SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECB311- OPTICAL AND MICROWAVE ENGINEERING

III YEAR/ VI SEMESTER

UNIT II-MICROWAVE PASSIVE DEVICES

TOPIC 7 -Magnetron

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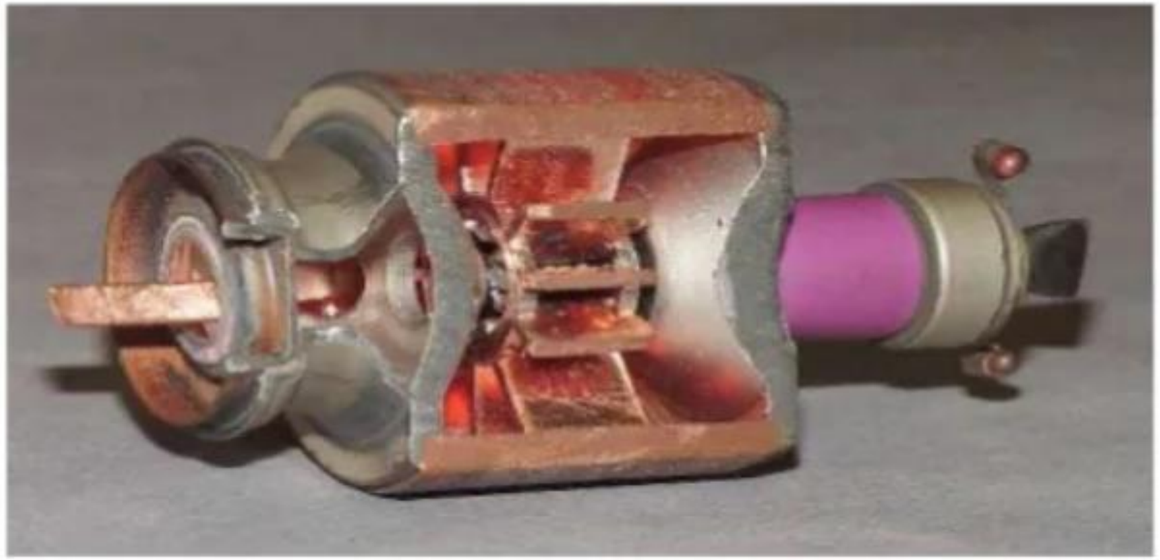
MAGNETRON

Magnetron



Introduction

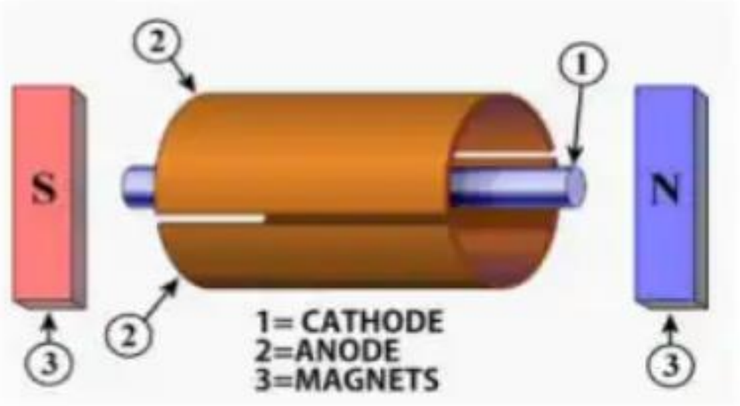
- The Magnetron is a vacuum tube which is used to generate microwaves of high power.
- Its working principle is based on the interaction between electron stream and magnetic field.
- The Magnetron Tube works on Direct Current power.

