HANDS ON LAB : ME 371 PROJECT

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THE BRAVO PRESENT ---> THE AIR GUN

A PROJECT BY-

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INTRODUCTION

This page demonstrates the functioning of a simple AIR-GUN of bore .22". It is simple yet a ingenious and effective weapon based on fundamental mechanics.The gun primarily employs a very stiff compression spring to transmit momentum to a light pellet.Here a very clever method of transmitting energy to the pellet is used-it is not by collision but using the dynamics of compressed air.

HISTORY

Early weapons had a reservoir of compressed air which, when suddenly released by a trigger, projected a single bullet or charge of shot with limited range and accuracy. During the 16th century a spring was substituted for the resevoir. The first reported use of such guns is in Nuxemberg in Germany around the year 1530. Later weapons were contructed on the older principle of a reservoir, but these use cylinders of compressed gas, usually carbondioxide.

To see a MUSEUM on air-pistols click on this www.airgunletter.net/amindex.html

SOME INTERESTING FACTS

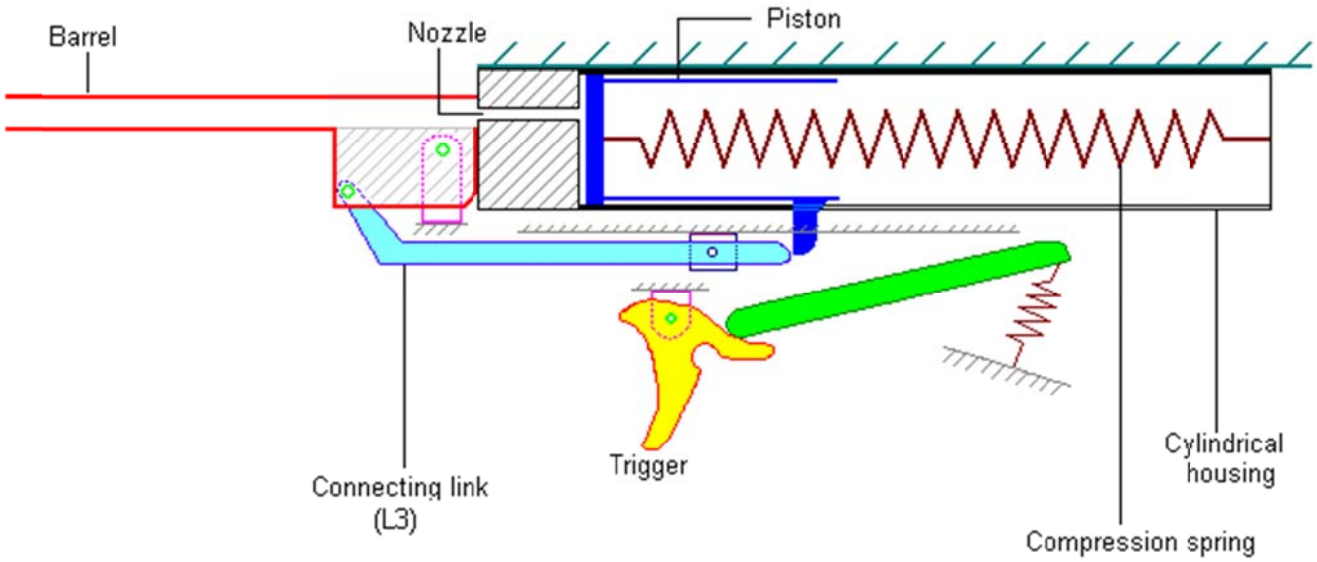
Most modern air guns are inexpensive BB guns (named for the size of the shot fired). The bestof these develop about half the muzzle velocity of light firearms, are accurate enough for marksmanship training at ranges up to 30m, and can kill small game. Darts with tranquillizing drugs may bge fired to immobilize animals for handling or capture. An air gun projectile is seldom carries beyond 90m.

