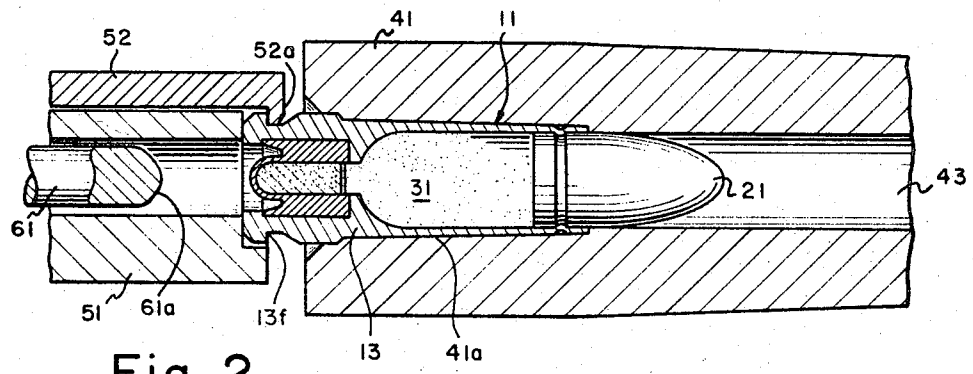

Fig. 2

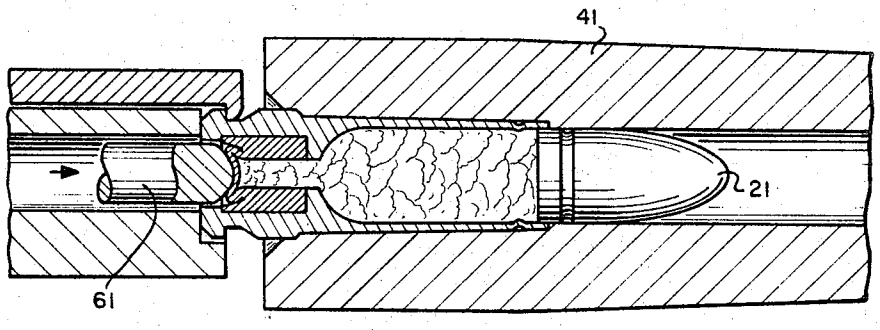

Fig. 3

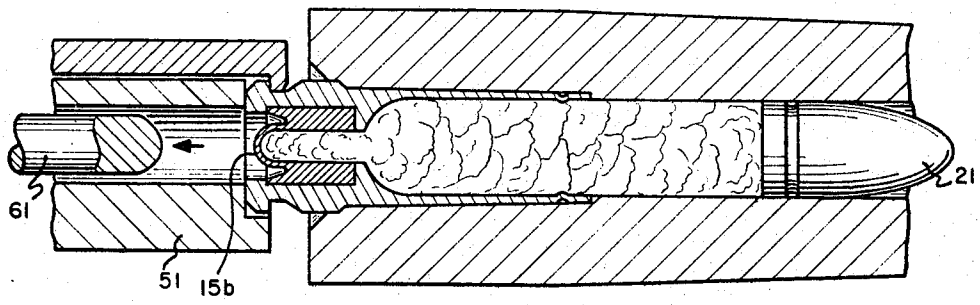

Fig. 4

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FIXED PRIMER SET-BACK CARTRIDGE

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U.S. Cl. 102—45 8 Claims

ABSTRACT OF THE DISCLOSURE

A cartridge is disclosed having a single-unit primer fixedly disposed in the base portion of a propellant containing cartridge casing for use in automatic and semi-automatic firearms which operate on the principle of primer set-back. The primer is open toward the interior of the cartridge casing and has a rearwardly protruding cup-shaped piston portion containing a primer charge that is adapted to be deformed into a circumferential rim anvil upon being struck by the head of a firing pin to ignite the primer charge contained therein and fire the propellant contained in the cartridge casing to create a high propellant gas pressure which in turn causes the piston portion to expand rearwardly and drive the firing pin backward.

This invention relates to cartridges of the primer set-back or piston-primer type.

In automatic, or semi-automatic firearms utilizing primer set-back cartridges for operation, a cartridge may be chambered in the barrel, and when the firing pin of the firearm strikes the primer in a forward stroke, a primer charge ignites which, in turn, ignites a propellant to create a high gas pressure that propels a projectile forward from the cartridge casing and through the barrel. In addition, the high gas pressure causes the primer to impart energy to the firing pin and drives it backward in a return stroke which operates the breech mechanism to extract the spent cartridge casing, cock the firearm and chamber another cartridge.