Types of Magnetron

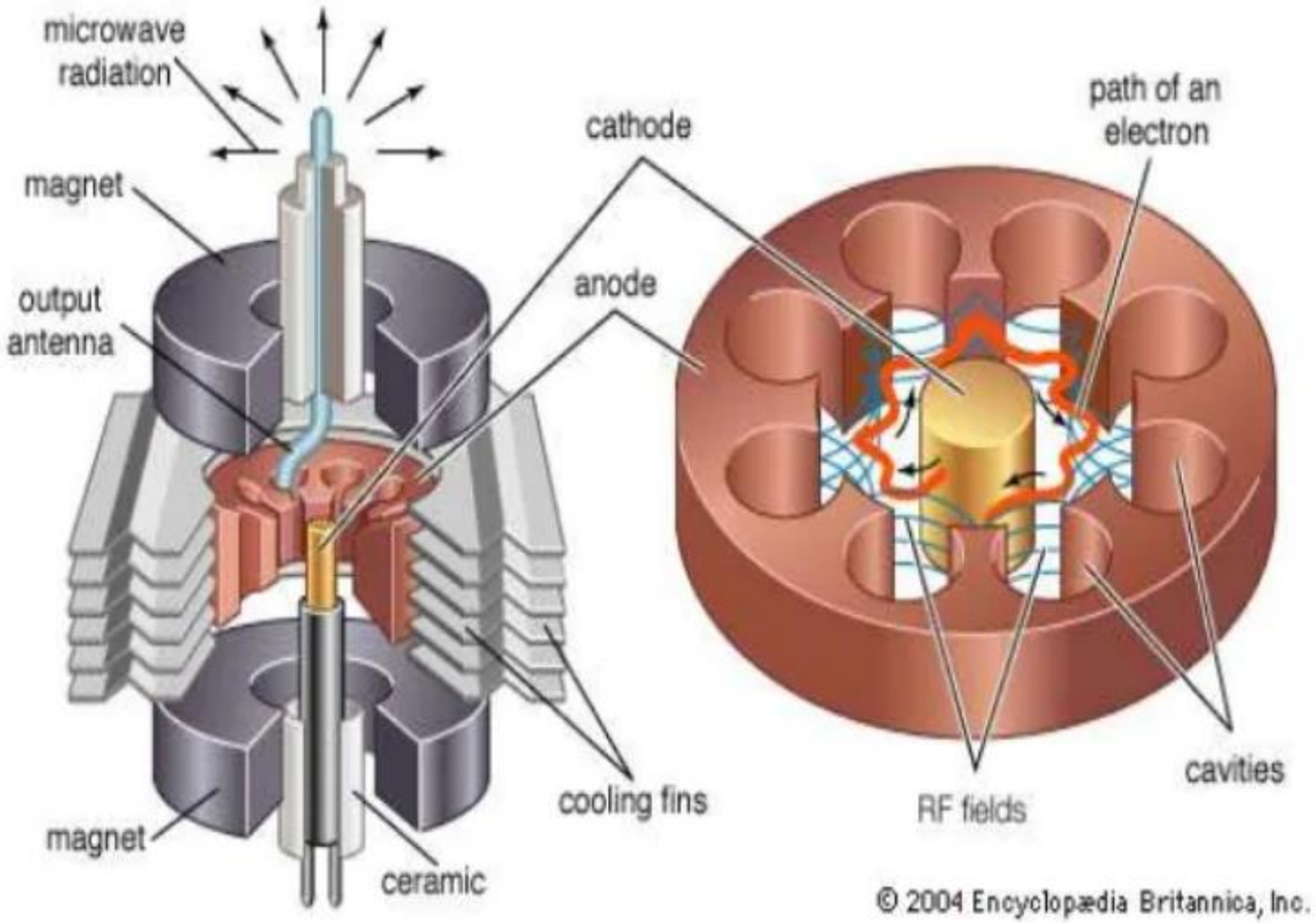
- Negative resistance magnetron
- Cyclotron frequency magnetrons
- Cavity type magnetrons : It depends upon the interface of electrons with a rotating electromagnetic field of constant angular velocity.

CONSTRUCTION

- Magnetron tube is constructed of a vacuum tube having two electrodes.
- The permanent magnet and both electrodes are placed in such a way so that the magnetic field of permanent magnet and electric field of cathode are perpendicular to each other.



- The cathode is in the center of the chamber or the cylinder.
- There are cylindrical cavities around the cathode and these are open along their length and connect the common cavity space.
- The output of the Magnetron is drawn from any one of the cavities by a co axial line or by using a Wave guide.