COMPONENTS

The airgun under study is made of the following components:

i) Mainbody

This primarily consists of
a)The rear cylindircal housing where the actual mechanism takes place.
b)The Barrel which provides an initial guideway for the pellet.
c)The casing for the trigger cam.



ii) Spring

This is the backbone of the mechanism. The important parameters of the spring under study are:
Length(l)=114mm
spring diameter(D)=11.94mm
wire diameter(d)=2.36mm
no. of active coils=21

The above can be used to find the sping constant using the formula

$$k=Gd/8nc^3$$

Using the material of the spring as hard tempered steel (i.e.G=73.1GPa), we calculate

$$k=7.93KN/m$$

A more accurate value can be calculated eperimentally.A mass of 5 kg was suspended and the deflection of the spring was found to be 7mm. This gives us the value of

$$k=7KN/m.$$

iii)Piston

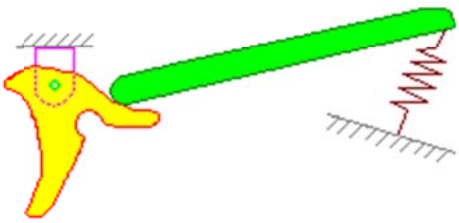
This serves the purpose of compressing the air. One end of the piston has a hook for locking the spring in the compressed state. The other end ahs a rubber washer(similar to the piston ring in a two-stroke engine) for prevent leakage of the air.

iv) Butt

This is basically to ease the holding of the gun. It is made of aluminium so that it has minimum weight.

v)Trigger

This basically consists of the tigger, a connecting rod and a spring as shown below.



The entire components are assembled to fire the PELLET. This weighs about .12 g and is hollow with a sharp forward end so that it experiences minimum drag in its passage through air.

MECHANISM

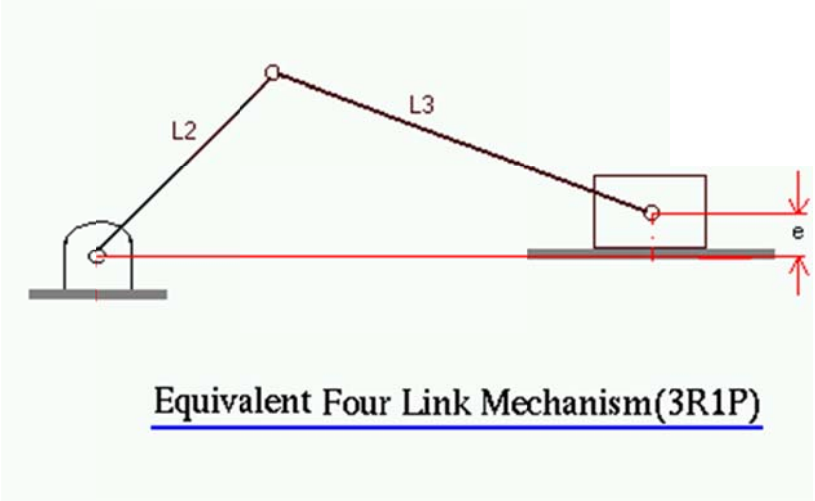
The working of the air gun can be understood to be in two parts viz..