To obtain the most effective operation of a primer set-back arrangement, it is necessary to use a cartridge which maximizes the amount of energy the primer imparts to the firing pin of the firearm during the return stroke. This can best be done by avoiding energy losses resulting from the friction between the primer and the cartridge casing, e.g. is inherent in a cartridge of the type utilizing a movable primer to drive a firing pin backward in a return stroke, while at the same time preventing the propellant gas from leaking rearward of the primer which would substantially reduce the differential gas pressure exerted on the primer and which is particularly a problem in cartridges utilizing a movable primer which necessitates the use of some type of movable gas seal. Furthermore, it is desirable to prevent the primer from being blown out the base of the cartridge because the resulting sharp reduction of the propellant gas pressure would substantially reduce the velocity of the projectile and hence affect the range and accuracy of the weapon. In addition, it is desirable that the primer be constructed of as few parts as possible to facilitate the manufacture of the cartridge and reduce the production costs.

Accordingly, it is a feature of the present invention to provide a cartridge of the primer set-back type wherein energy losses due to the friction between the primer and the cartridge casing are avoided while efficiently translating propellant gas pressure action into a rearward driving force on the primer; thereby enabling a maximum driving force to be imparted to the firing pin of the firearm during the return stroke.

It is another feature of the present invention to provide a primer which engages the cartridge casing in a manner that prevents the rearward leakage of the high pressure propellant gas to further maximize the amount of force exerted on the piston primer and also prevents the primer from being blown out the base of the cartridge by the propellant gas force.

It is a further feature of the present invention to provide a primer having a simple, compact and unitary construction to facilitate the manufacture of the cartridge and reduce the production costs.

In accordance with the present invention a cartridge casing is provided containing a propellant and having a bore formed in the base with a single unit primer fixedly disposed therein which opens toward the interior of the casing and contains a primer mixture adapted to be ignited to fire the propellant contained in the casing. The primer has a rearwardly protruding cub-shaped piston portion that is adapted to be deformed into a circumferential rim anvil to ignite the primer charge contained therein and subsequently expand rearwardly.

When the head of the firing pin strikes the base of the rearwardly protruding cup-shaped primer at the end of a forward stroke, the piston portion is deformed into a circumferential rim anvil that is crushed to ignite the primer charge, which in turn fires the propellant to create a high gas pressure that propels the projectile from the cartridge while at the same time causes the piston portion to expand rearwardly and drive the firing pin back in a return stroke. Due to the tight gas-sealing fit of the primer in the cartridge which prevents the propellant gas from leaking rearward of the primer and the lack of any loss of energy due to friction between the primer and the cartridge casing, the rearward expansion piston portion of the primer drives the firing pin backward in a return stroke and transfers a maximum amount of energy to operate the breech mechanism, extract the spent cartridge, cock the firearm, and chamber another cartridge.

Still other objects, features and attendant advantages will become apparent to those skilled in the art from a reading of the following detailed description of several physical embodiments constructed in accordance with the present invention, taken in conjunction with the accompanying drawings wherein:

FIG. 1 shows a longitudinal cutaway view of a cartridge according to the invention.

FIG. 2 shows the cartridge of FIG. 1 inserted in the chamber of a firearm with a bolt engaging the base of the cartridge and having a firing pin in the ready position.

FIG. 3 is a view similar to FIG. 2 showing the firing pin shortly after striking the base of the primer and igniting the propellant to provide the projectile-propelling high gas pressure.

FIG. 4 is a view similar to FIGS. 2 and 3 showing the base of the cartridge casing and the primer is fixedly disby the propellant gas pressure to force the firing pin backward in the return stroke.

FIG. 5 illustrates a second embodiment according to the invention wherein a conical recess is formed in the base of the cartridge casing and the primer is fixedly disposed in the cartridge casing by the friction resulting from the radial expansion caused by the high pressure propellant.

FIG. 6 illustrates a third embodiment according to the invention wherein a conical recess is formed in the base of the cartridge casing and the primer is fixedly disposed in the cartridge casing by screw threads.

FIG. 7 illustrates a fourth embodiment according to the invention wherein a conical recess is formed in the

base of the cartridge casing and the primer is fixedly disposed therein by friction and radial deformation into annular grooves formed in the cartridge casing caused by the high pressure propellant.

