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# Fabrication and Analysis Of Air Machine Gun

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***Abstract*— In recent years air guns have become popular among the people for hunting and other outdoor games. Air guns represent the oldest pneumatic technology. In this project, it is planned to build up a new model motor powered air machine gun, as the existing air gun is usually single targeted and single triggered, once it is shot, the probability of hitting the target is meager and the next shot is possible only after few seconds of reloading. These issues are considered as a problem statement in this project because the mobile target will escape, if the first shot is missed. The proposed air machine gun can be used for multiple shots. This will give additional advantage while hunting, as multiple bullets can be triggered simultaneously or individually depending on the target either with more power or with accuracy. Considering the latter, if the target escapes from the first shot, the next pellet can be immediately shot to hit the target without reloading. On the other hand, machine guns that are used in defense are powered with fire powder that can cause huge air pollution at the time of war. The proposed air machine gun will cause no pollution to the environment. The main challenge now is the weight of the gun as electric motor is fitted to the gun and the power of the drive. This problem makes the gun semi portable as power source is required, where the gun is to be used**

## I. INTRODUCTION

Air rifles have been the oldest form of pneumatic technology and many evolutionary changes have been made in the air rifle over the years. The first air gun ever designed in the year 1580s and now it is present in the Livrustkammaren Museum in Stockholm.

Later in the 17$^{th}$ century air guns with calibres where used for the purpose of hunting birds and these air rifles where charged by means of pump to fill the air reservoir. The power source for the air gun and air rifles are by means of spring piston, pneumatic and by means of carbon-di-oxide gas. The speed of the projectile or pellet rages from 650 to 1000 feet per second (200-300m/s).The most commonly used method for propelling the projectile or pellets by means of using a compressed air system or by means of using spring leaver mechanism. There are four major techniques used for launching the projectile with many variations based upon such techniques, (i) Using a stored compressed gas in the form of carbon-di-oxide cylinder or other high pressure storage tanks. (ii) Using a powerful spring to push the piston which compresses the air to pushes the projectile. (iii) Using a hand pump to pressurize the air for launching the projectile. (iv) A solenoid plunger or centrifugal force is used to hit the piston directly in order to launch the piston.

All of these methods have various disadvantages when compared to the present invention. Air gun is a variety of pneumatic weapon that propels projectiles by means of air or other gases. Air Machine Gun (AMG) works on the combination of both pneumatic pressure and electrical drive. Piston and electric motor are connected by means of crank shaft and connecting rod. **"Slider crank mechanism"** is used to make the piston slide inside the cylinder. Pellet will be feeded continuously with the help of a compressed open coil helical spring.

## II. SLIDER CRANK MECHANISM

The Slider-crank mechanism is used to transform rotational motion into translational motion by means of a rotating driving beam, a connection rod and a sliding body. In the present example, a flexible body is used for the connection rod. The sliding mass is not allowed to rotate and three revolute joints are used to connect the bodies. While each body has six degrees of freedom in space, the kinematical conditions lead to one degree of freedom for the whole system.

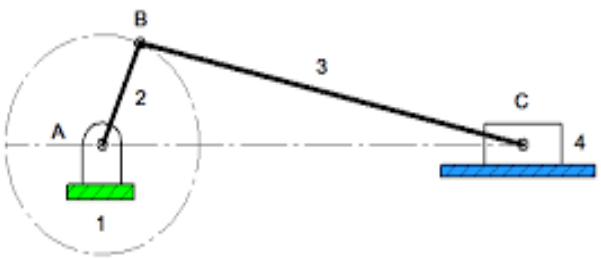



Fig 1: Slider Crank Mechanism

A slider crank mechanism converts circular motion of the crank into linear motion of the slider. In order for the crank to rotate fully the condition,

L> R+E

The above condition must be satisfied where R is the crank length, L is the length of the link connecting crank and slider and E is the offset of slider . A slider crank is a RRRP type of mechanism i.e. It has three revolute joints and 1 prismatic joint. The total distance covered by the slider between its two extreme positions is called the path length. Kinematic inversion of slier crank mechanisms produce ordinary an white work quick return mechanism.

*1. Crank*

Crank is a mechanical part used to convert reciprocrating motion and rotational motion. In a reciprocating piston, it translates rotational motion of the output shaft of an electric drive to the reciprocating motion of the piston. In order to do the conversion between two motions, the crankshaft has "crank throws" or "crankpins", additional bearing surfaces whose axis is offset from that of the crank, to which the "big ends" of the connecting rods from each cylinder attach.

Fig 2: Fabricated Crank

*2. Connecting Rod*

In a reciprocating, the connecting rod is used to connect the piston and the crank. Combined with the crank, it is used to covert the rotary motion to reciprocating motion. Connecting rods are commonly made from cast aluminum alloy and are designed to withstand dynamic stresses from combustion and piston movement.

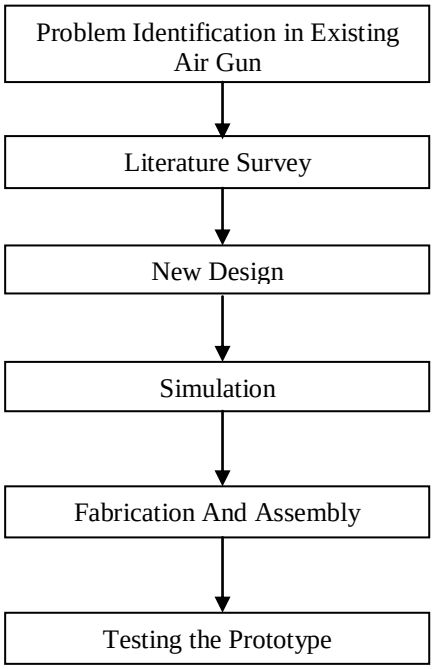
Fig 3: Fabricated Connecting Rod

*3. Piston*

Piston is the sliding member that compresses air inside the cylinder. It slides by the transformation of rotational motion from electric drive through crank and connecting rod.

