

Melde's Experiment

Object: To determine the frequency of electrically maintained tuning fork by means of Melde's apparatus in longitudinal and transverse mode of vibration.

Apparatus used: electrically maintained tuning fork, hanger/pan and weights (5, 10, 20 gm) and thread.

Formula Used:

A. Longitudinal mode of vibration: The frequency of electrically maintained tuning fork in longitudinal mode of vibration is determined by following formula.

$$n = \frac{p}{l} \sqrt{\frac{T}{m}} \quad (1)$$

B. Transverse mode of vibration: The frequency of electrically maintained tuning fork in transverse mode of vibration is determined by following formula.

$$n = \frac{p}{2l} \sqrt{\frac{Mg}{m}} \quad (2)$$

Where l = loop length of the thread

T = tension applied to the wire = Mg ,

M = total mass loaded on thread

m = mass per unit length of the thread,

Figure and Circuit:

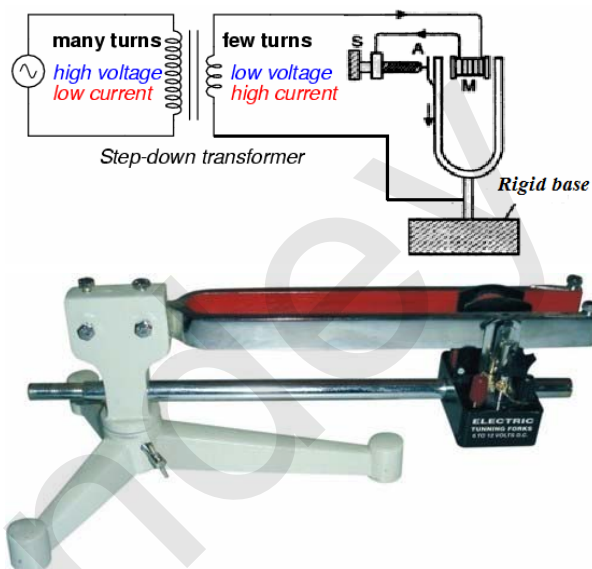


Fig.1: Electrically maintained tuning fork

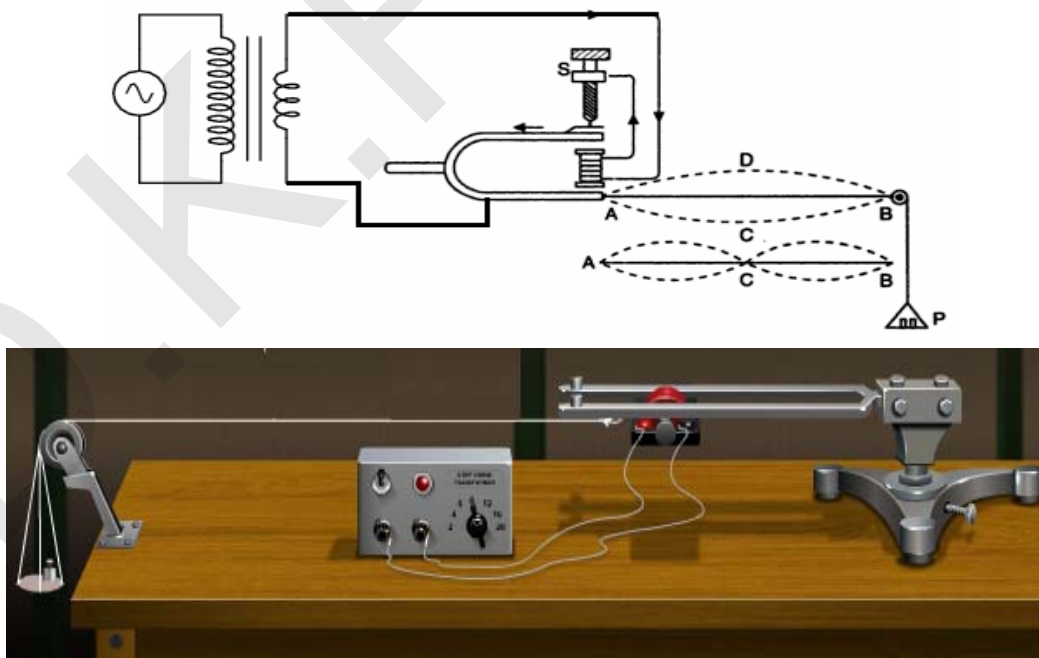


Fig.2: Arrangement for transverse mode of vibration

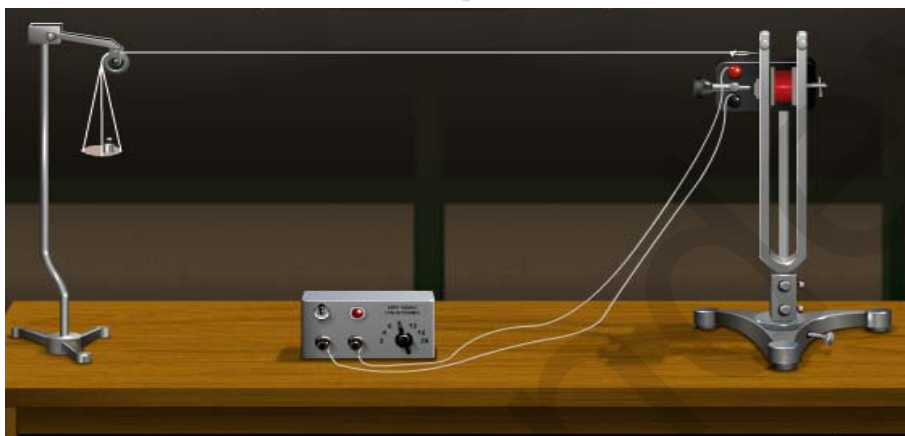
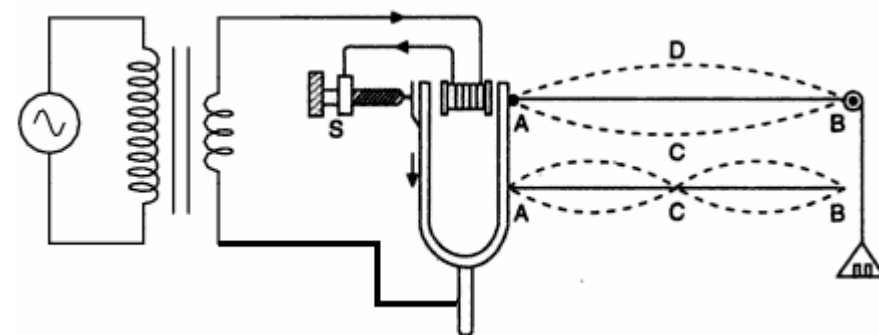


Fig.3: Arrangement for longitudinal mode of vibration

Procedure:

1. Connect the primary of the step down transformer to A.C mains, while the secondary to the given point of electrically maintained tuning fork.
2. Tight the one end of thread to the prong of tuning fork and other end to a scale pan. Hang the scale pan with pulley that is fixed at end of table.
3. Arrange the electrically maintained tuning fork in transverse situation (Fig.2) (i.e. arrange in such a way that length of string is parallel to the prong of tuning fork) and load a mass of 5gm on its pan. Now rotate the screw S (i.e. excite the tuning fork), so that vibration in tuning fork gets started.
4. Move the tuning fork toward or away from pulley to adjust the length of thread, so that loops could be formed. Now measure the length thread for one and two loop when stable loops are formed in horizontal plane. This will give the value l for one and two loops.
5. Now increase the mass on scale pan ($m=10, 20$ gm) and repeat the step 4.
