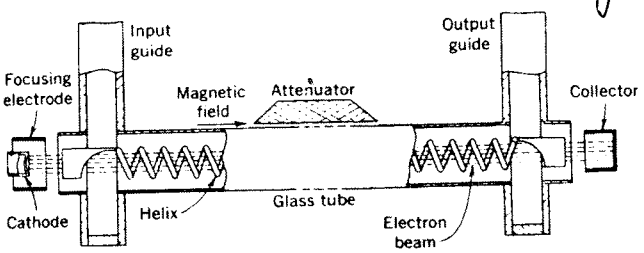
# TWT ( TRAVELLING WAVE TUBE )

The travelling Wave tube used as microwave amplifier. Unlike two Cavity Klystron, it is a device in which the interaction between the beam and the RF field is continous. The TWT is capable of enormous bandwidth. The intraction between the beam and the RF is increased by using "slow Wave structure".

**Construction :** A typical TWT using helix as slow wave structure is shown in diagram.




TWT (Helix type)

An electron gun is employed to produce a narrow beam which is sent through the centre of helix. The helix is made positive w.r.t cathode and the collector so. The Focusing of beam is done with the help of PPM (periodic permanent Magnet) which produced axial magnetic fiela which help the electron beam to move through centre of helix.

Signal is applied to the input end of the helix via a Waveguide. This field propogates around the helix with speed that is hardly different from the velocity of light in free space. But the speed with which the electric field advances axially is equal to the $\left[ c \times \frac{\text{pitch of helix}}{\text{circumference of helix}} \right]$

This comes out quite slow and approximately equal to the electron beam velocity. The axial RF field and Beam can now interact continously, with the beam bunching and giving energy to the field. Almost complete bunching is the result and so is high gain.

OPERATION :- The TWT may be considerd as limiting case of multicavity klystron, one that has very large number of closely spaced gaps. Electrons leaving the cathode at random quickly encounter the weak axial RF field at the input end of the helix, which is due to input signal. As with the passage of electrons accross the gap, velocity modulation takes place and with it, between adjacent turns some more bunching. The process continues as the wave and electron beam both travel toward the output end of the helix. Bunching become more and more pronounced until it is almost complete. Simultaneously the RF Wave on the helix grows exponentially and maximum at the output ends.

PREVENTION OF OSCILLATIONS :- The actual gain signal can exceed 80dB. So oscillations in such high gain device can create problem. The problem of Oscillation is due to very close coupling of slow wave circuits. And thus oscillations are prevented by "Attenuator" which may be lossy Metallic coating (Aquadag) on the surface of glass tube.

## PERFORMANCE OF TWT

1) Freq of operation : 0.5 GHz to 95 GHz
2) Efficiency : 5 to 20%
3) Power o/p : 250 kW (CW) at 3 GHz
   10 mW (pulsed) at 3 GHz
4) Noise figure : 25 dB (at 40 GHz)

## APPLICATIONS OF TWT

1) Low Noise RF amplifier in broad band receivers
2) Long distance telephony
3) It is used in troposcatter communication
4) It is used in satellites (Because of long life 50,000 hr)
5) Airborne and Ship borne radars.