Frequency of A.C. mains using Sonometer

Object: To find the frequency of A.C mains by using sonometer.

Apparatus Required: Sonometer with non-magnetic wire (brass wire) stretched over it, stepdown transformer of 6-8 volts, horse shoe magnet, meter scale, screw gauge and 250gm weights.

Formula Used: The frequency of A.C mains is determined by formula for fundamental frequency of stretched string which is given by:

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}} \qquad (1)$$

Where l = length of the sonometer wire between the two bridges when it is thrown into resonant vibrations.

T = tension applied to the wire=Mg,

m = mass per unit length of the wire= $\pi r^2 \rho$

r= radius of sonometer wire,

ρ= density sonometer wire material

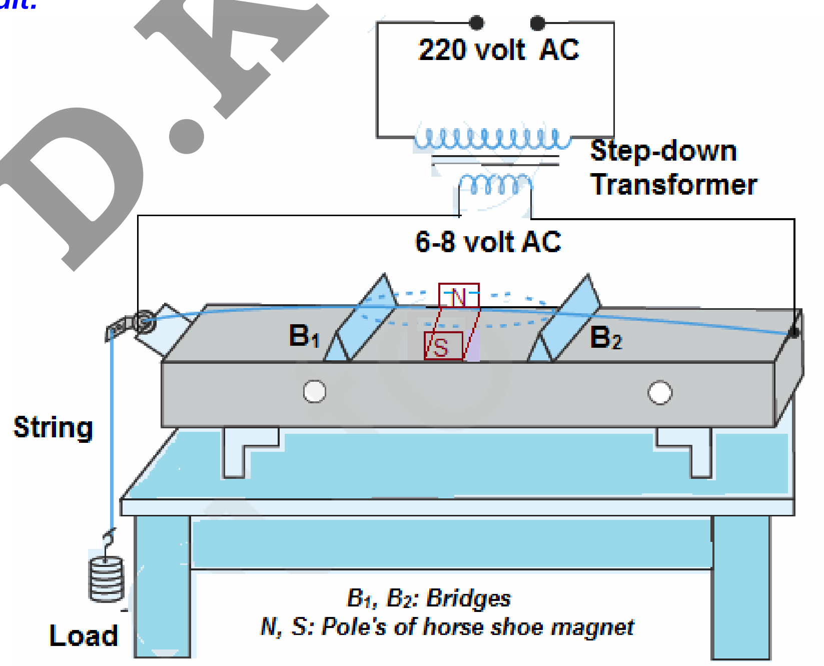
Putting values in eq.(1)

$$n = \frac{1}{2l}\sqrt{\frac{Mg}{m}}$$

$$n = \frac{1}{2} \times \sqrt{\frac{g}{m}} \times \frac{\sqrt{M}}{l} \qquad (2)$$

Eq.(2) is used determination of frequency of AC mains.

Figure and Circuit:



Procedure:

(i) Connect the primary of the step down transformer to A.C mains, while the secondary to the two ends of the sonometer wire.

(ii) The horse shoe magnet is placed in the middle of the wire such that the magnetic field is applied in a horizontal plane and at right angles to the length of the wire.

(iii)Hang a mass M (say 250gm) from one end of the wire and adjust the distance between two bridges symmetrically with respect to magnet till the wire appears to be vibrating with the maximum amplitude. Note the distance l between the two bridges.

(iv)By increasing the tension on the wire, repeat the experiment for three or more different tensions / weights.

(v) Take readings with decreasing weight.

(vi) Measure the diameter of the wire using screw gauge.

(vii)Note the density of the material wire from the table of constants.

Observation:

1. Table for determination of $\sqrt{M}\,/\,l$

Sr. No.	Load in gm including the mass of hanger (M)	Length of wire *(in cm)* between bridges at resonances			$\frac{\sqrt{M}}{l}$	Mean $\frac{\sqrt{M}}{l}$
		On weight increasing (l_1) ($l_1=x_2-x_1$)	On weight decreasing (l_2) ($l_2=x_2-x_1$)	Mean Length (l) $l=(l_1+l_2)/2$		
1						
2						
3						
4						
5						

2. Least count of screw gauge= ……….cm
   Zero error in screw gauge=………….cm
   Table for diameter of sonometer wire:

Sr. No.	Main scale reading (MS)	Circular scale reading (CS)	Total uncorrected Diameter (in cm) T=MS+(CSxLC)	Total corrected Diameter (in cm) D=T±Error
1				
2				
3				
4				
5				

Mean diameter (D)=……..cm
Radius of wire (r) =……..cm

3. Density of wire (ρ)=…………….

Calculation: 1. m= $\pi r^2 \rho$ 2. $n=\frac{1}{2}\times\sqrt{\frac{g}{m}}\times\frac{\sqrt{M}}{l}$

Result: The frequency of A.C mains = …c/s.

Standard Result: The frequency of A.C mains = 50c/s

Percentage Error: ….%

Precautions and Sources of Error:

1. There should be no kinks in the sonometer wire and pulley should be frictionless.
2. Horse shoe magnet should be placed in the middle.
3. Mass of the hanger should be included in tension,T.
4. The distance between the two bridges should be altered very slowly otherwise resonance point would be missed.
5. The diameter should be determined at various points.