United States Patent

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[54] **LASER IGNITION SYSTEM FOR FIREARMS**
9 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **42/84**
[51] **Int. Cl.** **F41c 19/12**
[50] **Field of Search** ..... 42/84; 89/28 R, 28 C, 135; 102/70.2

[56] **References Cited**

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ABSTRACT: A laser assembly is mounted on a firearm so as to direct a laser beam through an optical system to an explosive charge contained within the chamber of said firearm. The beam may be directed to the explosive through the side of a shell or through a plastic window inserted in the end of the shell in place of the usual primer. The trigger of the firearm connects the laser assembly to a source of electrical energy to actuate the laser so that a beam of energy is discharged therefrom.

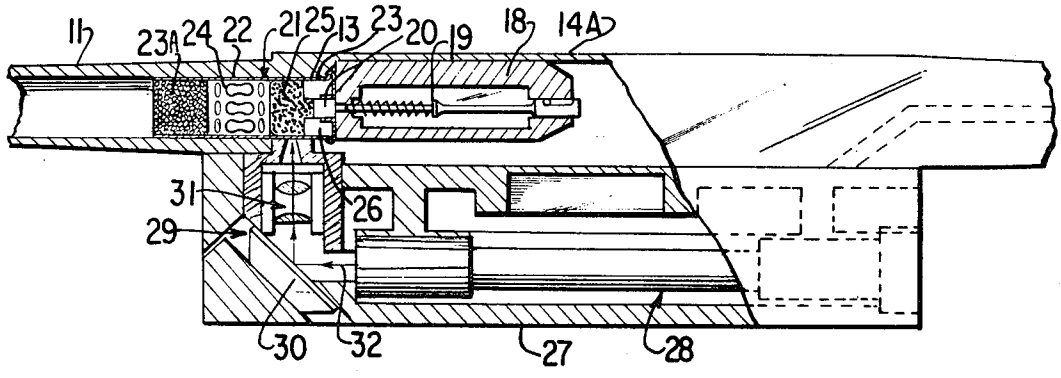


FIG. 1

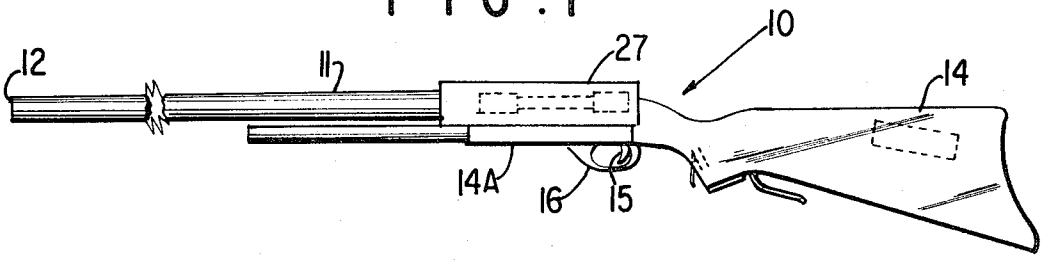


FIG. 2

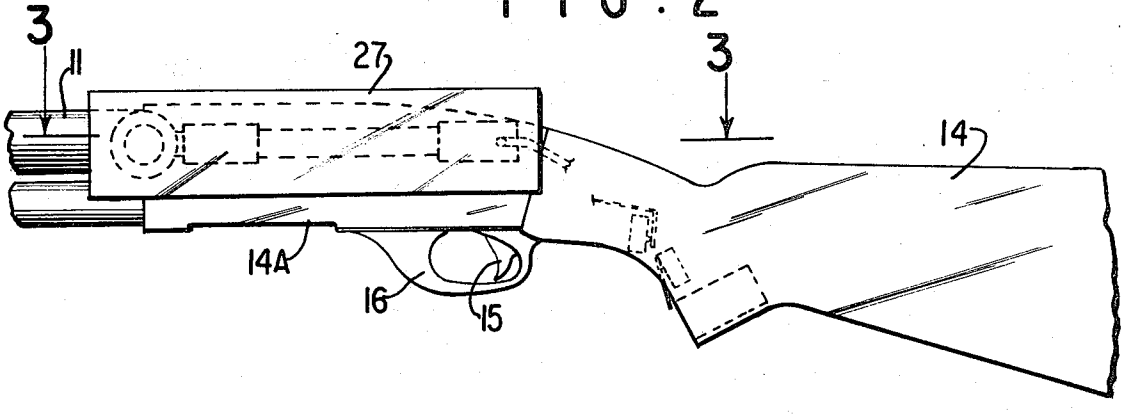
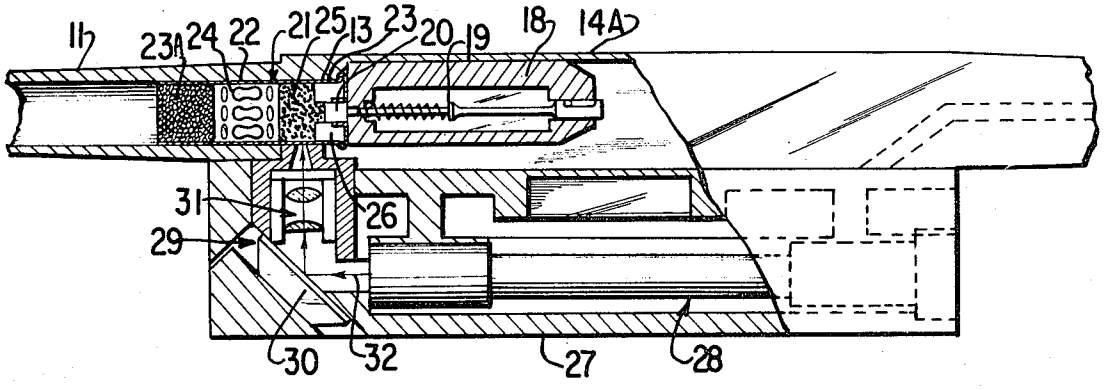