Referring now in detail to the figures of the drawings, in FIG. 1 is shown a cartridge suitable for use in a firearm which is operated on the primer set-back and energy transfer principle. The cartridge, generally indicated at **11**, includes a casing, generally indicated at **13**, containing a single-unit piston primer, generally indicated at **15**, a projectile **21**, and a propellant **31** disposed between the piston primer **15** and the projectile **21**. In the forward portion of the cartridge casing **13** is formed a propellant-containing cavity **13***a* which is adapted to securely grip an annualr groove **21***a* of the projectile **21** by means of an annular indentation **13***b*. In the base of the cartridge casing **13** is formed a cylindrical recess **13***c* which is connected by means of an annular shoulder **13***d* to a bore **13***e* which opens to the rear of the cartridge casing **13**. The cylindrical recess is also connected by means of an annular shoulder **13***f* to a cylindrical port **13***g* which opens to the propellant-containing cavity **13***a* in the forward portion of the cartridge casing **13**.

Disposed inside the cylindrical recess **13***c* is a single-unit piston primer **15** having a relatively thick tubular wall **15***a* with an outer diameter and length that engages the interior diameter and the forward and rearward annular shoulders **13***f* and **13***d* in a tight gas-sealing fit to prevent any rearward propellant gas leakage while also fixedly maintaining the longitudinal position of the primer **15** in the base of the cartridge casing. The single-unit cup-shaped piston primer **15** is open towards the interior of the cartridge casing and contains a primer mixture **17** which is separated from the propellant **31** by only a thin, easily frangible and preferably combustible moisture seal **19** of suitable material such as a coating of wax or Krylon. While the moisture seal **19** is not absolutely required for functional operation, it is desirable to aid against malfunction due to undesired moisture absorption by the primer mixture which, for example, might occur during assembly of the cartridge.

At the reaward end of the tubular wall is formed a conical recess or annular beveled shoulder **15***b* that tapers inwardly to a rearwardly protruding cup-shaped piston or base portion **15***c* relatively thinner and more easily deformable than the tubular walls. Upon being struck by the head of a firing pin, the cup-shaped piston portion **15***c* is adapted to be deformed and pressed against the wall of the conical recess **15***b* which serves as an effective circumferential anvil and, in conjunction with the firing pin, provides a tight fitting internal chamber seal to prevent the relatively thin-walled piston portion **15***c* from being laterally ruptured by the high gas pressure resulting from the ignition of the propellant **31**.

In FIGS. 2–4 is illustrated the operation of the cartridge **11** shown in FIG. 1. In FIG. 2, the cartridge **11** is shown inserted in a chamber **41***a* of a conventional barrel **41** having a bore **43** with a bolt **51***a* pressed against the base of the cartridge casing **13** and having extractor fingers **51***a* engaging an extractor groove **13***f* formed in the rear of the cartridge casing **13**. Disposed inside the bolt **51** is a firing **61** having a head **61***a* for striking the base of the readily deformable rearwardly protruding cup-shaped piston portion **15***c* of the primer **15** to cause ignition of the primer charge **17** to fire the propellant **31**.

In FIG. 3 is shown the head **61***a* of the firing pin **61** striking the base **15***c* of the piston portion of the cup-shaped primer **15** at the end of a forward stroke. The rearwardly protruding piston portion **15***c* is crushed and pressed against the wall of the conical recess **15***b* formed at the rearward end of the tubular wall portion of the primer **15** which effectively serves as a circumferential rim anvil thereby igniting the primer charge. In addition, the head **61***a* of the firing pin **61** and the wall of the inwardly tapering conical recess co-act to provide a seal which prevents any lateral rupture of the relatively thin-walled piston portion **15***c* of the cup-shaped primer **15**. The ignition of the primer charge **17** fires the propellant **31** which generates a high gas pressure that propels the projectile **21** forward away from the cartridge casing **13**. Leakage of the high pressure propellant rearward through the bore **13***c* in the base of the cartridge **11** is prevented by the tight gas-sealing fit by which the primer **15** is disposed inside the cylindrical recess **13***c* in the base of the cartridge casing **13**.

As the high pressure gas propels the projectile **21** forward through the barrel **41**, it also exerts a pressure throughout the interior of the primer **15** and causes the relatively thin and easily deformable piston **15***c* to expand rearwardly into a semispherical shape as shown in FIG. 4. The rearward motion of the expansion of the cup-shaped piston portion **15***c* drives the firing pin **61** backward in a return stroke to operate the breech mechanism and/or other components of the firearm.