microwave radiation
magnet
output antenna
magnet
ceramic
cooling fins
cathode
anode
path of an electron
RF fields
cavities
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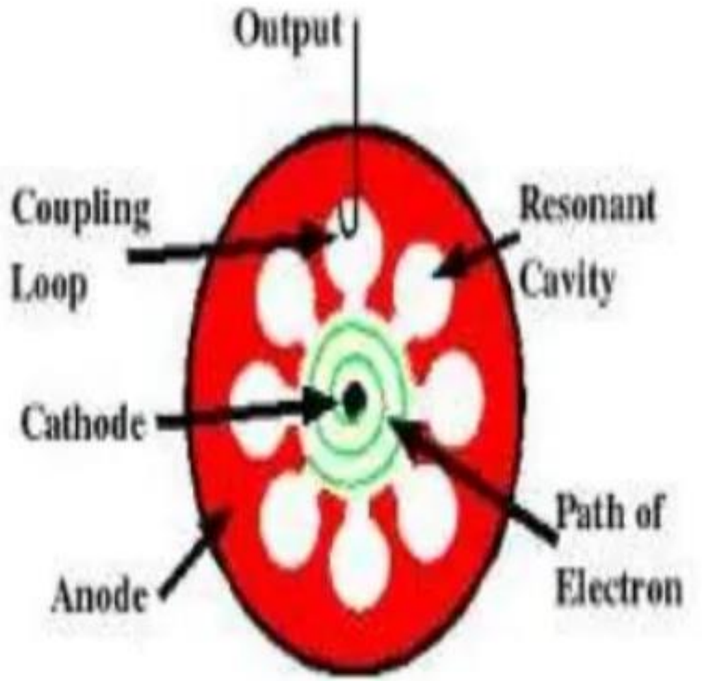
Working

- Depending upon the relative strength of the magnetic and electric field the electrons released from the cavity move towards the anode will navigate through the interacting space.

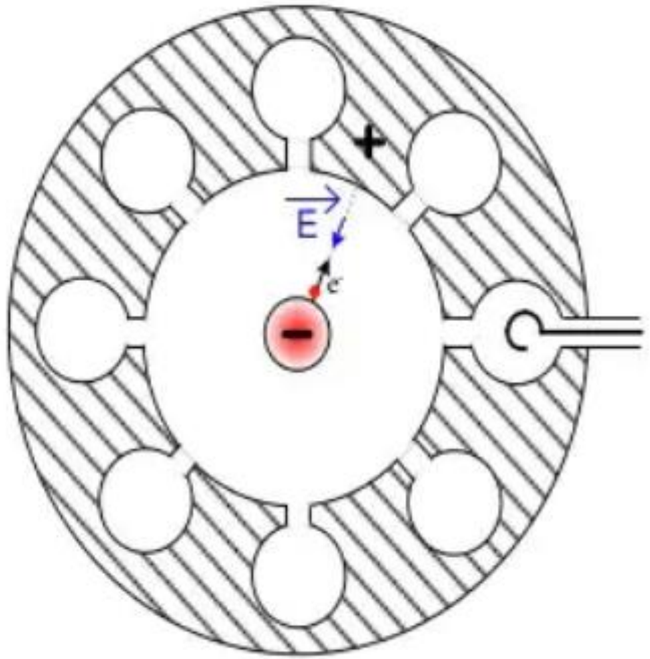


Effect Of Electric Field Only

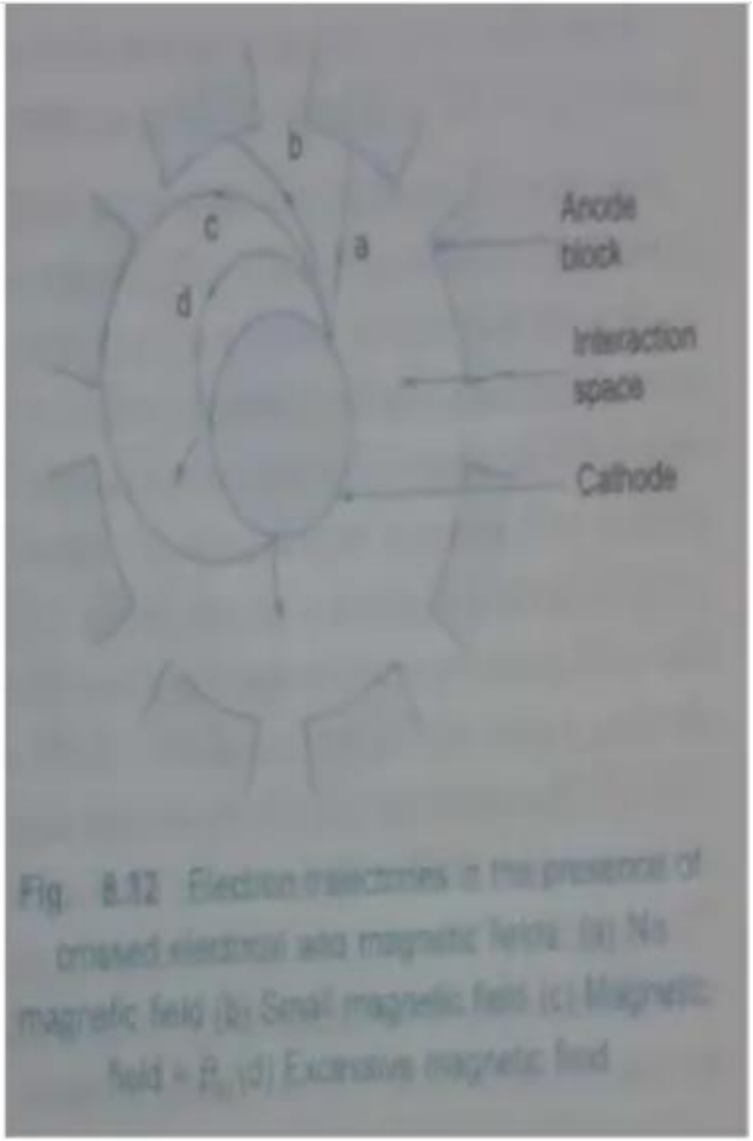
1. Magnetic field (B=0)