FIG. 3



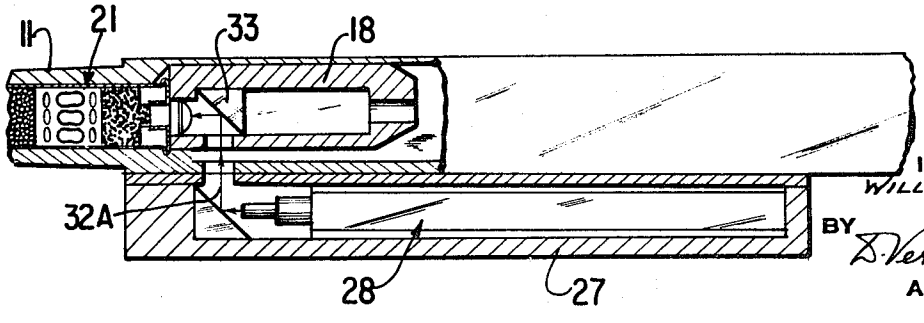


FIG. 4

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FIG. 5

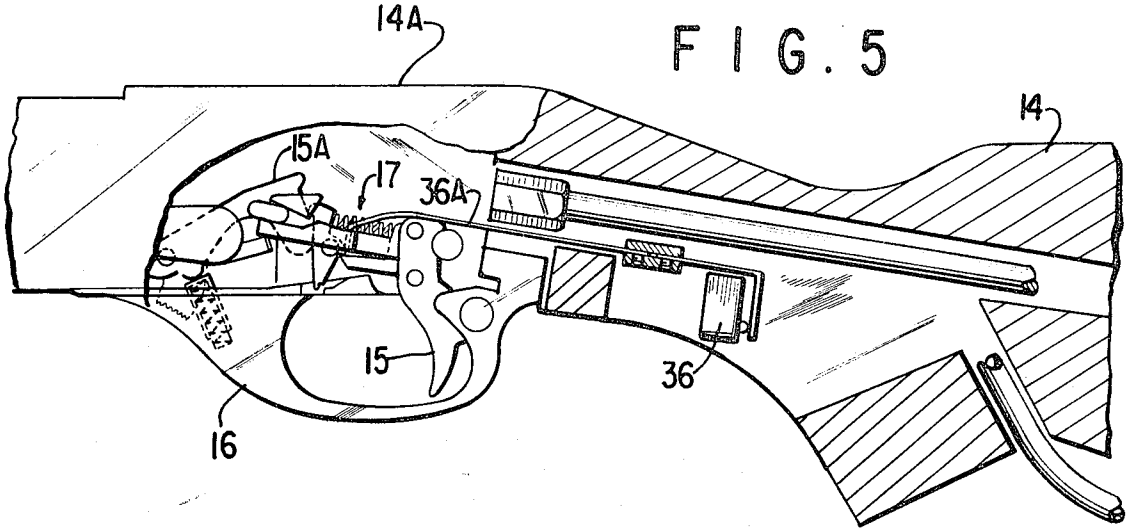


FIG. 6

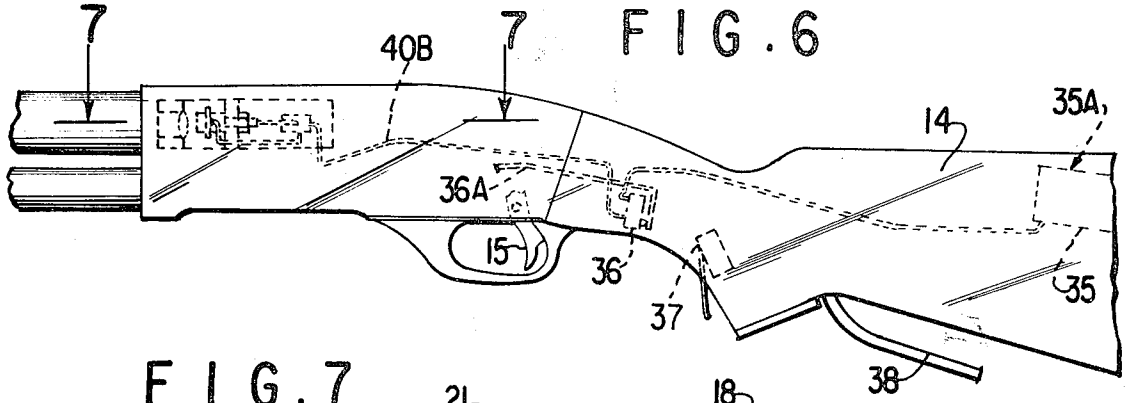
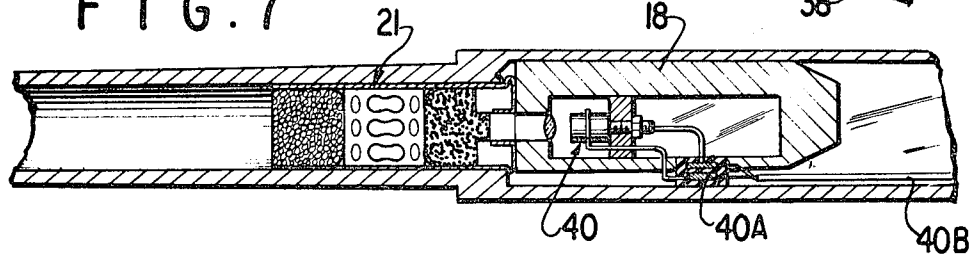


