

FORENSIC FIREARM IDENTIFICATION OF AN INGENIOUSLY MODIFIED AIR RIFLE-FIREARM

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ABSTRACT

Introduction: A conventional spring-piston based air rifle is designed to propel metal pellets. By making certain alterations and modifications, the standard, legal weapon can be transformed into an illegal weapon, and it can be used in different crimes. **Aim:** We report an interesting firearm case, related to a convertible weapon, particularly one which can be operated both as an air gun and as a firearm with some alterations. A .22" caliber break-barrel, spring powered air rifle was ingeniously modified to an illegal firearm by the accused for hunting purposes. The air rifle was illegally converted by altering its chamber diameter to load .22" rimfire cartridges and by incorporating a movable metallic round plunger bolt as a firing pin. **Methodology:** The chemical analysis and work testing of the submitted weapon was successfully carried out. This type of modified weapon allowed the successful test firing of .22" rimfire cartridges. **Results:** Forensic firearm identification revealed that the .22" rimfire cartridge cases recovered from the scene of crime had been fired from the submitted weapon. **Conclusion:** In this study, an interesting case has been presented, wherein a .22" caliber air rifle was modified to chamber and fire .22" rimfire cartridges by altering the chamber diameter. Laboratory examination and microscopic comparison revealed that the evidence cartridge cases had been fired from the modified air rifle-firearm.

Keywords: Firearms identification, convertible air rifle-firearm, movable metallic bolt, rimfire firing pin

INTRODUCTION

In different countries there are different legal restrictions regarding the possession, use and purchase of air guns and firearms (Nay RL, 1990). Moreover, regulations also vary for different calibers, muzzle energies and velocities, and nature of ammunition materials. Firearms designed to discharge powder-driven cartridges are more strictly controlled than are air rifles and air guns. Though air guns are significantly less powerful than firearms, they can be deadly, and are therefore nowadays regulated. Air guns can be lethal, as they can inflict serious and fatal injuries (Veenstra M. et al., 2015; Krystin M. et al., 2018; Naude G., and Bongard F., 1996; Christoffel K. et al., 1984; DeCou J. et al., 2000, Radhakrishnan J. et al., 1996 and Spitz L., 1969). Grievous injuries or even deaths have been frequently reported following accidental or intentional use of air guns (Beaver B. et al., 1990; Lawrence H., 1990; Ceylan H., 2002). Nowadays, air guns have been more frequently used in different criminal activities and wildlife

hunting practices (Benjamin M. and Sarah M., 2019; Green G. and Good R., 1982; Milroy C. et al., 1998; Simon G. et al., 2019; Sharma G. and Mendiratta U., 2023;). Air guns have gained popularity as they are commercially available and can be legally held without license under certain specific conditions. The manufacture, use and sale of air weapons in India are subjected to the Arms Regulations 2016 (Government of India, Gazette, 2016). However, prior to this regulation being enacted, there was no regulatory framework for manufacturing, control and distribution of air weapons in India.

Post-Independence, hunting has been prohibited by the Govt. of India under the Wildlife (Protection) Act, 1972, except for certain specified purposes.

A conventional spring-piston based air rifle is designed to propel metal pellets. Its compressed gas-powered assembly provides pressurized air, and its trigger on actuation causes pressurized air-venting, fluidly connecting to the

chamber of the weapon, which propels the metal pellet through the bore and out of the muzzle of the barrel. Nevertheless, making certain alterations / modifications to any standard, legal weapon can transform that weapon into an illegal one that can result in prosecution. These weapons can be improvised using basic tools and materials that are often readily available. The locally made or improvised weapons are commonly used in criminal cases. The reason is that these weapons can be easily available and cheap. On the other hand, getting licensed firearm is difficult task in India.

In this paper, we present a case wherein a standard caliber air rifle was converted to an illegal firearm by the accused for hunting a black buck (*Antilope cervicapra*) known as Indian Antelope. A .22" caliber air rifle was modified so as to discharge relatively high powered rimfire cartridge of the same caliber. To the best of our knowledge, such type of convertible air gun-firearm has not been reported in literature to date.

Prima facie, it appeared that the submitted weapon was a .22" caliber air rifle, but further evaluation was needed in order to ascertain if that was actually the case. Therefore, the objective of forensic casework was to evaluate whether the air rifle-firearm is capable of discharging .22" rimfire cartridges during commission of the crime.

