Output power $P_{out} = \frac{\beta_0 I_2 V_2}{2}$

Max. Efficiency $\eta = 58.2\%$

Characteristics:

Efficiency $\approx 40\%$

Power output : Continuous wave average power $\approx$ 500 kW

Pulsed Power 30 MW at 10 GHz

Power Gain $\approx$ 30 dB

Applications:

i) Troposphere scatter transmitters

ii) Satellite communication ground stations

iii) UHF TV transmitters

iv) Radar transmitters.

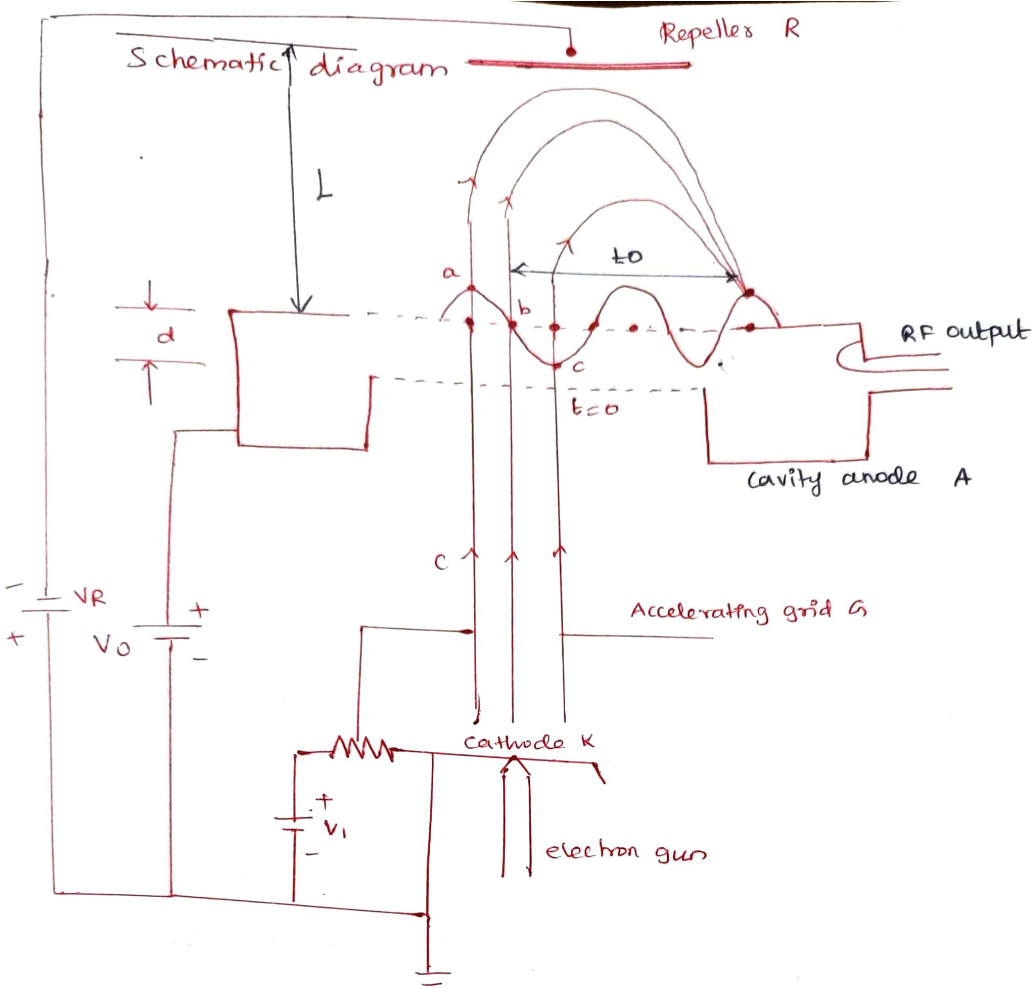
Reflex klystron Oscillator [Single cavity klystron]

The reflex klystron is an oscillator with a built in feedback mechanism. It uses the same cavity for both bunching and the output.