FIG. 7



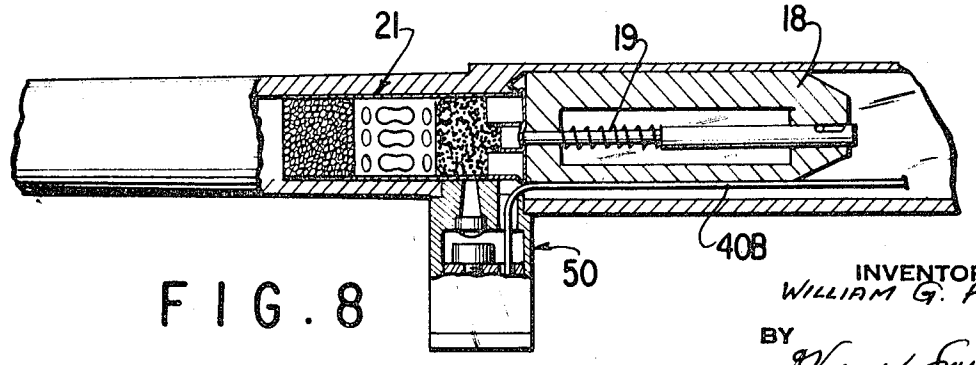


FIG. 8

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LASER IGNITION SYSTEM FOR FIREARMS

This invention relates to firearms and particularly to the use of a laser therein.

A gun or firearm is a form of weapon from which a missile or projectile is projected by force obtained from the ignition and combustion of an explosive chemical termed the propellant. The propellant is contained within a cartridge or shell case which also holds the projectile or shot. The cartridge is positioned in the chamber located at one end of the barrel and then fired by causing a firing pin to strike the base or rim of the cartridge or shell. The firing pin is mechanically connected through a suitable sear mechanism to the trigger. In larger guns, such as cannon, the trigger is replaced by other firing mechanisms. In all such constructions of guns there must be a direct mechanical contact with the primer in the cartridge in order to set off the explosive charge therein.

While the trigger and sear mechanism connected to the firing pin mechanism has been significantly improved over the years, the basic concepts of firing cartridges have remained the same for many years.

One of the objects of the present invention is to provide a laser ignition system for guns.

Another object of the present invention is to provide an arrangement for firing cartridges in guns without mechanical contact with the cartridge during the ignition and burning process.

Still another object of the present invention is to provide a simplified trigger system for guns by eliminating the firing pin.

The high intensity and the coherence property of a laser's output radiation is utilized by this invention to provide the electromagnetic energy concentration necessary for the ignition of chemical compounds used as propellants in ammunition of all types. Propellants in the solid, liquid, or gaseous state can be ignited by focusing the laser radiation to an intensity greater than that of the source. This may be accomplished with a simple optical system, and it is well known that this increase in intensity is not possible with incoherent sources such as the tungsten filament light source. Emission from a laser source is called coherent because all elements of its emitting surface reach their maximum intensities at the same time and therefore are in phase both spatially and temporarily. The size of the spot to which the laser's radiation can be focused by a simple lens is equal to the product of the divergence of the laser's output beam and the focal length of the lens. Thus, if a laser emitted 1,000 watts from 1 square millimeter and with a divergence of 1/1,000 of a radian, a 25 mm. focal length lens would focus this radiation to an intensity of approximately 1 million watts per square millimeter. To apply this radiation for the ignition of both primary and secondary explosives requires a transmitting medium to the location of the explosive within the shell and a means for focusing the radiation to a high intensity at the explosive's surface. Shell casings made of materials such as polyethylene are transparent to many laser wavelengths and allow the laser output to be focused through the casing at any convenient point for igniting the explosive. Shell casings made of opaque materials can be adapted for laser ignition by incorporating a window of optically transparent material at a convenient point on the casing. Caseless types of ammunition may also be fired in this manner by locating an optical transparent window in the wall of the shell chamber at the location of the explosive. An obvious requirement for the explosives to be ignited by laser is that they be somewhat absorbent to the laser's wavelength of radiation. In cases where it is not, absorption can be increased by the addition of opaque material.

According to one aspect of the present invention, there is disclosed a firearm and means for discharging a cartridge having an explosive charge therein. The firearm may comprise a means for receiving a cartridge having an explosive charge. A laser assembly is mounted on the firearm and the output radiation from the laser assembly is optically coupled to the explosive charge in the cartridge which is positioned within a cartridge which is positioned within a cartridge-receiving means such as the chamber. Further means are provided on the firearm for actuating the laser assembly so as to generate selectively a beam therefrom to fire the cartridge as desired.

