JYOTHISHMATHI INSTITUTE OF TECHNOLOGY & SCINCE

TOPIC : MAGNETRON

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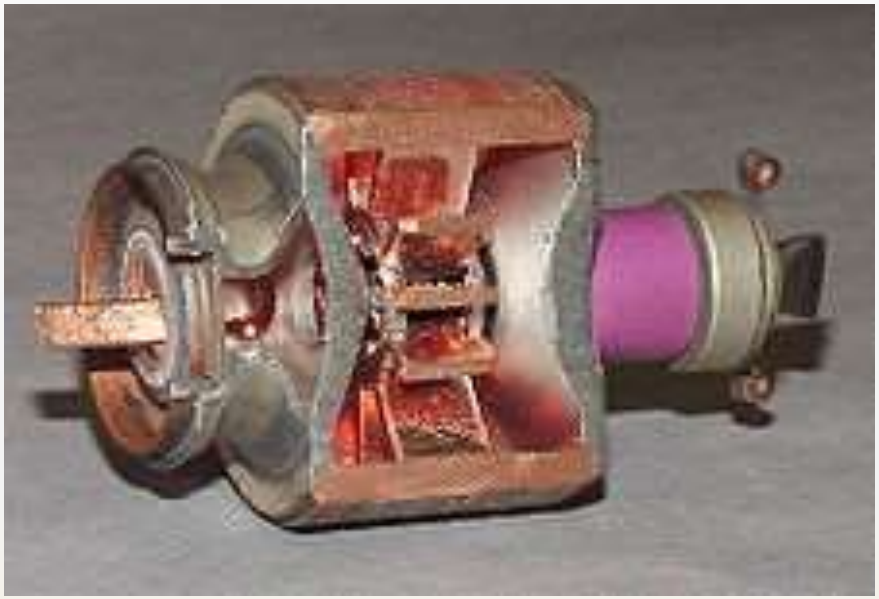
MAGNETRON