The repeller electrode - negative potential sends the bunched electron beam back to the resonator cavity. ⇒ Positive feedback mechanism which supports oscillations.

Mechanism of oscillation:

If the power delivered by the bunched electrons to the cavity is greater than the power loss in the cavity, the electromagnetic field amplitude at the resonant freq. of the cavity will increase to produce microwave oscillations.



Applegate Diagram:

The electrons passing thro' the buncher grids are accelerated / retarded / passed thro' with an unchanged initial dc velocity depending upon whether they encounter the RF signal field at the buncher cavity gap at positive / negative / zero crossing phase of the cycle, respectively shown by distance time plot. This is called the applegate diagram.

Modes of oscillation:

$$t_o = \left(n + \frac{3}{4}\right) T \qquad = NT$$

where, $N = n + 3/4$

mode of oscillation

$n = 0, 1, 2, 3 \ldots$

T is the time period at the resonant freq.

t_o is the time taken by the reference electron to travel in the repeller space.

Velocity Modulation

$$v(t_1) = v_0 \left[1 + \frac{\beta_i V_1}{2V_0} \sin\left(\omega t_1 - \frac{\theta_g}{2}\right) \right]$$

Round-trip dc transit time

$$T_0' = \frac{2mL v_0}{e(V_r + V_0)}$$

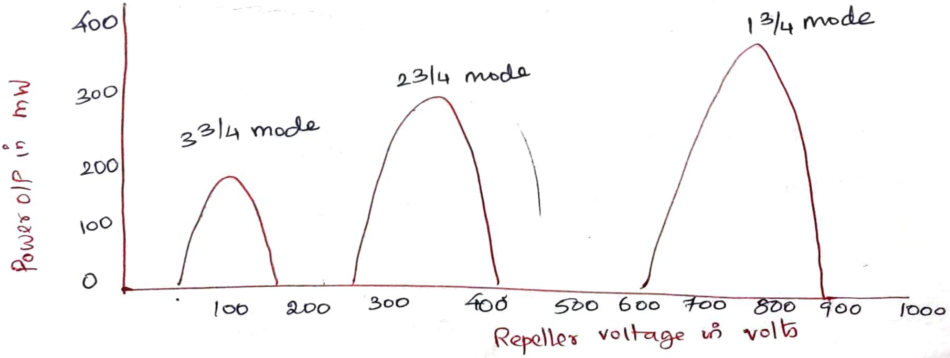
Round-trip dc transit angle

$$\theta_0' = \omega T_0'$$

Bunching Parameter $\quad X' = \frac{\beta_i V_1}{2V_0} \theta_0'$

Efficiency $\quad \eta = \frac{2X' J_1(X')}{2\pi n - \pi/2}$

Max. efficiency $\quad \eta_{max} = 22.78\%$.



Power o/p and freq. characteristics

Characteristics:

Freq. range : 1 to 25 GHz

Power output : Low-power generator of 10 to 500 mW

Efficiency : About 20 to 30%.

Applications:

- Laboratory microwave measurements
- In microwave receivers, as local oscillators in commercial and military applications
- In airborne Doppler radars as well as missiles

Outcome:

Able to analyze the amplification/oscillation process in two cavity and reflex klystron and derive velocity modulation equations.

—x— x—

Traveling-Wave Tube (TWT) Amplifier

Aim:

To understand the need of, slow wave structure used in microwave amplifiers & TWT operation.

Objective: To study the construction of TWT

Microwave resonators are tunable circuits used in microwave oscillators, amplifiers, wave meters and filters.

TWT - Construction:

It uses a helix slow wave non resonant microwave guiding structure and thus a broadband microwave amplifier.

* Electron beam
* Slow wave structure (structure supporting a slow electromagnetic wave)