1. If the magnetic field strength increases vaguely it will apply a lateral force bending the path of electron.

1. If the strength of the electrons is made adequately high enough so as to avert the electrons from reaching the anode, the anode current becomes zero.

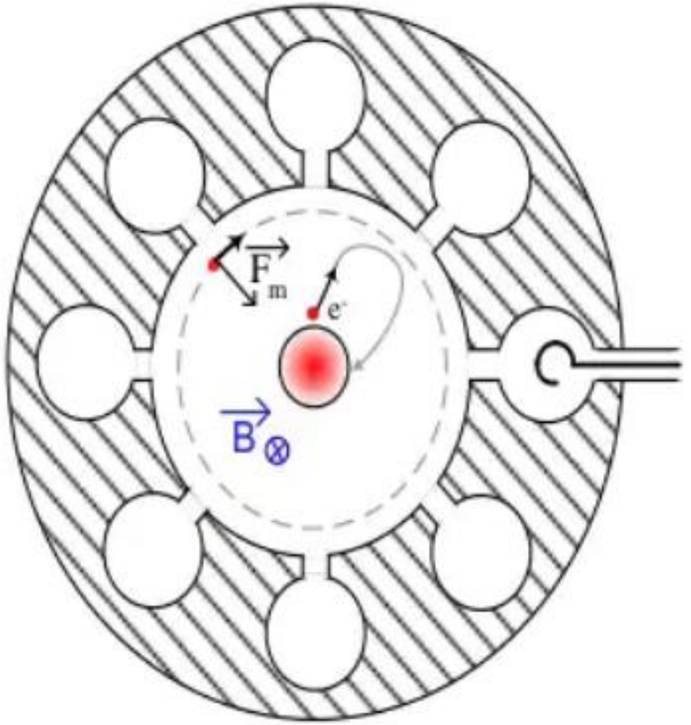


- The magnetic field required to return electrons back to cathode just gazing the surface of the anode is called the critical magnetic field or cut-off magnetic field(Bc).
- If the magnetic field is larger than critical Magnetic field (B>Bc),the electrons experiences a greater rotational force and may return back to cathode quite faster .



Effects of magnetic fields only

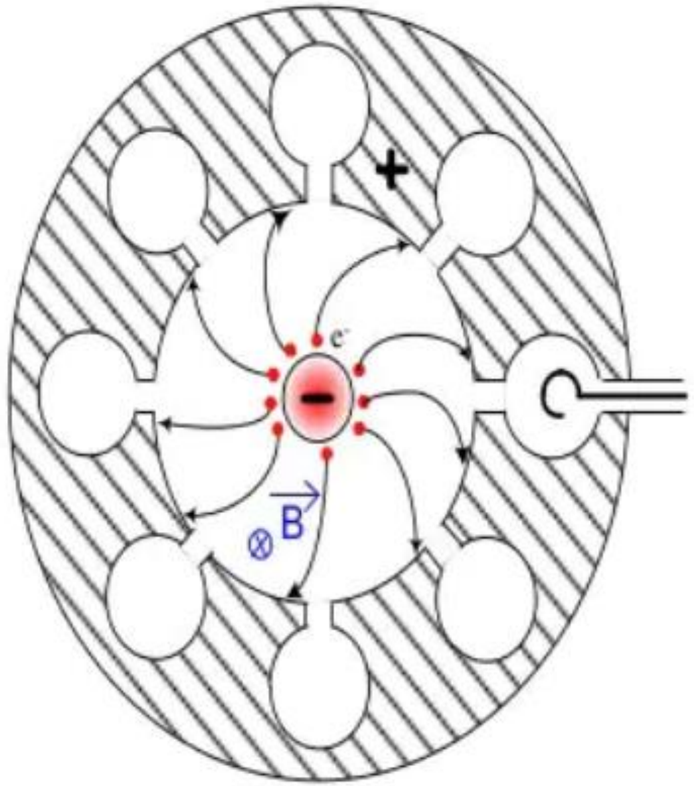
- The magnetic field is applied perpendicular to electric field hence is called <u>axial magnetic field</u>, therefore the magnetrons are called **<u>cross field devices</u>** because radial electric field and axial magnetic field are perpendicular to each other.
- If the magnetic field strength is more, the electrons emitted will return back to cathode with high velocity which may destroy the cathode cavity. This effect is called back heating of cathode.