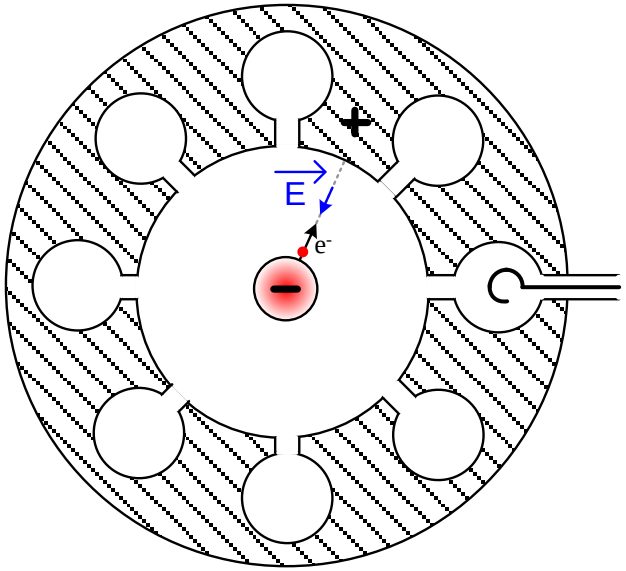
CONSTRUCTION

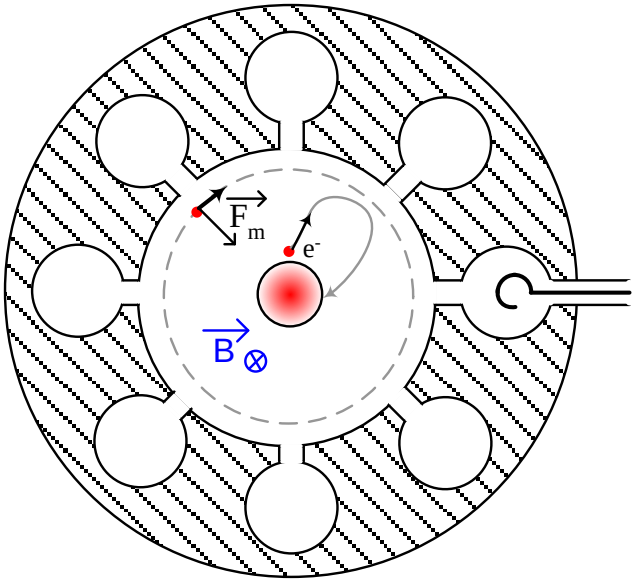
APPLICATIONS

ADVANTAGES & DISADVANTAGES

CONCLUSION

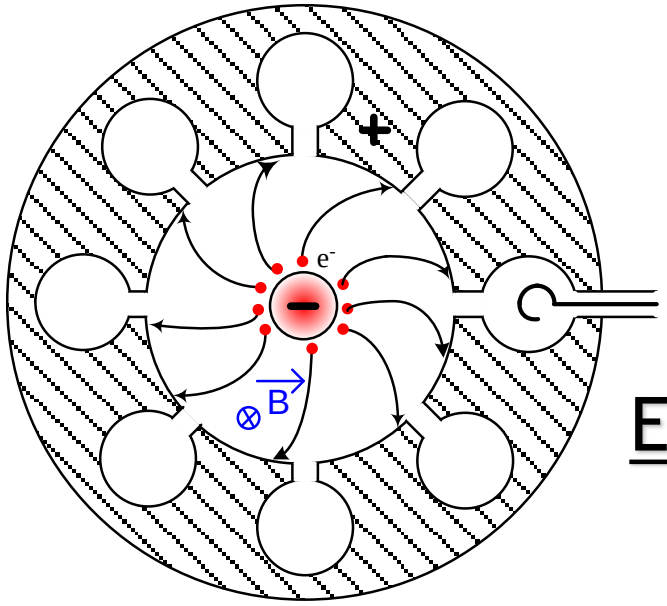
CONSTRUCTION & OPERATION





Effect of electric field

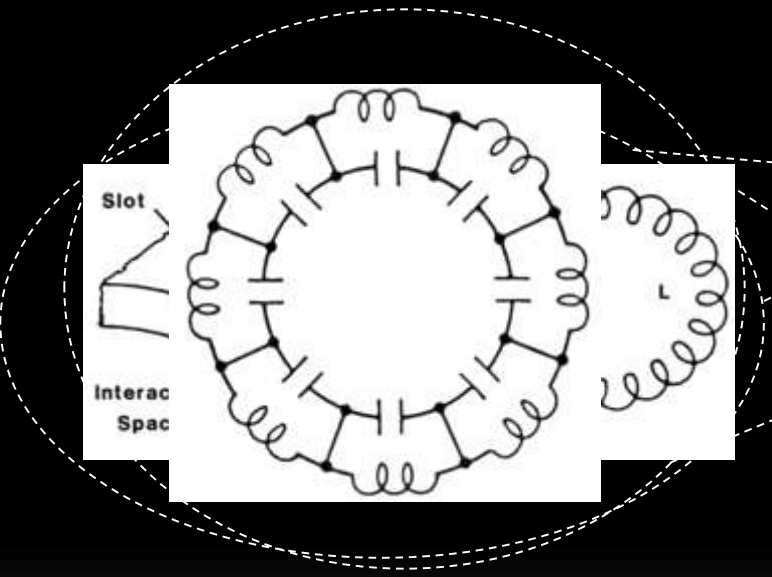
Effect of magnetic field

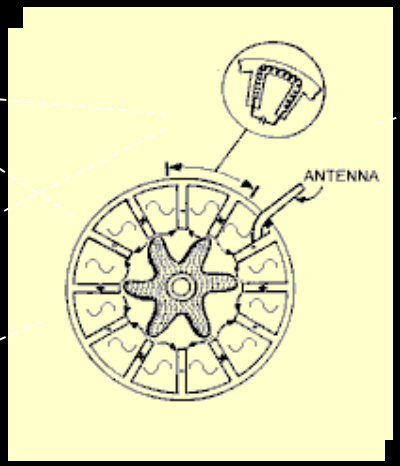


Effect of Crossed-Fields

CONSTRUCTION

- As shown in the figure, a cavity magnetrons consist of a hot filament (cathode) kept at, or pulsed to, a high negative potential by a high-voltage, direct-current power supply. The cathode is built into the center of an evacuated, lobed, circular chamber.
- A magnetic field parallel to the filament is imposed by a electro-magnet. The magnetic field causes the electrons, attracted to the (relatively) positive outer part of the chamber, to spiral outward in a circular path rather than moving directly to this anode.