(a) Loading

(b) Firing

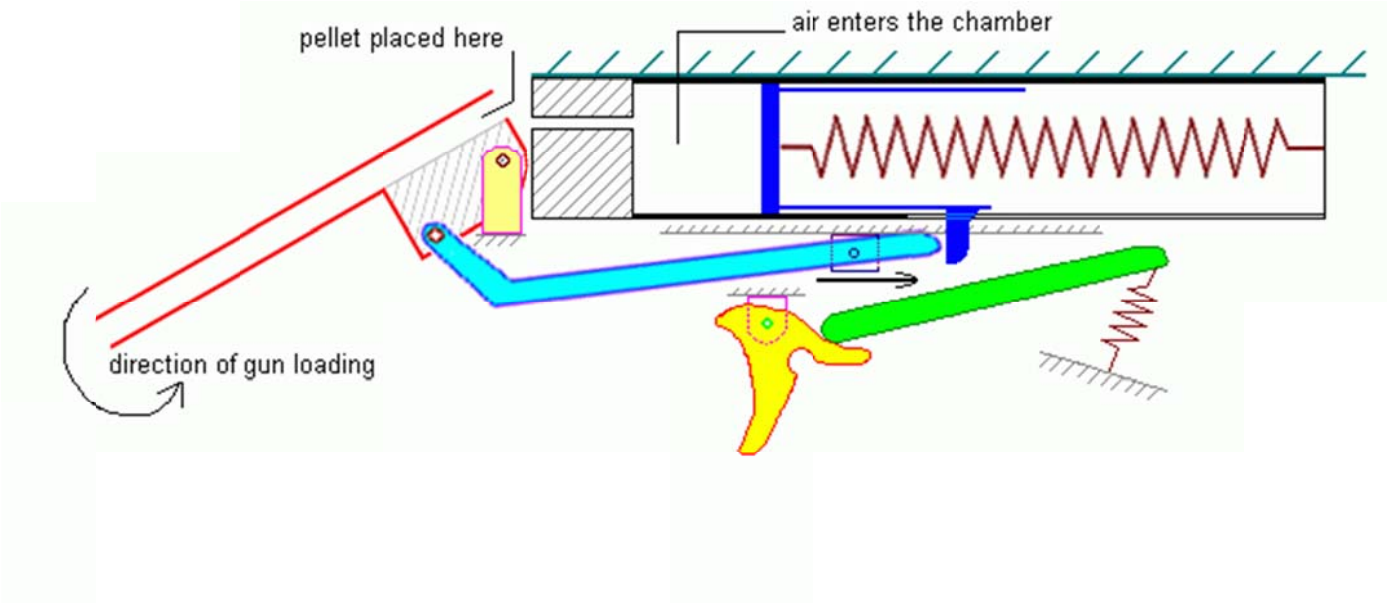
LOADING

The barrel of the gun is hinged to the cylindrical casing. The barrel is connected to the piston via a slider crank mechanism as shown

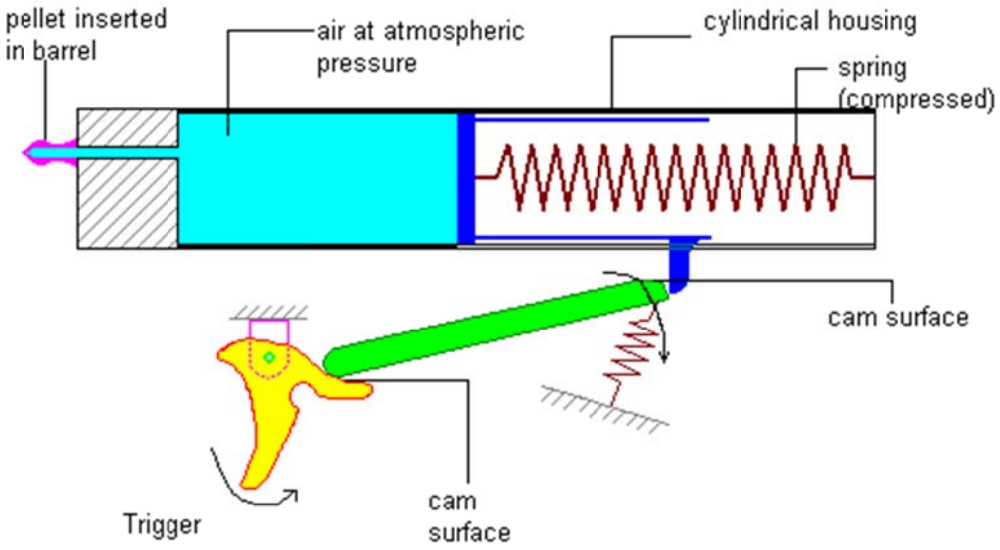


L2=50mm, FL3=10mm, e=10mm.

Thus on rotating the barrel about the hinge the piston moves which in turn compresses the spring.



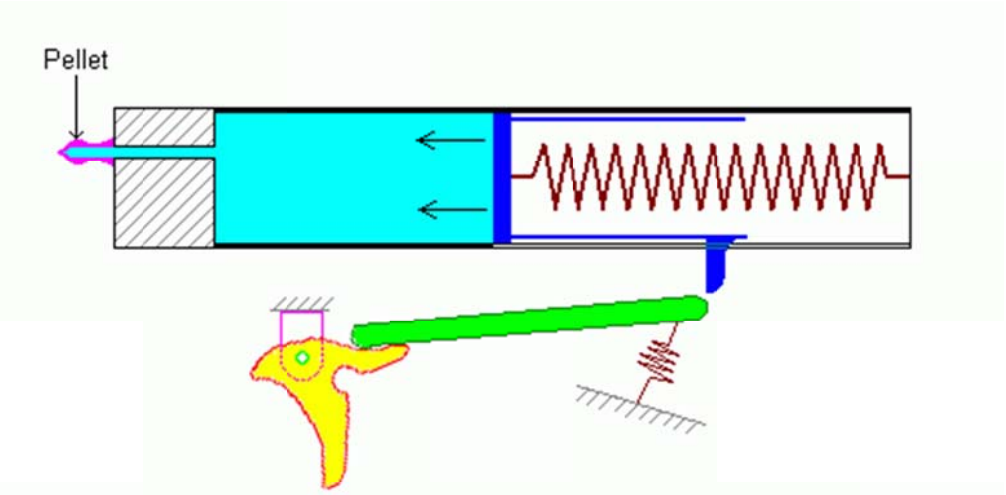
The trigger locks the piston with the spring in the compressed state in the manner shown below.



