ULTRASONICS WAVES

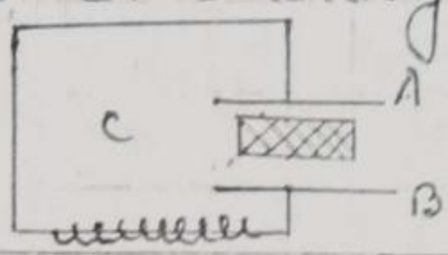
Ques:- what are ultrasonic waves? How it produced? Give the two methods of their generation and briefly describe their properties and uses.

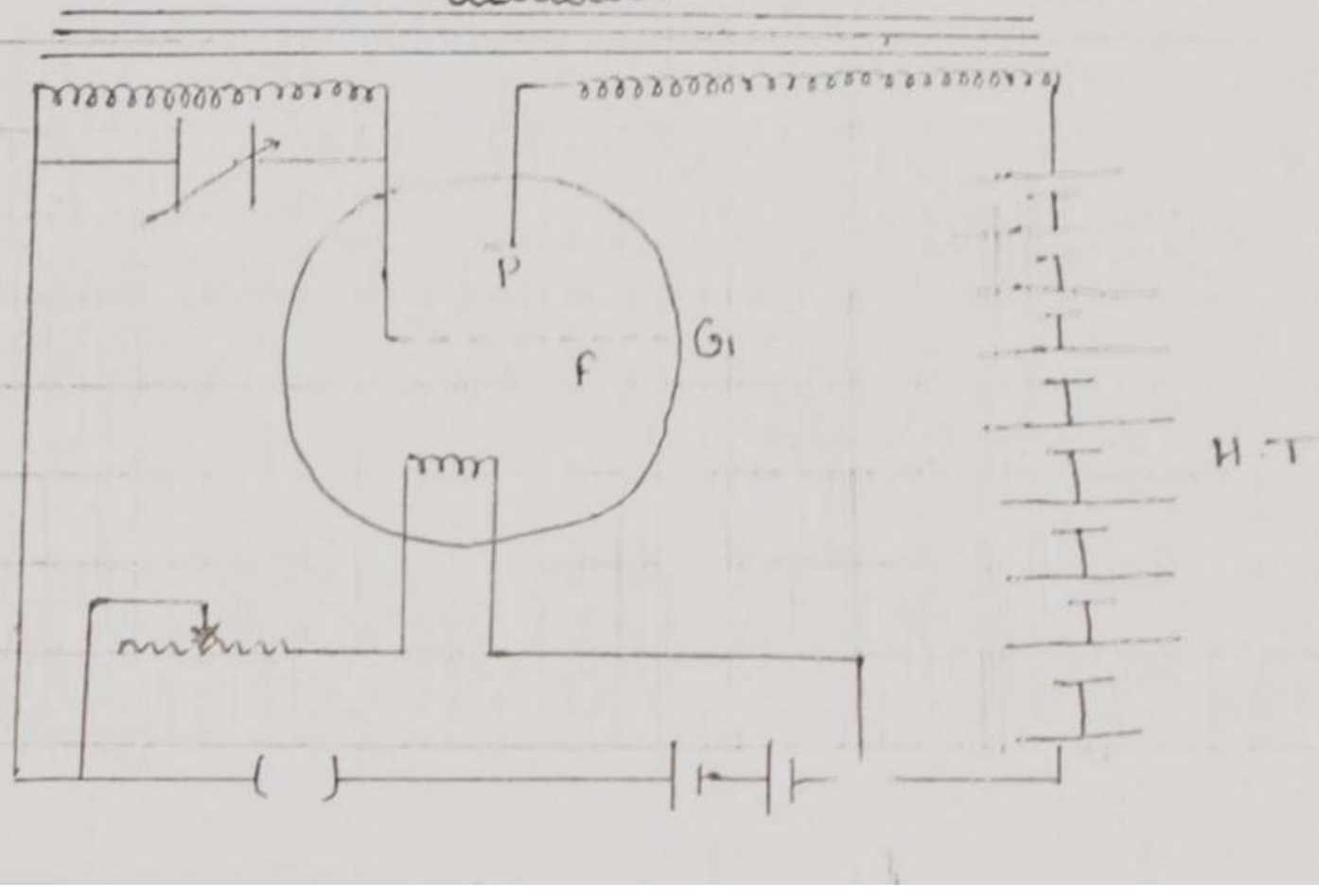
Sol:- Ultrasonic waves :->

Ultrasonic waves are longitudinal waves beyond the upper limit of human audibility. The approximate upper limit of the frequencies to which the human ear can respond is about 20,000 Hz. Hence we may say that " Ultrasonics are longitudinal waves of frequencies greater than 20,000 Hz. Man cannot hear ultrasonics but many inferior animals can hear them. Birds, Bats can hear ultrasonics but also produce them.

PRODUCTION OF ULTRASONICS :-

2) Piezo-electric method :-> This method utilises the principle of Piezo-electric effect. The Piezo-electric crystal is placed between two metal plates A and