Lab 3

Determination the speed of a bullet shot from a gun using ballistic method

3.1 Objectives: determation the speed of the bullet by ballistic method based on the conservation of energy and conservation of angular momentum laws.

2. Theory: Ballistic pendulum is the simple method of determinating the speed of bullet. To determine it uses massive frame with additional mass, as pendulum The inital speed can be determined by using conservation of angular momentum

$L_i = mvL$ - Angular momentum Before collision

m - mass of Bullet (1,84g)

v - velocity

L - distance Between Axis and Line

$L_f = (I_p + 2ML_1^2)\omega$ - Angular momentum after collision

I_p - ang. momentum of the frame without weight

M - mass of each additional weight

L_1 - distance from axis of rotation

$L_1 = L_f$ (According to the cons. of ang. momentum (aw) $\Rightarrow V = \frac{(I_p + 2ML_1^2)\omega}{mL}$

Final Equation of angular speed:

$$\omega = \varphi\left[\frac{D}{(I_p + 2ML_1^2)}\right]^{\frac{1}{2}}$$

φ - max. angle reached by frame

D - torsion modals of the thread

$I_p\ddot{\varphi} = -D\varphi$ (Rotation of frame under the torque due to. restoring force)

$\ddot{\varphi} = -\omega^2\varphi$

I_p - rotational inertia

$$\omega_0 = \sqrt{\frac{D}{I}}$$

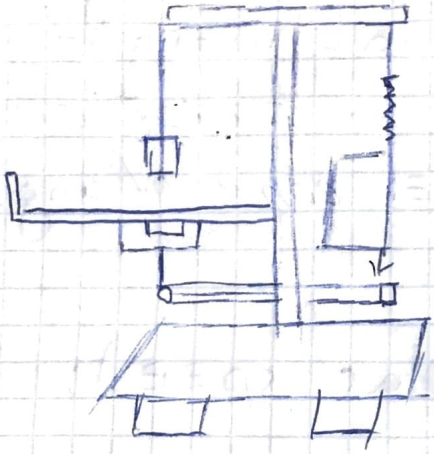
$$T_0 = 2\pi\sqrt{\frac{I}{D}} \text{ (without weight) } \omega = \frac{2\pi\varphi_m}{T}$$

$$I_p + 2ML_1^2 = 2ML_1^2 T^2/(T^2 - T_z)$$

The final formula of the speed is:

$$\omega = \frac{4\pi ML_1^2 I\varphi_m}{mL(T_2^2 - T_1^2)}$$

3. Equipment: Torsion pendulum



1- STEEL string
2- post
3- base
4- pilot (spring with string) spin with spring
5- RELEASE DEVICE
6- photo DETECTOR

4. Experimed procedure: N=10

$\varphi_1 = 45^\circ$ $t = 21$ sec $T = \frac{1}{10} = \frac{21}{10} = 2,1$

$\varphi_2 = 49^\circ$ $t = 17,8$ CEC $T_1 = \frac{1}{10} = \frac{17,8}{10} = 378$

$\varphi_3 = 47^\circ$ $L = 11,7$ cm

$\varphi_4 = 41^\circ$ $L_1 = 10.6$ cm $/ 2 = 5,3$

$\varphi_5 = 43^\circ$ $M = 111,5g$

$$\varphi_m = \frac{45+43+47+41+43}{5} = 45^\circ = \frac{\overline{\Delta L}}{4}$$

$$\left(\varphi_m = \frac{\sum_{n=1}^{5} \varphi_m}{5} = \frac{\sum_{i=1}^{5} \frac{\overline{\Delta L}}{4}}{5}\right) =$$

$$U = \frac{4 \cdot \overline{\Delta L} \cdot 111,5 \cdot 10^{-3} \cdot (5,3 \cdot 10^{-2})^2 \cdot 2,1 \cdot \frac{\overline{\Delta L}}{4}}{484 \cdot 10^{-3} \cdot 11,7 \cdot 10^{-2} (2,1^2 - 1,78^2)} = 24,28 \text{ m/s}$$

5 Conclusion

in this LaBorotory work; I have measured the speed of BuLLEt using ballistic method. We used torsion pendulum to do it. finally I got the SPEED v=24,28 m/s. This isn't Entirely accurate answer. The real speed of Bullet is about 400m/s. Our speed is about 15 time LESS than the real speed. It's all because of measurement accuracy. To get more closely answer, it is recomment to use gun Chronograph. This tool measures the speed fairly accurately.