6. After it arrange the electrically maintained tuning fork in longitudinal situation (Fig.3) (i.e. arrange in such a way that length of string is perpendicular to the prong of tuning fork) and load a mass of 5gm on its pan. Excite the tuning fork, so that vibrations get started in tuning fork.
7. Move the tuning fork toward or away from pulley to adjust the length of thread, so that loops could be formed. Now measure the length thread for one and two loop when stable loops are formed in transverse plane. This will give the value l for one and two loops. The observed length should come double length of transverse case.
8. Now increase the mass on scale pan ($m=10, 20$ gm) and repeat the step 7 for this arrangement.
9. Find out length of thread per loop (l/p) for each case of load.
10. Measure the mass (m_T) of 10m length of thread and mass of scale pan (m_P). Value of $m_T/10$ gives mass per unit length of thread.
11. Calculate frequency of tuning fork for transverse and longitudinal case using M , m and l/p ,

Observation:

1. Table for transverse mode of vibration

Sr. No.	Mass loaded on pan, m (gm)	Mass of pan, m_p (gm)	Total mass $M=m+m_p$ (gm)	No. of Loops (p)	Loop Length, l (cm)	l/p	Mean l/p
1	5			1			
				2			
2	10			1			
				2			
5	20			1			
				2			

2. Table for longitudinal mode of vibration

Sr. No.	Mass loaded on pan, m (gm)	Mass of pan, m_p (gm)	Total mass $M=m+m_p$ (gm)	No. of Loops (p)	Loop Length, l (cm)	l/p	Mean l/p
1	5			1			
				2			
2	10			1			
				2			
5	20			1			
				2			

3. Mass per unit length of thread (m)=.....gm/cm

Calculation: Calculate the frequency for each mass and mode of vibration using expressions (1) and (2).
Take mean of frequencies of both longitudinal and transverse case.

Result: The frequency of electrically maintained tuning fork in transverse arrangement =Hz
The frequency of electrically maintained tuning fork in longitudinal arrangement=Hz
Mean frequency of electrically maintained tuning fork=Hz

Precautions:

1. The thread should be uniform and inextensible.
2. Friction in pulley should be small. Otherwise it causes the tension to be less than the actual applied tension.
3. The loops in central part of thread should be counted for measurement. The nodes at pulley and tip of prong should be neglected as they have some motion.
4. The longitudinal and transverse arrangements should be correct otherwise the length measured will be wrong.