B as to form a parallel plate condenser with crystal C, as the dielectric. The plates are connected to the primary of a transfer which is coupled inductively to the oscillatory of a value shown in figure.





when the valve oscillates, high frequency alternating voltage are impressed on the plates A and B. Inverse Piezo electric effect takes place and the crystal contracts and rarefactions in the surround. medium. when the frequency of the oscillation produced by the valve is equal to the natural frequency of crystal resonance occure and the amplitudes of the vibrations becomes very large Thus ultrasonic waves are generated. Here very high frequency can be obtained by exciting higher harmonics of the fundamental.

ii) Magnetostriction Method :→

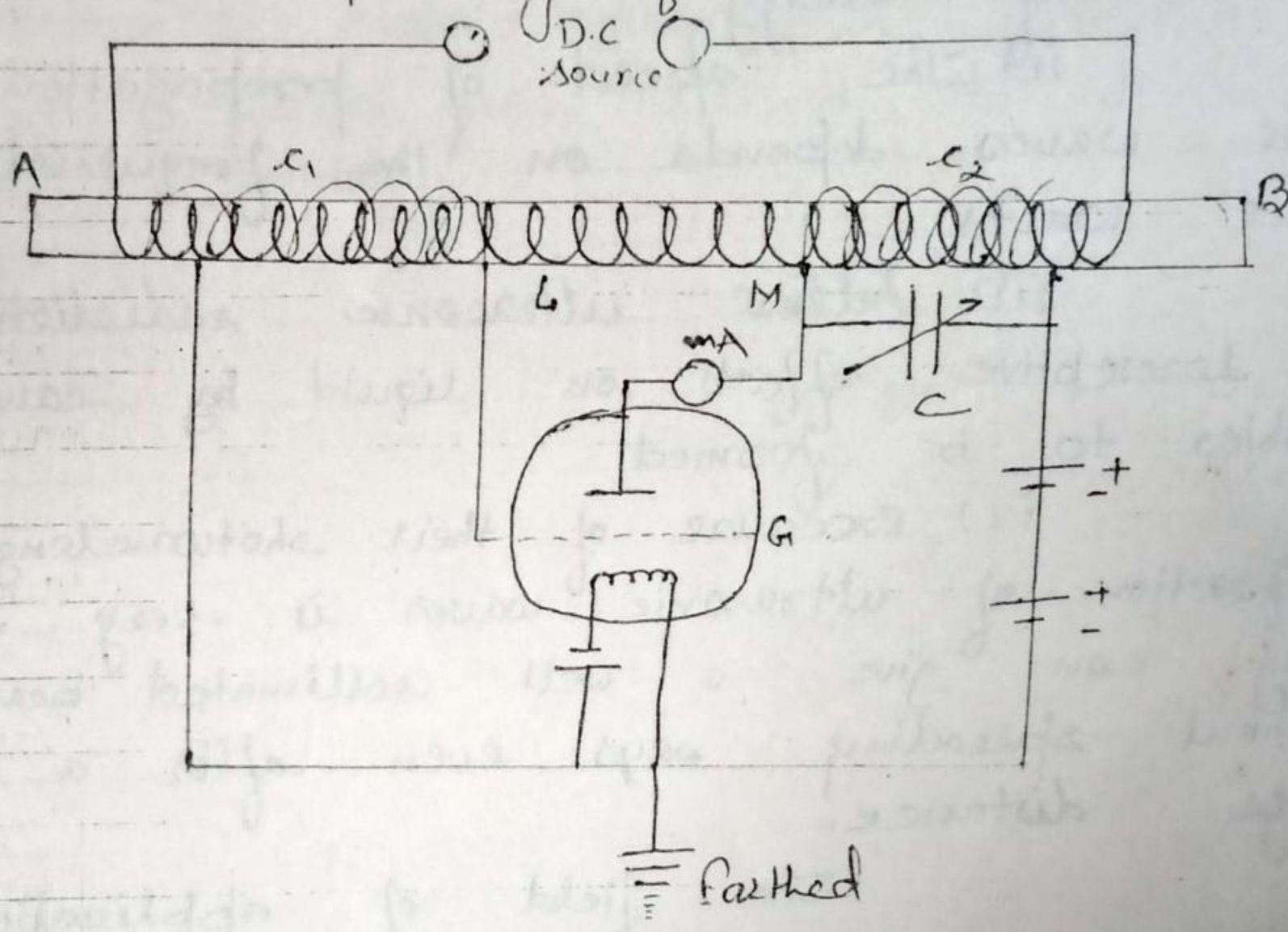
This method is based on the principle of Magnetostriction effect.