In FIG. 5 is shown another embodiment of a cartridge **11** suitable for use in a firearm employing the primer set-back and energy transfer principle. In this embodiment, generally indicated at **111**, a bore **113***a* is formed in the base of the cartridge casing **113**, which is connected by an annular beveled shoulder **113***b* which serves as a conical recess to a coaxial and larger diameter bore **113***c* which opens to the rear of the cartridge casing **113**. The smaller diameter bore **113***a* is also connected by means of an annular shoulder **113***d* to a cylindrical port **113***e*, which opens to a propellant-containing cavity **113***f* in the forward portion of the cartridge casing **113**. Disposed inside the smaller diameter bore **113***a* in a tight interference fit and protruding rearwardly into the conical recess **113***b* and the large diameter bore **113***c* is a cup-shaped piston primer generally indicated at **115** which is open at the forward end and engages the forward annular shoulder **113***d*. Compacted inside the cup-shaped piston primer **115** is a primer charge **117** which is separated from a propellant **131** contained in the forward portion of the cartridge casing **113** by only a thin, easily frangible, preferably combustible moisture seal **119** of suitable material such as wax or Krylon.

Upon being struck by the head of a firing pin at the end of a forward stroke, the rearwardly protruding cup-shaped base portion of the primer **115** is adapted to be inwardly deformed and pressed against the annular beveled shoulder **113***b* which forms the inwardly tapering conical recess and serves as a circumferential anvil, thereby igniting the primer charge **117** which in turn fires the propellant **131** contained in the cavity in the forward portion of the cartridge casing **113** to create a high pressure gas that propels a projectile forward while at the same time effecting a rearward expansion and energy transfer motion of the cup-shaped piston portion **115** as hereinbefore described in relation to the cartridge shown in FIG. 1. The primar **115** is retained in the base of the cartridge casing **113** by the friction between the primer **115** and the small diameter bore **113***a* resulting from radial expansion of the wall of the primer **115** caused by the high pressure propellant.

In FIG. 6 is shown still another embodiment of a cartridge suitable for use in a firearm employing the primer set-back and energy transfer principle. In this embodiment, generally indicated at **211**, a bore **213***a* is formed in the base of a cartridge casing **213**, which is connected by an annular beveled shoulder **213***b* which serves as a conical recess to a coaxial and larger diameter bore **213***c* which opens to the rear of the cartridge casing. The smaller diameter bore **213***a* is also connected by means of an annular shoulder **213***d* to a cylindrical port **213***e* which opens to a propellant-containing cavity in the forward portion of the cartridge casing **213**. Screw threads **213***f* are formed in the small diameter bore **213***a* which extend longitudinally throughout a portion of the length

of the bore from the rearward end thereof. Disposed inside the smaller diameter bore **213***a* and protruding rearwardly into the larger diameter bore **213***c* is a cup-shaped piston primer **215** having screw threads **215***a* formed on the exterior surface throughout part of its longitudinal length which engage the threads **213***f* of the small diameter bore **213***a* and which is open at the forward end and engages the forward annular shoulder **213***d*. Compacted inside the cup-shaped piston primer **215** is a primer charge **217** which is separated from a propellant **231** contained in the forward portion of the cartridge casing **213** by only a thin, easily frangible, preferably combustible moisture seal **219** of suitable material such as wax or Krylon.

Upon being struck by the head of a firing pin at the end of a forward stroke, the rearwardly protruding cup-shaped base portion **215** is inwardly deformed and pressed against the annular beveled shoulder **213***b* which forms an inwardly tapering conical recess and serves as a circumferential anvil thereby igniting the primer charge **217** which in turn fires the propellant **231** contained in the interior of the cartridge casing **213** to create a high pressure gas that propels a projectile forward from the cartridge **211** while at the same time effecting a rearward expansion and energy transfer motion of the readily deformable cup-shaped piston portion **215** as hereinbefore described in relation to the cartridge shown in FIG. 1. The primer **215** is retained in the small diameter bore **213***a* by the screw threads **215***a* and **213***f* in addition to the friction between the primer **215** and the small diameter bore **213***a* resulting from the radial expansion of the wall of the primer **215** caused by the high pressure propellant.