Gun in the loaded state

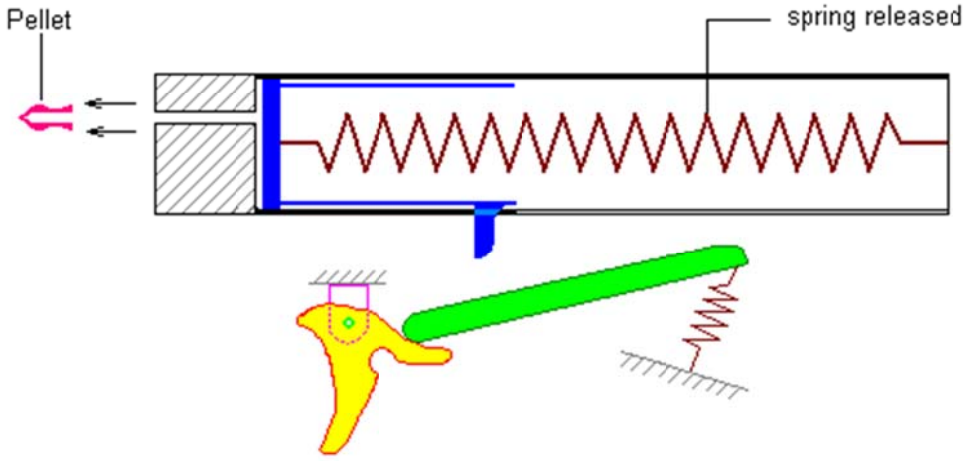
Now we have the spring in a compressed state attached to the piston finally we return the barrel to its initial position This is the loaded state of the gun

FIRING



On pressing the trigger the hook is released. The stored energy in the compressed spring pushes the piston forth.

Firing is done by pressing the trigger. When the trigger is pressed it releases the spring, thus actuating the springwhich compresses the air, which in turn drives the pellet through the bore or barrel of the gun.



The pellet is released by the escaping air.

This is the ***firing*** *of the gun*

SPEED OF THE PELLET
Speed of the pellet was experimentally measured using simple projectile method. Pellet was shot from a height H=1.5m & average range after repeated no. of trials was found to be R=15m. Now using the formula

V=R(g/2H)^1/2

On using g=9.8m/s^2 we found V=27 m/s(Usually speed is much higher but the found result was due to buckling of the spring)
Another very simple method to measure the speed of the pellet can be seen in

- VIEW SPEED

C7-53: AIR TRACK - SPEED OF AIR GUN PELLET

PURPOSE: To determine the speed of an air gun pellet using conservation of momentum in an inelastic collision.

DESCRIPTION: The pellet is shot into a receptacle mounted on an air track glider. Conservation of momentum in the ensuing totally inelastic collision allows determination of the velocity *v* with which the pellet was shot: $v = [(M+m)/m]\,V$, where *m* is the mass of the pellet, *M* is the mass of the glider/receptacle, and *V* is the measured velocity with which the glider leaves the collision. The speed of the glider is determined using a photocell gate timer. Compare this result with the result from the standard ballistic pendulum demonstration using the air gun pellet, Demonstration C7-51.

For adequate repeatability, pump the gun eight times. Be familiar with the safety mechanism, and know where the pellet exits the gun before firing.

SUGGESTIONS: BE CAREFUL WITH GUN!!!

REFERENCES: (PIRA unavailable.)

EQUIPMENT: Pellet gun with pellets, glider with receptacle, air track, and photocell gate timer.

SETUP TIME: 5 min.

Go back to Lecture-Demonstration Home Page.