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 ~~c~~ coil parallel to its axis and a high frequency. ate alternating current is passed through the coil, the rod is magnetised and dimagnetised with the current. The length of the rod changes accordingly and its free end produce high frequency vibrations or ultrasonics If the length of the rod is so adjusted that its natural frequency of the 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 valve oscillation.

Description →

AB is a nickel rod clamped at it middle point M as shown in figure. 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 ~~found~~ bound on the ends of end, and they are included in the anode and grid circuits respectively of a triode valve.



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 ~~rod~~ longitudinal oscillations of the rod are maintained and ultrasonics are produced in the surrounding medium.

A steady current is called the polarising current is passed through a seperate coil bound uniformely over the entire rod. By adjusting the capacitance of capacitor C, the frequency of oscillations of the inductive capacitance circuit can be made exactly the same as that

of the rod. The rod oscillating in reson
e produces a very strong beam of
ultrasonic waves.

Properties of Ultrasonic waves :—

i) These waves posses a large amount of energy.

ii) The speed of propagation of these waves depends on the frequencies of these waves.

iii) Intense ultrasonic radiation has a desceptive effects on liquid by causing bubbles to be formed.

iv) Because of their shotwavelengths, the diffraction of ultrasonic waves is very small. They can give a well collimated beam without spreading says even after a very large distance.

The field of applications of ultrasonics is steamily wide. Some of the importaul applications are :—

(i) Depth of surrounding :—

Ultrasonic waves are used for signallised for finding the depth of the sea and to detect the position of submerged socks, submarines and ice bergs.

ii) Velocity of sound in liquid :—

Ultrasonics have been used to find the velocity of sound in liquids available in small quantities. This determinations reveals many physical and chemical properties of the substances.

iii) Thermal effect :- A liquid subjected to

ultrasonic shows a slightly higher temperature than that of its surrounding due to the absorption of waves.

iv) Agriculture use :-

There is a use of ultrasonic waves also in agriculture. When small plants are exposed to ultrasonics, they grow rapidly.