CASE REPORT

The investigating range forest officer submitted the following Exhibits to the Forensic Science Laboratory that comprised of a modified air rifle-firearm (Exhibit 1, **fig. 1**), five intact .22" rimfire cartridges (Exhibit 2) as well as two rimfire cartridge cases (Exhibits 3 & 4) recovered at the scene of offence in connection to hunting of a black buck.

It was therefore necessary to examine and identify these evidence cartridge cases to ascertain whether they were or were not fired from the submitted weapon.

For a comparative evaluation of the physical dimensions of submitted weapon, a .22" caliber

air rifle model: MOD 1 HP 35B (1 HP National Air rifle, Made in India) was used as a reference weapon. A comparison microscope (Reichert Inc, U.S.A.) was used for cartridge case identification, whereas a digital camera (Canon EOS 550D, Japan) was used for photographing the images.

Experimental:

Preliminary Examination

Initially, the submitted air weapon was checked for the presence of all its necessary action components and physical dimensions were measured and noted. The comparative data is given in **Table 1**. It was then checked to confirm whether a .22" rimfire cartridge can be accommodated in the chamber of the said weapon and it was found to chamber satisfactorily.

Observations

During preliminary examination, it was observed that the submitted air weapon had undergone some modifications as follows:

i) It was obvious that a chamber that is designed for housing a .22" metal pellet would probably not be the optimal configuration for use with a .22" rimfire cartridge. The chamber dimensions had been altered internally so as to chamber powder-driven .22" rimfire cartridges.

ii) A movable metallic round plunger bolt was found axially positioned in between the compressed air assembly and the chamber of weapon (in inset **fig. 1**). The exit air orifice (i.e., transfer port) of the compressed air assembly was modified so as to precisely fit this movable metallic round plunger bolt. When fired, the force of compressed air displaces the movable metallic round plunger bolt along its moving path, which causes the forward edge of the said bolt to act as the rimfire firing pin striking against the rim of the cartridge. The forward edge of the said bolt has a raised, wedge-shaped surface that upon striking crushes the base's rim against the edge of the barrel breech, sparking the primer compound within the rim, and in turn igniting the propellant within the case. This impact produces a notch (firing pin impression) at the edge of the casing.



Figure 1: Improved .22" air rifle

Table 1: Physical parameters of standard air rifle and improvised air rifle

Physical parameters	Standard .22" Air Rifle (cm)	Improved .22" Air Rifle (cm)
Total length	114	112.5
Length of barrel	48.4	48.4
Diameter of muzzle end	0.50	0.50
Thickness of muzzle end	0.52	0.52
Diameter of breech end	0.55	0.55
Thickness breech end	0.62	0.62
Length of Detachable firing pin	NA	1.96
Diameter of Detachable firing pin tip	NA	0.20

NA-Not applicable

Chemical Examination

Residues of fired ammunition-nitrite were detected in the barrel washings of the weapon, which indicated that the weapon was used for firing prior to its receipt in the laboratory. Similarly, residues of fired ammunition-nitrite were detected in the cartridge case washings, which indicated that the evidence cartridge cases had been fired prior to their receipts in the laboratory.

Test firing

The work testing of weapon was successfully performed in an indoor shooting range. There were no obvious issues observed with its functioning. Randomly selected two .22" rimfire cartridges were successfully test fired through the said weapon. Test firing revealed that the submitted air weapon had been modified to chamber and discharge .22" rimfire cartridge.

RESULTS AND DISCUSSION

Firearm examination revealed that a .22" caliber air rifle was converted to an illegal firearm by altering the chamber diameter and by using a movable metallic bolt as firing pin, so as to

facilitate firing of powder-driven .22" rimfire cartridges.

The firing pin impression on the percussion cap of fired cartridge case is important evidence to potentially link the weapon with the crime. The significance of firing pin impression is well recognized and is helpful in linking weapon with the crime (Sharma B., 1963; Valentina M. et al., 2020). The unique identifying part of the firearm is the firing pin. Every fired cartridge case bears an indentation mark when a firing pin hits its percussion cap. The depth of this firing pin indentation is never constant since every stroke on the firing pin varies in force and direction. However, the firing pin has its unique microscopic individualities that are impressed on the percussion cap. Therefore, examination and microscopic comparison of evidence cartridge case with the test-fired cartridge case would help to ascertain whether it was / was not fired from the submitted weapon.