Slot
Interac
Spac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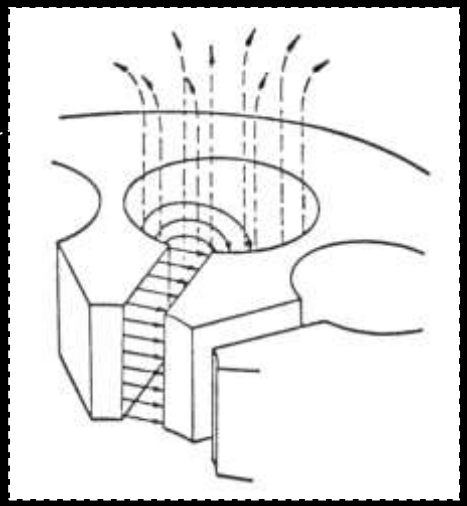
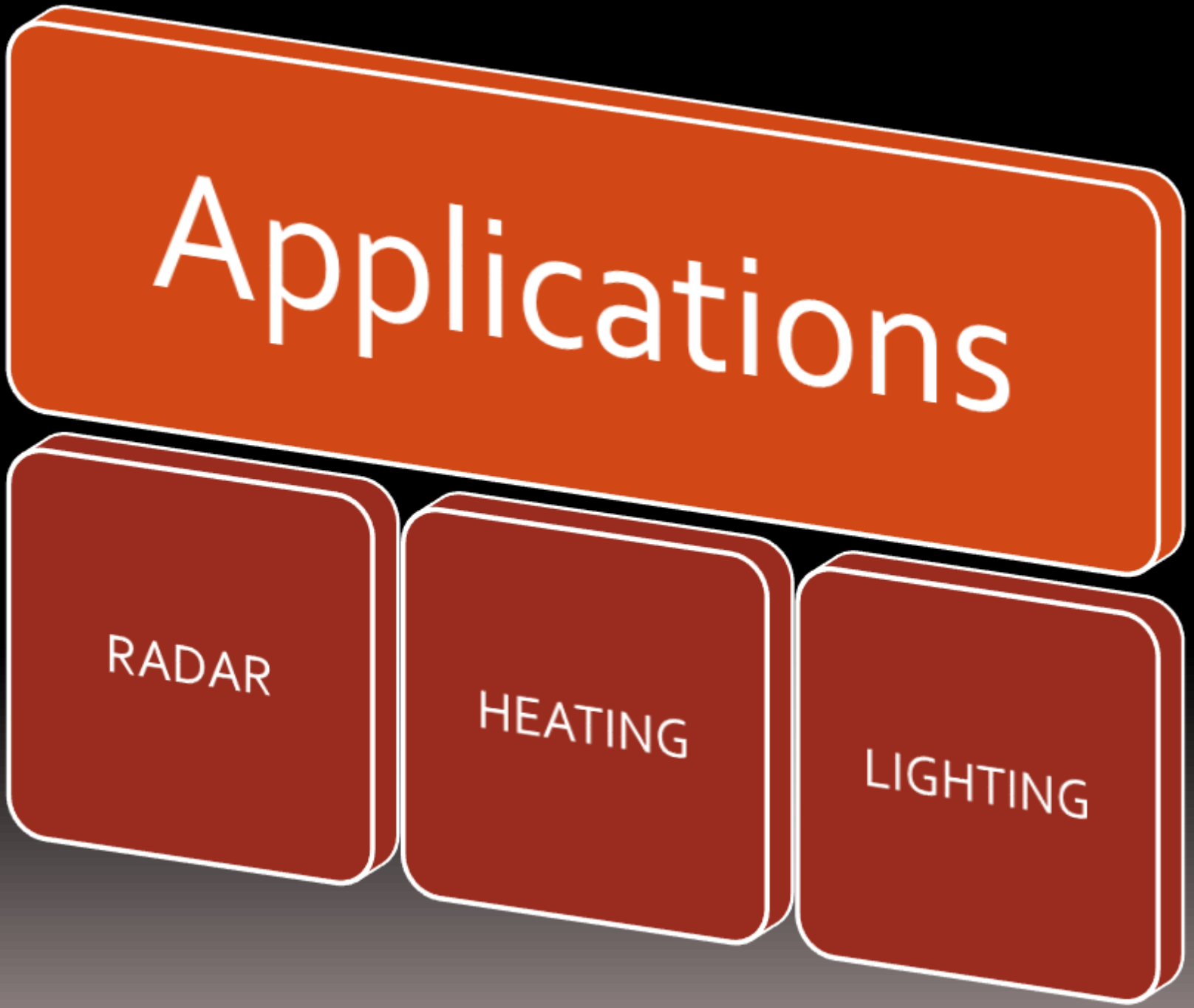