Other objects, advantages, and features of the present invention will be apparent from the accompanying description and drawings, which are merely exemplary.

In the drawings:

FIG. 1 is a side elevational view of a shotgun incorporating the present invention;

FIG. 2 is a side elevational view but in enlarged scale of a portion of the shotgun in FIG. 1 showing the laser assembly mounted thereon;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2;

FIG. 4 is a view similar to that of FIG. 3 but showing a modification wherein a laser ignition system acts upon the end of a cartridge;

FIG. 5 is a side elevational view of a portion of a gun incorporating the present invention with a portion cut away to show the trigger mechanism for use in the modification shown in FIGS. 1 to 3, inclusive;

FIG. 6 is a side elevational view of a modification showing a portion of a shotgun incorporating a laser ignition system positioned at the end of a cartridge;

FIG. 7 is a sectional view taken along the line 7—7 of FIG. 6; and

FIG. 8 is a view similar to that of FIG. 7 but showing a modified side ignition system.

Proceeding next to the drawings wherein like reference symbols indicate the same parts throughout the various views a specific embodiment and modification of the present invention will be described in detail.

In FIGS. 1 to 4, inclusive, there is indicated generally at 10 a shotgun having a barrel 11 with a muzzle 12 and a breech or chamber 13 (FIG. 3) with the barrel being mounted upon a stock 14 through receiver or housing 14A. The shotgun has a conventional trigger system comprising a trigger 15 within a trigger guard 16, hammer 15A, the trigger operating a sear mechanism indicated generally at 17 to release the hammer. One example of such a trigger mechanism is seen in U.S. Pat. No. 2,719,375. In the form shown in FIG. 3 using side ignition, breech bolt or block 18 has mounted therein a firing pin 19 which, when struck by a conventional firing mechanism as shown in FIG. 5, can strike a primer 20 carried in a shotgun cartridge 21.

The illustrated cartridge 21 comprises a plastic casing or body 22 mounted upon a base 23. Within the casing is shot 23A, an overpowder wad 24, an explosive charge 25, and a base wad 26. When the cartridge is to be used in a shotgun having the laser ignition system according to the present invention, the primer 20 can be replaced by a dummy primer or a plastic window of a material transparent to the wavelength of the laser being used, such as optically clear epoxy resins, "Plexiglas," a trademark of Rohm & Haas Co. for its synthetic resinous sheets, , and "Lexan," a trademark of General Electric Co. for its polycarbonate resin. The plastic must be of sufficient strength to contain the pressures involved.

Mounted on the side of the gun is a housing 27 in which is mounted a laser assembly 28 which may comprise a neodymium glass laser made by the American Optical Company of Southbridge, Mass. under the trademark "Uni-Laser Mark II." This particular laser assembly is of a small compact size, relatively low in cost, and has a high output, but it is to be understood other laser assemblies having similar characteristics can be employed in this invention. The laser used for demonstrating the principle of this invention is a neodymium doped glass laser made by the American Optical Company under the trademark Uni-Laser Mark II. It is a laser device, incorporating the laser rod, flashlamp, and reflector in a head only three-fourths inch in diameter by 6% inches length and putting out 1 joule in a 3 mm. beam at a 1.06-micron wavelength.

Referring to FIG. 3, the housing 27 can be made of Lexan and is provided with an optical system at its forward end indicated at 29 comprising a 45° mirror 30 and a lens system 31

for directing a laser beam 32 against the plastic side of the cartridge 21. It has been found that the polyethylene casing of a conventional plastic shot shell cartridge readily admits laser radiation having a wavelength of about 1.06 microns. The color of the casing has no apparent effect on the transmission of the laser beam.

Since the original firing pin mechanism of the shotgun was not disturbed by modification for laser ignition, cartridges or shells with dummy primers can be used for laser ignition. The side firing system as illustrated in FIG. 3 is advantageous because of its simplicity and because it permits operation of the shotgun with regular ammunition using percussion primer ignition as well as ignition by the laser.

