ULTRASONICS

I – UG (Regular)
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INTRODUCTION:

Sound waves are classified into 3 depending on the frequency range

Classification	Frequency Range
Infrasonics	< 20 Hz
Audible	20 Hz – 20 kHz
Ultrasonics	> 20kHz

PRODUCTION OF ULTRASONIC WAVES

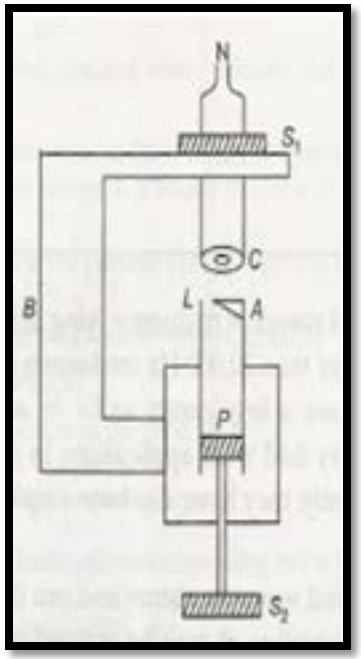
1. Galton whistle
2. Magnetostriction oscillator
3. Piezo-electric oscillator

GALTON WHISTLE

To produce ultrasonic waves of frequencies of 30,000 hertz.
Only some animals can hear (Dog's whistle)

Principle : Organ Pipe

Air through the wind system creates pressurized air and sound is produced.
Air is blown through nozzle N. Blast air coming from closed air column C strikes L (lip) and air is set into vibration. On adjusting length of air column in A it is brought to resonant position.



Resonant frequency depends on length and diameter of the pipe

Wavelength $\lambda = 4 (l+x)$

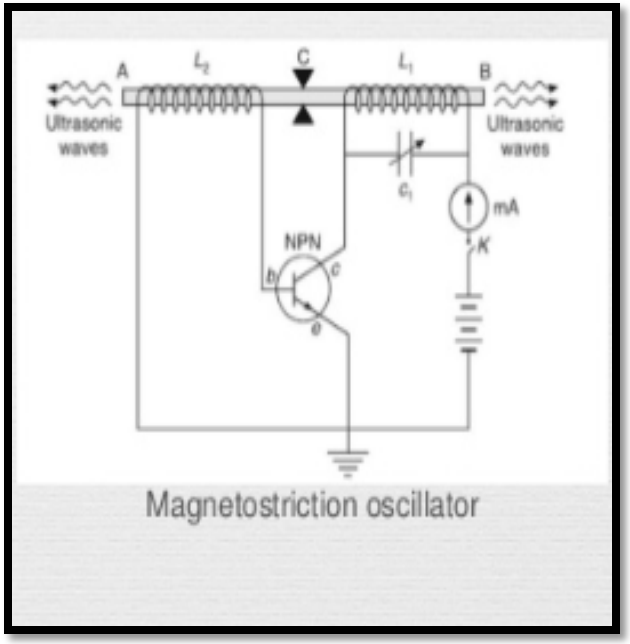
Frequency of sound $n=V/\lambda$

MAGNETOSTRICTION OSCILLATOR

To produce ultrasonic waves of frequencies from few hundred hertz to about 3MHz only.

Principle: Magnetostriction Effect

When a ferromagnetic material is subjected to varying magnetic field, the length of the ferromagnetic rod changes and whenever the frequency of the tank circuit coincides with the vibration of the ferromagnetic rod it is set to resonant vibration.



Magnetostriction oscillator

AB – Ferromagnetic rod (iron or nickel)
L_1 L_2 – Coils
C_1 - Condenser

Value of L_1 and C_1 determines the frequency of the oscillatory circuit.

Frequency depends on length, density and elasticity of the material of the bar

PIEZO-ELECTRIC OSCILLATOR

To produce ultrasonic frequencies as high as 5 x 10^8 hertz.

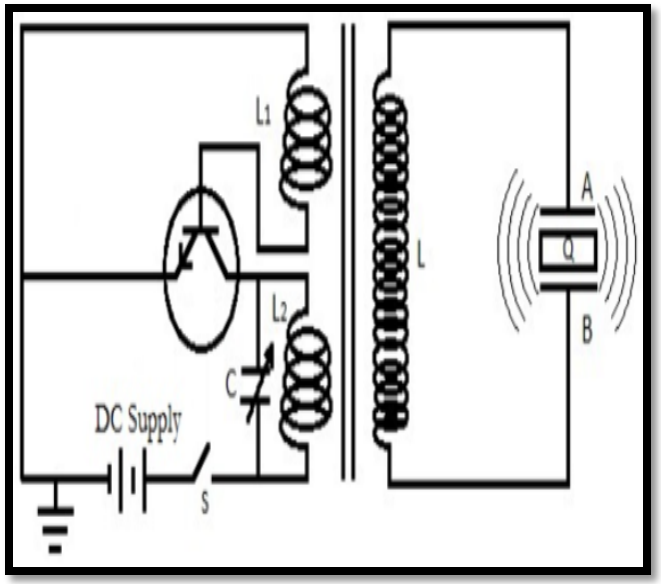
Principle: Piezo-electricity

It uses the mechanical resonance of a vibrating crystal of piezo-electric material to create an electric signal with precise frequency.

If one pair of opposite faces of a crystal is subjected to pressure, the other pair of opposite faces develops opposite electric charges.

Crystals used – quartz, tourmaline and Rochelle salt

The crystal will continuously contract and expand.



Frequency of alternating voltage = natural frequency of crystal

Resonant vibration and amplitude will be large

Frequency $\mathbf{n = p/2l\ \sqrt{Y/P}}$

Velocity $\mathbf{\rho = \sqrt{Y/P}}$

The value of v= 5.5 x 10^3 m/s for quartz

DETECTION OF ULTRASONIC WAVES

- **Kundt’s tube method**
- **Sensitive Flame method**
- **Thermal detectors**
- **Quartz crystal Method**

APPLICATIONS OF ULTRASONIC WAVES

Ultrasonic waves have large number of practical applications

1. Depth of sea
2. Signaling
3. Heating effects
4. Mechanical effects
5. Crack in metals
6. Formation of alloys
7. Chemical effect
8. Soldering
9. Medical applications
10. Sterilization
11. Enemy of lower life


Thank you