Fig 4: Piston

## III. METHODOLOGY




## IV. MODELING AND DESIGNING OF COMPONENTS

*1. Base Model*

An existing air rifle from the market is taken as base model and several modifications were done in its design and it has

been converted to an Air Machine Gun (AMG). This base model is an spring powered air rifle.

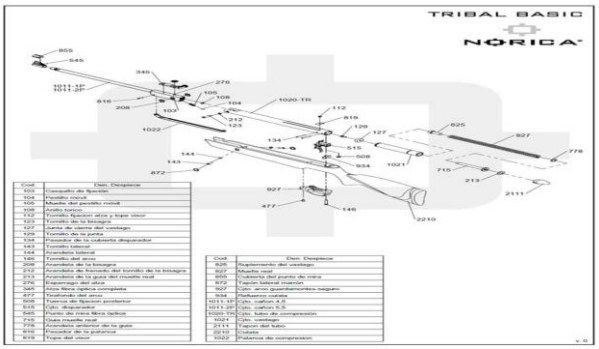



Fig 5: Base Model

*2. Designed CAD Model:*

Several parts such as barrel, cylinder and piston were taken from the base model and dimensions are determined from them after study. Dimensions for other parts such as crank, connecting rod, piston and electric motor are determined and the following CAD model has been generated by using solidworks software.

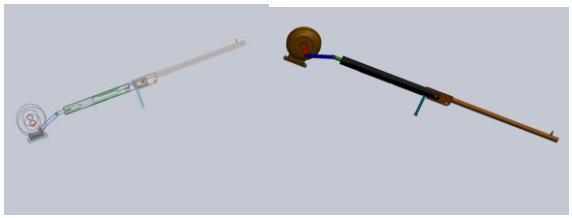


Fig 6: Final CAD Design

## V. FABRICATION ANFD ASSEMBLY

An existing air rifle has been dismantled completely and required parts such as barrel, cylinder and piston were taken. Electric motor and barrel were fitted to a wooden cardboard base as per the designed dimensions. Mild steel channels of rectangular cross section are used as clamping element. Mild steel channels are cut from stock as per required dimensions. These channels are inspected for straightness and the flatness of the edges was checked. This inspected channels are bent in the form of L clamps. These L clamps are drilled with holes on both sides to fix them with the base wood using nuts and bolts.

Fig 7: Clamps

Fig 8: Nuts, Bolts and Stock

A wooden handle provided with trigger in the form of switch is fitted to bottom side of cardboard base. Electrical lines are provided to drive the motor. Crank and connecting rod are made as per the designed dimensions and holes are drilled at their edges. One ends of the crank and connecting rod are connected by means of a copper rivet. The other end of the connecting is fitted to the piston with a copper rivet. Piston is inserted into the cylinder and other end of the crank is fitted to the output shaft of the motor with a gear to avoid slip. The total assembly in the base wood is fitted to the wooden handle with the help of bolts and nuts. Stoppers are provided on both side of the wooden handle to avoid rotation of wooden handle by means of screws. Holes are made in the barrel to provide pellet feeder in the form of pipe. Open coil helical springs are inserted into the pellet feeder followed by the pellets in order to feed pellets continuously.

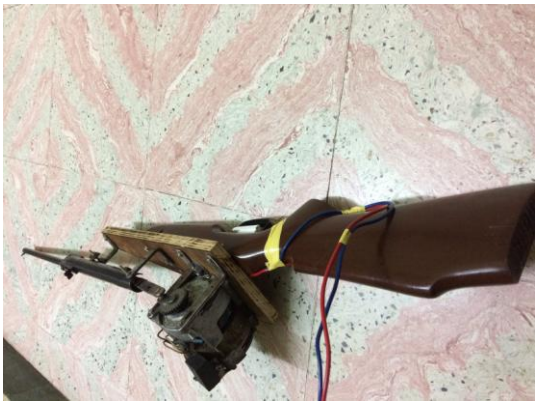


Fig 8: Air Machine Gun

## VI. ANALYSIS

After the final fabrication has been completed, it has been tested several times in order to determine its performance. It is found that, the gun fires one pellet for every second once it is triggered.

It was found that, the velocity of pellet was very less as compared with a normal spring powered air rifle. This is due to the time taken by the piston to compress the air.

It has been found that, the piston takes almost 0.5 seconds to compress the air inside the chamber. This is a very high number as compared with a normal air rifles available in the market.

## VII. RESULTS

The following results are obtained from this project,

- Continuous pellets can be fired from the gun without any re-loading.
- Impact of the pellet was found to be very less as compared with a normal air rifle due to higher stroke time.
- Impact and velocity of the pellet can be increased by increasing the speed of the electric drive.
- The weight of the prototype was found to be very high and it makes the gun difficult for transportation.
- Requirement of power source to drive the electric motor becomes as a major drawback while using gun.
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## *Acknowledgment*

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