- Spaced around the rim of the chamber are cylindrical cavities. The cavities are open along their length and connect the common cavity space. As electrons sweep past these openings, they induce a resonant, high-frequency radio field in the cavity, which in turn causes the electrons to bunch into groups.
- A portion of this field is extracted with a short antenna that is connected to a waveguide (a metal tube usually of rectangular cross section). The waveguide directs the extracted RF energy to the load, which may be a cooking chamber in a microwave oven or a high-gain antenna in the case of radar.


Applications
RADAR
HEATING
LIGHTING

APPLICATIONS

RADAR

- In radar devices the waveguide is connected to an antenna. The magnetron is operated with very short pulses of applied voltage, resulting in a short pulse of high power microwave energy being radiated. As in all radar systems, the radiation reflected off a target is analyzed to produce a radar map on a screen.

APPLICATIONS

HEATING

- In microwave ovens the waveguide leads to a radio frequency-transparent port into the cooking chamber. It is important that there is food in the oven when it is operated so that these waves are absorbed, rather than reflecting into the waveguide where the intensity of standing waves can cause arcing. The arcing, if allowed to occur for long periods, will destroy the magnetron.

APPLICATIONS

LIGHTING

- In microwave-excited lighting systems, such as Sulphur Lamps, a magnetron provides the microwave field that is passed through a waveguide to the lighting cavity containing the light-emitting substance (e.g. Sulfur, metal halides etc.)

HISTORY

- The oscillation of magnetrons was first observed and noted by Augustin Žáček, professor at the Charles University, Prague in the Czech Republic.
- The first magnetron developed was the two-pole magnetron, also known as a split-anode magnetron, which had relatively low efficiency. The cavity version (properly referred to as a *resonant-cavity magnetron*) proved to be far more useful.

ADVANTAGES

- The magnetron is a fairly efficient device. In a microwave oven, for instance, an 1100 watt input will generally create about 700 watts of microwave energy, an efficiency of around 65%.
- 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.

- The use in radar itself has reduced to some extent, as more accurate signals have generally been needed and developers have moved to klystron and traveling-wave tube systems for accurate frequencies.

- A microwave oven with a warped door or poor microwave sealing can be hazardous.

- There is also a considerable electrical hazard around magnetrons, as they require a high voltage power supply. Operating a magnetron with the protective covers removed and interlocks bypassed should therefore be avoided.

CONCLUSION

- The sizes of the cavities determine the resonant frequency, and thereby the frequency of emitted microwaves.
- The voltage applied and the properties of the cathode determine the power of the device.
- Even though the magnetron is widely used at places which require high power, it is avoided where accurate frequency control is required.