KLYSTRON

What is klystron

A **klystron** is a specialized linear-beam vacuum tube (evacuated electron tube). The pseudo-Greek word *klystron* comes from the stem form κλυσ- (*klys*) of a Greek verb referring to the action of waves breaking against a shore, and the end of the word electron.

An electron tube in which bunching of electrons is produced by electric fields and which is used for the generation and amplification of ultrahigh-frequency current.

Figure of klystron

A klystron looks and works something like an organ pipe

In an organ pipe:

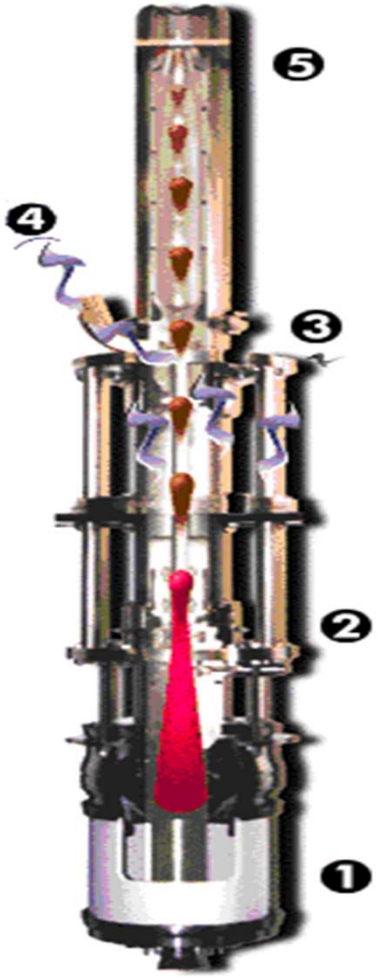
- Blowing into the organ pipe produces a flow of air.
- Flowing air excites vibrations in the cavity of the whistle.
- The vibrations flow into the surrounding air as sound waves.

Organ Pipe

A klystron looks and works something like an organ pipe

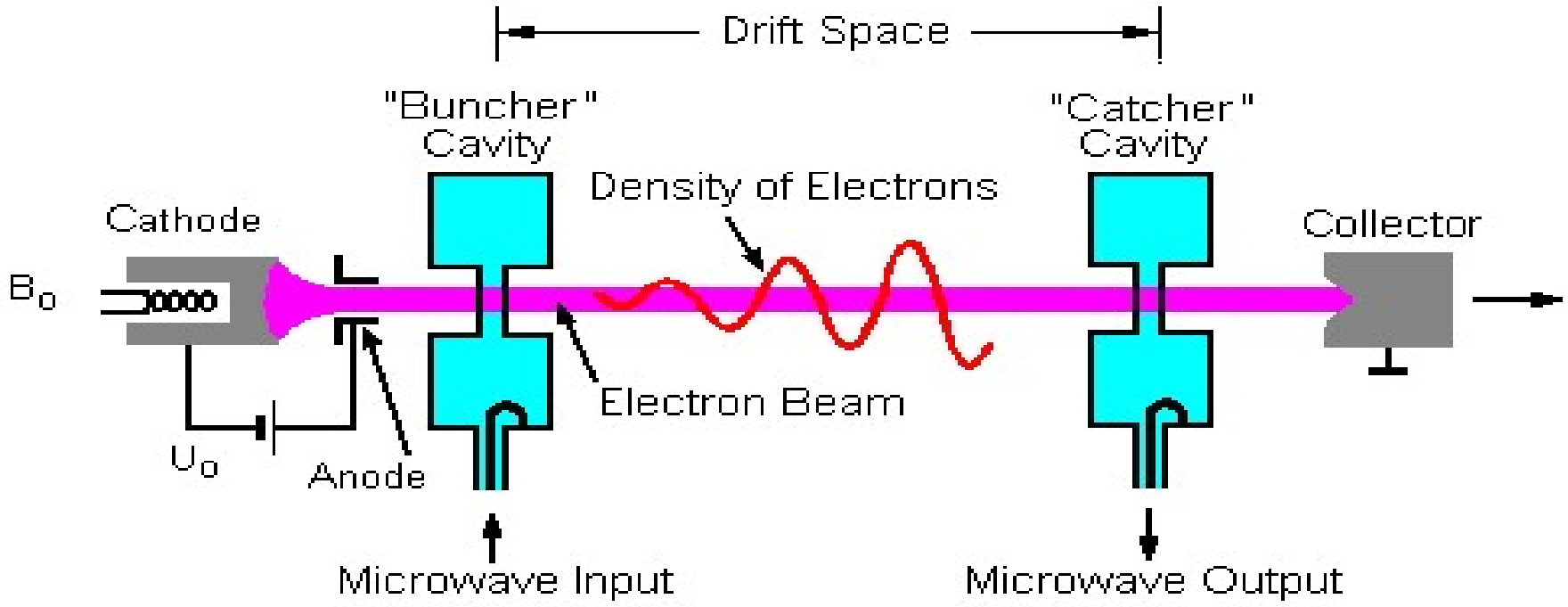
In a klystron:

- The electron gun produces a flow of electrons.
- The bunching cavities regulate the speed of the electrons so that they arrive in bunches at the output cavity.
- The bunches of electrons excite microwaves in the output cavity of the klystron.
- The microwaves flow into the wave guide, which transports them to the accelerator.
- The electrons are absorbed in the beam stop



klystron

Two-cavity klystron amplifier



In the two-chamber klystron, an electron beam from the cathode of an electron gun is injected into a resonant cavity. The electron beam is constrained by an axial magnetic field and is accelerated by a positive potential into a connecting passage (called a *drift tube*) to a second resonant chamber containing a positively charged anode.