Combine effect of E and H

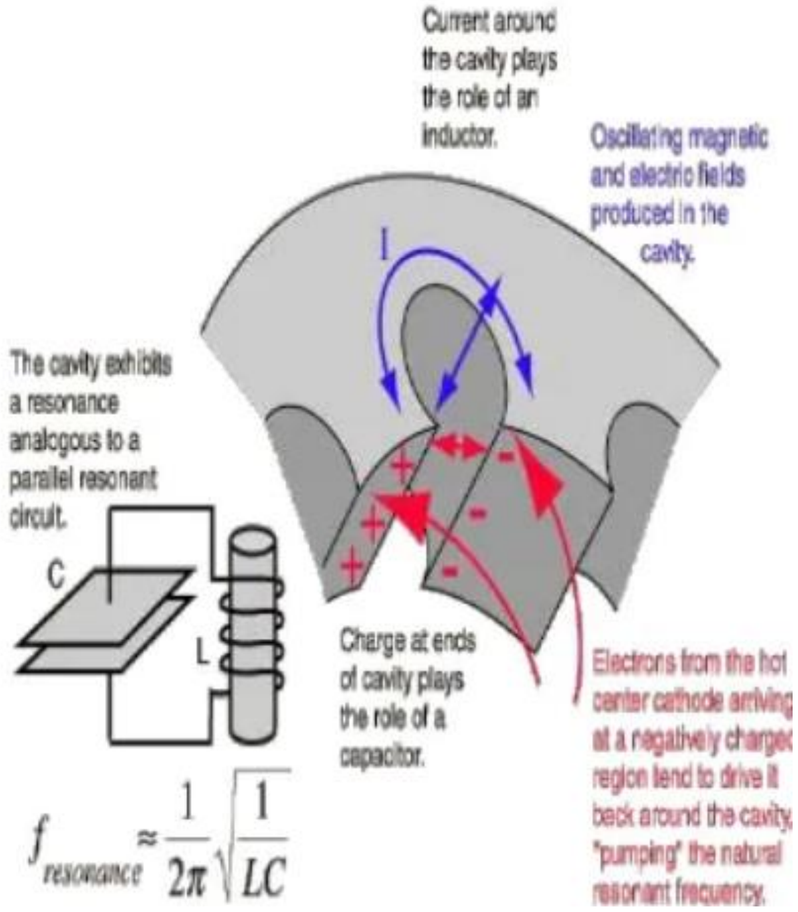
- When both fields are existing in that case the electron may have dissimilar path depending upon the strength of E and H.

1. If E>H, the electrons reach at the anode but the path will be bend because of small magnetic field.
2. If H>E, the electrons return back to the cathode.



Operation

- High negative potential at cathode is created with high voltage DC power.
- Cathode emits electrons; path depends on strength and direction of Magnetic and Electric Field.
- The magnetic field causes the electrons to get attracted towards positive anode and starts to spiral in a circular path.



APPLICATIONS

- Radars
- Heating(Microwave Oven)
- Lighting(Sulphur lamp)

Advantages

- The magnetron is a fairly efficient device.
- The combination of the small-cavity magnetron, small antennas, and high resolution allowed small, high quality radars to be installed in aircraft.

Disadvantages

- They are costly and hence limited in use.
- Although cavity magnetron are used because they generate a wide range of frequencies , the frequency is not precisely controllable.

THANK YOU