As previously mentioned in section 3.4., test-firing of two .22" rimfire cartridges was carried out through the submitted weapon. As can

be seen in **fig. 2**, a notch at the edge of the rim of the test-fired cartridge case (LHS) was formed due to the impact of front edge of the movable metallic round plunger bolt serving as firing pin. The test-fired cartridge case was then microscopically compared with the evidence cartridge cases. A notch at the edge of the rim of evidence cartridge cases was similar in appearance with that on the test-fired cartridge case. **Fig. 2** represents the microscopic image of test-fired cartridge case (on LHS) for comparison with that of evidence cartridge case (on RHS). The microscopic overlay image of the firing pin impression observed on the test-fired and evidence cartridge case is given in **fig. 3**.

The characteristic features of firing pin impression in the form of a notch observed on the evidence cartridge cases matched with those on the test-fired cartridge (examined under



Figure 2: .22" test fired cartridge (Lt) and exhibit (Rt)

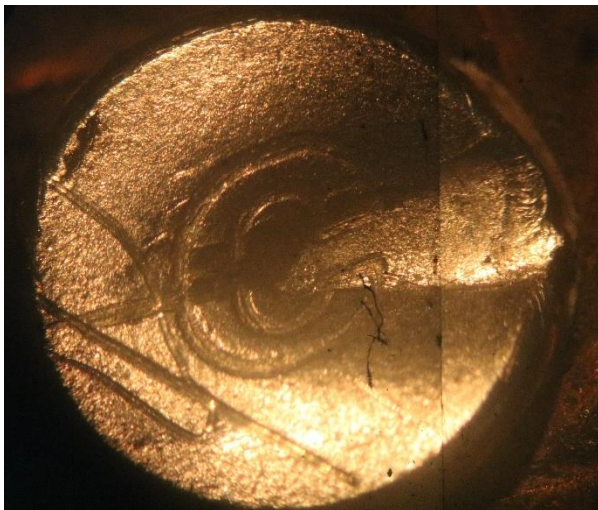


Figure 3: Firing pin impression match on test fired cartridge (Lt) with exhibit (Rt)

comparison microscope), which revealed that the evidence cartridge cases had been fired from the weapon under question.

Firing Mechanism of Modified Air Rifle-Firearm

A different type of weapon modification involved alteration in the firing mechanism. The kinetic energy imparted to the movable metallic round plunger bolt utilized the dynamics of compressed air. The compressed air assembly within a .22" caliber air rifle generates air pressure of about 1250-1600 psi, which is adequate to push the movable metallic plunger bolt forward. When fired, the driving force of compressed air throws the movable metallic plunger bolt forward along its moving path, forcing its forward edge to act as a firing pin to impact against the circumferential rim of chambered .22" rimfire cartridge, which activates the .22" rimfire cartridge thus firing the weapon. The schematic diagram of modified air rifle-firearm action is given in **fig. 4**.

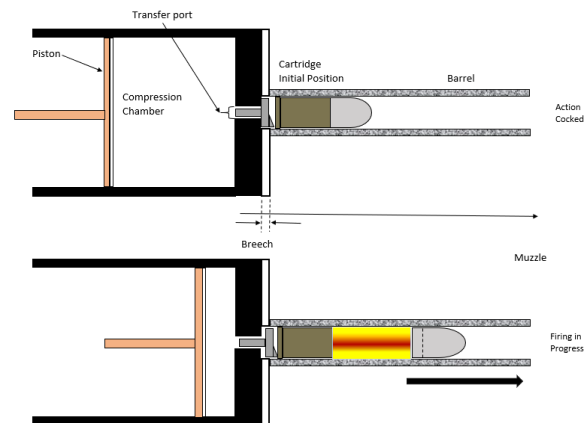


Figure 4: Firing mechanism of improvised .22" air rifle

CONCLUSIONS

An interesting casework has been presented, wherein a .22" caliber air rifle was indigenously modified by the accused, so as to chamber and fire .22" rimfire cartridges. By altering the chamber diameter and by incorporating a movable metallic round plunger bolt as rimfire firing pin, the .22" caliber air rifle was converted to an illegal firearm so as to facilitate firing of powder-driven .22" rimfire cartridges. Examination and microscopic comparison of evidence cartridge cases with the

test-fired cartridge case revealed that the evidence cartridge cases had been fired from the modified air rifle-firearm.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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