In FIG. 7 is shown a further embodiment of a cartridge suitable for use in a firearm employing the primer setback and energy transfer principle. In this embodiment, generally indicated at **311**, a bore **311***a* is formed in the base of a cartridge casing **313**, which is connected by an annular beveled shoulder **313***b* which serves as a conical recess to a coaxial and large diameter bore **313***c* which opens to the rear of the cartridge casing. The small diameter bore **313***a* is also connected by means of an annular shoulder **313***d* to a cylindrical port **313***e* which opens to a propellant-containing cavity in the forward portion of the cartridge casing **313**. Screw threads or annular grooves **313***f* are formed in the small diameter bore **313***a* which extend longitudinally throughout a portion of the length of the bore. Disposed inside the smaller diameter bore **313***a* and protruding rearwardly into the larger diameter bore **313***c* is a cup-shaped piston primer, generally indicated at **315**, which is open at the forward end and engages the forward annular shoulder **313***d*. Compacted inside the cup-shaped piston primer **315** is a primer charge **317** which is separated from a propellant **331** contained in the forward portion of the cartridge case **313** by only a thin, easily frangible, preferably combustible, moisture seal **319**, of suitable material such as wax or Krylon.

Upon being struck by the head of a firing pin at the end of a forward stroke, the rearwardly protruding cup-shaped base portion **315** is inwardly deformed and pressed against the annular beveled shoulder **313***b* which forms an inwardly tapering conical recess and serves as a circumferential anvil, thereby igniting the primer charge **317**, which in turn fires the propellant **331** contained in the interior of the cartridge casing **313** to create a high gas pressure that propels the projectile forward while at the same time effecting a rearward expansion and energy transfer motion of the deformable cup-shaped piston portion **313** as hereinbefore described in relation to the cartridge shown in FIG. 1. The primer **315** is retained in the base of the cartridge casing **313** by the radial expansion of the primer wall due to the high pressure propellant which deforms the primer wall against the screw threads **313***f* to form interfitting screw threads in addition to causing friction between the primer **315** and the small diameter bore **313***a*.

That which is claimed is:

1. In a cartridge of the primer set-back type including a casing having an open forward end with a projectile fastened therein containing a propellant and having a bore formed in the base portion with a piston primer disposed therein and having a piston portion adapted for longitudinal movement along the axis thereof, the improvement comprising:

a cup-shaped piston primer containing a primer mixture and being fixedly disposed in said bore and having a forward end open towards the propellant contained in the cartridge casing and a rearwardly extending base portion adapted to be deformed into a circumferential rim anvil and pressed against the wall of a conical recess upon being struck by the head of a firing pin to ignite the primer mixture contained therein and fire the propellant to create a high gas pressure and effect a rearward expansion of the cup-shaped piston base portion to drive the firing pin rearwardly in the opposite direction.

2. In a cartridge of the primer set-back type according to claim **1**, comprising:

said conical recess being formed in the base portion of said cartridge casing coaxially with the bore formed therein.

3. In a cartridge of the primer set-back type according to claim **2**, further comprising:

a first screw thread being formed partially throughout the longitudinal extent of the bore formed in the base of said casing, and

a second screw thread being formed on the exterior surface of the piston primer and adapted to engage said first screw thread formed in the bore in the base of said casing to enable the piston primer to be fixedly disposed in the bore of the base of said casing.

4. In a cartridge of the primer set-back type according to claim **2**, further comprising:

said cup-shaped piston portion having a tubular wall adapted to engage the bore formed in the base of said casing in a light interference fit and adapted to expand radially upon ignition of the primer mixture and propellant to create a sufficient frictional force between the exterior tubular wall of the primer and the bore in the casing to fixedly maintain the primer in the base of the casing.

5. In a cartridge of the primer set-back type according to claim **1**, wherein:

said cup-shaped piston portion has a tubular wall adapted to engage the bore formed in the base of said casing in a light interference fit and adapted to expand radially upon ignition of the primer mixture and propellant to create a sufficient frictional force between the exterior tubular wall of the primer and the bore in the casing to fixedly maintain the primer in the base of the casing.

6. In a cartridge of the primer set-back type according to claim **1**, comprising:

screw threads being formed partially throughout the longitudinal extent of the bore formed in the base of said casing, and

screw threads being formed on the exterior surface of the piston primer and adapted to engage the screw threads formed in the bore in the base of said casing to enable the piston primer to be fixedly disposed in the bore of the base of said casing.

7. In a cartridge of the primer set-back type according to claim **1**, comprising:

a cylindrical recess formed in the base of said casing coaxially with the bore formed therein, and

said primer having a tubular wall portion relatively thicker than the rearwardly protruding cup-shaped piston portion and adapted to be disposed in a gas-sealing interference fit in the cylindrical recess formed in the base of said casing.

8. In a cartridge of the primer set-back type according to claim 7, further comprising:

a conical recess formed in the rearward end of the tubular wall portion of said primer coaxially with the rearwardly protruding cup-shaped piston portion to provide a wall against which the cup-shaped piston portion may be pressed to ignite the primer mixture contained therein.

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