Prof. Vidya Sagar
Department of physics
Raja Singh College, Siwan

B.Sc (part-I) Hons
paper-I

Ultrasonics wave and their Generation

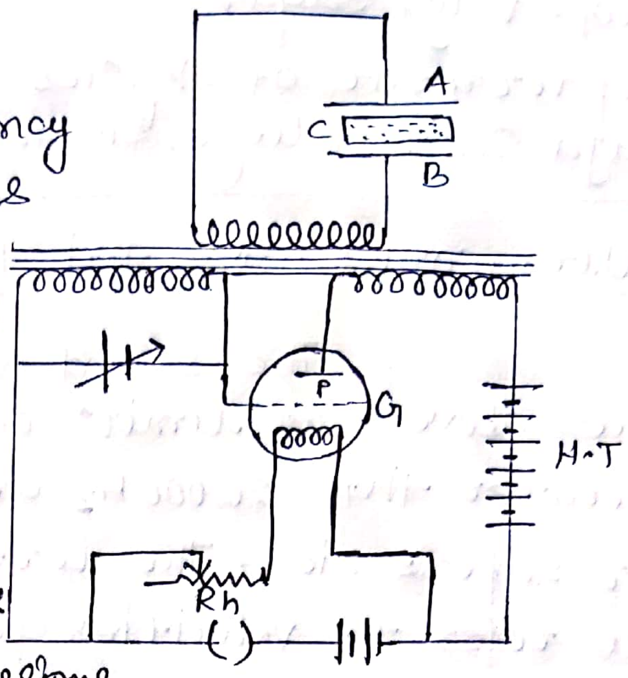
The Sound waves in which the frequencies are above the limits of human audibility i.e. greater than 20,000 Hz are known as Ultrasonics or supersonics. The term Super Sonic is now used to refer to velocities greater than that of Sound 1120 Km/h whic are now becoming very Common in aviation. Some animals like dogs and bats show response to ultrasonic waves. These waves can be generated either by the use of 'piezo-electric' of the 'Magnetastriction' effects.

Generation of ultrasonics:—

(i) Mechanical method:- The most important mechanical generator of ultrasonics is Galton whistle. It produces Sounds of frequencies upto 100 Kilo Hertz with a constant amplitude.

(ii) Piezo-electric method:- This method utilises the principal of piezo-electric effect. The piezo-electric crystal is placed between two metal plates, A and B so as to form a parallel plate condenser with crystal c as a dielectric. The plates are connected to the primary of a Transformer which is coupled inductively to the ascillatory of a value.

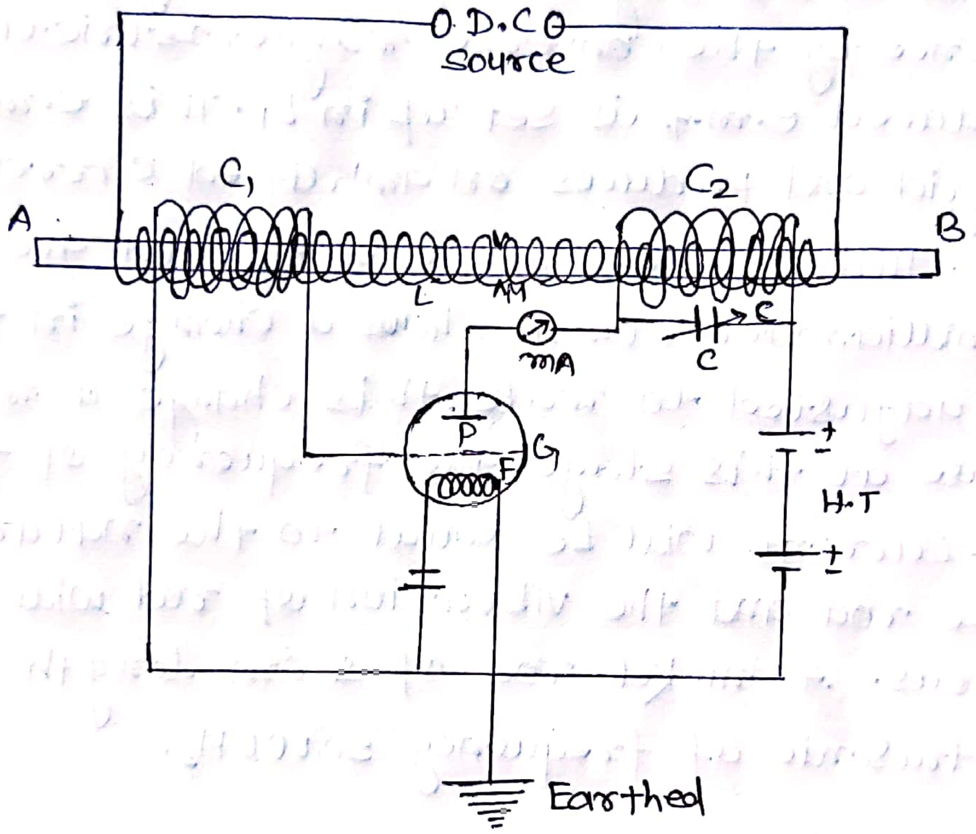
When the valve oscillates, high frequency alternating voltages are impressed on the plates A and B. Inverse piezo-electric effect takes place and the crystal contracts and expands periodically.



This produces compressions and rarefactions in the surrounding medium. When the frequency of the oscillations produced by the valve is equal to the natural frequency of the crystal, resonance occurs and the amplitude of the vibration becomes very large. Thus ultrasonic waves are generated. Here very high frequencies can be obtained by exciting higher harmonics of the fundamental.

(iii) Magnetostriction method :— This method is based on the principle of magneto-striction effect.

If a rod of invar (64% Fe + 36% Ni) or monel (68% Ni + 21% Cu + 4% Fe, Si, Mn and C) is placed inside a coil parallel to its axis and a high frequency, alternating current is passed through the coil, the rod is magnetised and demagnetised with the current. The length of the rod changes accordingly and its free ends produce high frequency vibrations or ultrasonics. If the length of the rod is so adjusted that its natural frequency of vibration is the Same as the frequency of the applied alternating current, resonance takes place and the amplitude of vibrations becomes very large. The high frequency A.C. is obtained from a wave oscillator.



AB is a nickel rod clamped at the middle point M. It is placed in a Solenoid L, fed by D.C. Supply, which polarises the rod by producing steady polarising magnetic field. Two other coils C_1 and C_2 are wound on the ends of the rod, and they are included in the anode and grid circuits respectively of a triode value. The frequency of the oscillating anode circuit is adjusted with the variable condenser C. When this frequency equals the natural frequency of the rod, then the longitudinal oscillations of the rod are maintained and ultrasonic are produced in the surrounding medium.

Circuit operation:- The steady polarising magnetic field magnetised the rod. This produces a periodic vibration in the anode-circuit. The anode current passing in the Coil C_2 causes a variation in magnetisation and a consequent variation in the length of the rod. This variation in length causes a variation in the magnetic flux through the grid-coil C_1. Hence by the converse magnetostriction effect, an induced e.m.f. is set up in L_1. This e.m.f. acts on the grid and produces on amplified current variation in C_2. Thus the oscillations of the rod are maintained. The milliammeter (m.A) shows a change in the Condencer C is adjusted to make this change a maximum because at this stage the frequency of the oscillating anode-current will be equal to the natural frequency of the rod and the vibration of rod will be most rigorous. A nickel rod of 5 cm length can produce an ultrasonic of frequency 50,000 Hz.