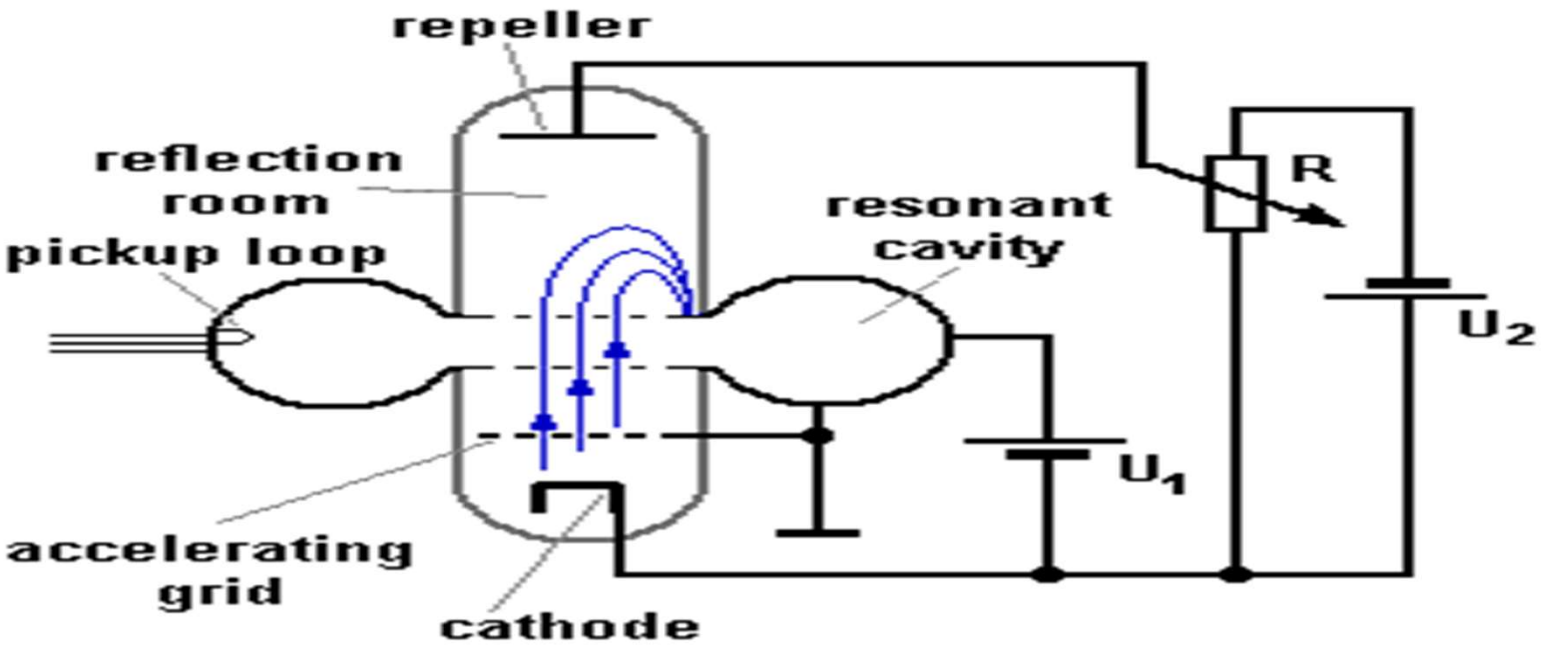
Characteristics of Two-cavity klystron

- Efficiency: about 40%
- Power out put: average power is up to 500 kW and pulsed power is up to 30 MW at 10 GHz
- Power gain: about 30 dB

Two-cavity klystron oscillator

- The two-cavity amplifier klystron is readily turned into an oscillator klystron by providing a feedback loop between the input and output cavities.
- Two-cavity oscillator klystrons have the advantage of being among the lowest-noise microwave sources available, and for that reason have often been used in the illuminator systems of missile targeting radars.
- The two-cavity oscillator klystron normally generates more power than the reflex klystron.

Reflex klystron



In the reflex klystron, the electron beam passes through a single resonant cavity. The electrons are fired into one end of the tube by an electron gun. After passing through the resonant cavity they are reflected by a negatively charged reflector electrode for another pass through the cavity, where they are then collected. The electron beam is velocity modulated when it first passes through the cavity.

Tuning klystron

- Some klystrons have cavities that are tunable. Tuning a klystron is delicate business that if not done properly can cause damage to equipment (klystrons can cost as much as a house or a luxury car) or even injury to the technician.

Optical klystron

- In an optical klystron the cavities are replaced with undulators. Very high voltages are needed. The electron gun, the drift tube and the collector are still used.

Floating drift tube klystron

- The floating drift tube klystron has a single cylindrical chamber containing an electrically isolated central tube. Electrically, this is similar to the two cavity oscillator klystron with a lot of feedback between the two cavities.

Applications

- Klystrons produce microwave power far in excess of that developed by solid state. In modern systems, they are used from UHF (100's of MHz) up through hundreds of gigahertz (as in the Extended Interaction Klystrons in the CloudSat satellite). Klystrons can be found at work in radar, satellite and wideband high-power communication (very common in television broadcasting and EHF satellite terminals), and high-energy physics (particle accelerators and experimental reactors).