In the modification of FIG. 4, there is shown an end laser ignition system where the firing pin is removed from breech bolt 18 and is replaced by a 45° mirror 33 to reflect the laser beam 32A against the end of the cartridge 21. For end ignition, the cartridges must be modified by replacing the primer with a plastic window which has optical characteristics which will permit transmission of the laser beam.

FIG. 5 shows a conventional trigger mechanism which is connected to laser firing switch 36 for use in conjunction with side-firing laser arrangements. Switch 36 is operable by trigger 15 through rod or connector 36A upon pulling the trigger.

In the form shown in FIG. 6, a powerpack 35A for providing the necessary current to operate the laser is mounted in the gun stock 14 and includes a flash tube trigger transformer 35, a firing switch 36 and a charging switch 37. In this embodiment, if desired, power from an outside source may be obtained through a powerline 38. The charging switch 37 is closed to clear all circuits for firing and the actual firing occurs when the firing switch 36 is closed by pulling the trigger 15. The firing switch is operated by spring wire coupling 36A through the trigger mechanism.

In FIG. 7, there is disclosed a modification wherein a compact laser assembly indicated generally at 40 is mounted within the breech block and acts directly against the end of the cartridge 21 to provide an end laser ignition system. Contactors 40A must register due to the bolt 18 being in locked position before the laser can be actuated. Wire 40B leads to the switch 36.

In the modification of FIG. 8, the laser assembly indicated generally at 50 is mounted on the side of the gun and acts directly against the side of the cartridge 21 to provide a side laser ignition system.

Thus, it can be seen that the present invention discloses a laser ignition system for guns which eliminates any mechanical contact between the ignition system and the cartridge to be fired. Further, the trigger mechanism is simplified since the firing pin is not necessary. The relatively small size of the laser assembly and powerpack enables these structures to be mounted within the gun stock.

It will be understood that various details of construction and arrangement of parts may be made without departing from the spirit of the invention.

What is claimed is:

1. In a firearm for discharging a shell having a propellant charge therein, the combination of means for receiving a shell having said propellant charge therein, a laser assembly mounted on said firearm, and means on said firearm for optically coupling the output radiation of said laser assembly to the charge in said shell within said means for receiving said shell, said means for optically coupling the radiation also being of sufficient strength to contain the pressure involved in said firearm when said shell is fired.

2. In a firearm as claimed in claim 1 and comprising means on said firearm for actuating said laser assembly to generate a shell-receiving

3. In a firearm as claimed in claim 1 wherein the firearm is a gun having a barrel and a stock with said shell receiving means being in the stock end of said barrel.

4. In a firearm as claimed in claim 3 and comprising a trigger for connecting said laser assembly to a source of electrical energy to actuate the laser.

5. In a firearm as claimed in claim 4 wherein said source of electrical energy is self-contained and mounted within the stock.

6. In a firearm for discharging a shell having a propellant charge therein, the combination of a barrel and stock, means for receiving a shell in the stock end of the barrel, said shell having said propellant charge therein, a laser assembly in a housing mounted on the side of said firearm, and means on said firearm for optically coupling the output radiation of said laser assembly to the charge in said shell within said means for receiving said shell.

7. In a firearm as claimed in claim 6 and an optical system between said housing and said shell-receiving means for directing a laser beam onto a side of a shell within said receiving means.

8. In a firearm as claimed in claim 6 and an optical system between said housing and said shell-receiving means for directing a laser beam against the base end of a shell within said receiving means.

9. In a firearm as claimed in claim 7 wherein the shell has wadding at the base end of the shell and there is a lateral opening positioned immediately above the wadding within the base end of the shell.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,631,623 Dated January 4, 1972

Inventor(s) William G. Platt

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, lines 73 and 74, delete "which is positioned within a cartridge". Column 4, line 19, "shell-receiving" should be --beam therefrom.--.

Signed and sealed this 23rd day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
★ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334

UNITED STATES PATENT OFFICE

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