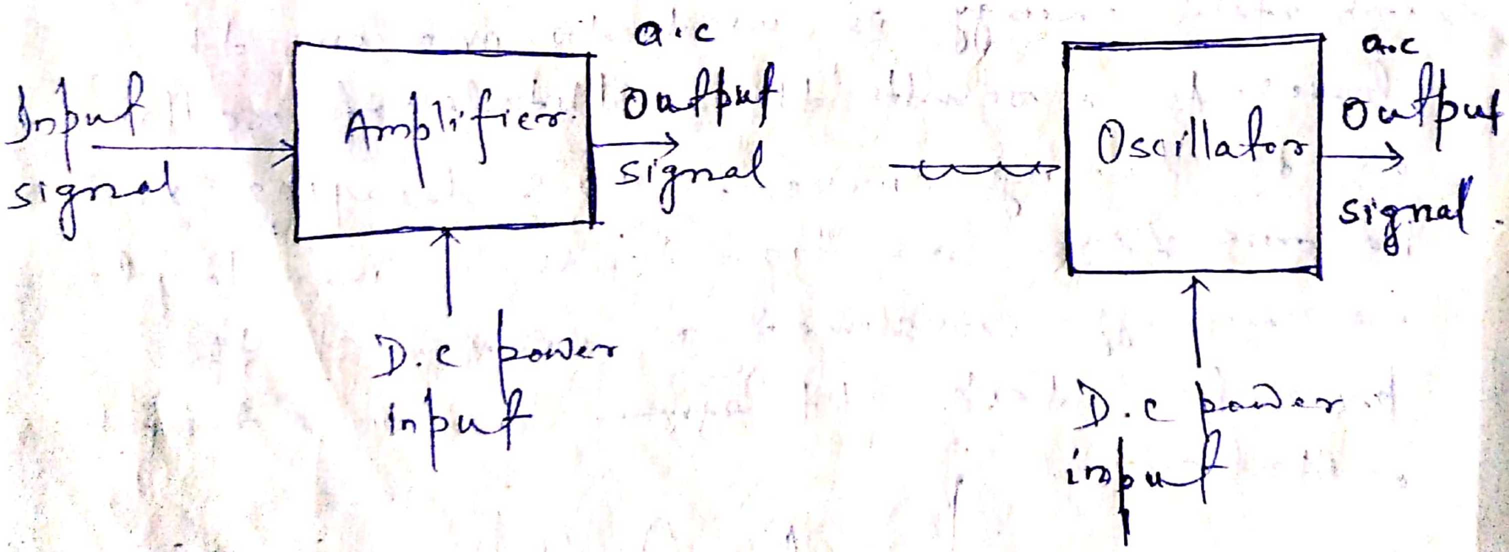
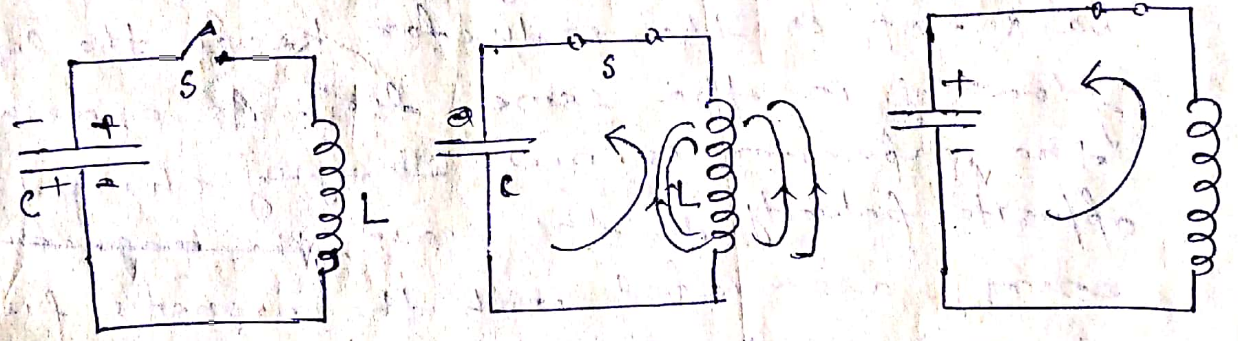
Oscillators.

An electronic device which generates alternating signal of desired or the device which converts the d.c input power in a.c output power without requiring any external input signal is called the Oscillator. Thus, an oscillator factions is opposite to the rectifier. The figure given below shows the block diagram of amplifier and oscillator



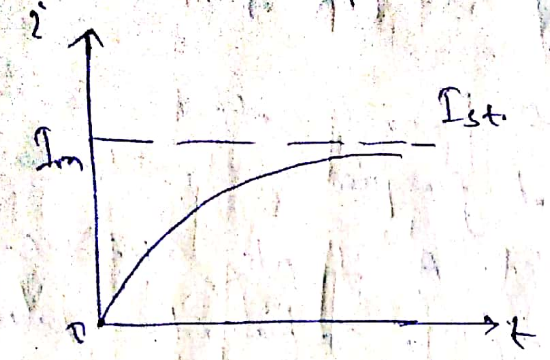
The oscillatory ckt (OR tank ckt)

A circuit which provide the electrical oscillation of any desired frequency is known as oscillatory ckt or tank ckt. A tank ckt consist of parallel combination of a capacitor and inductor. The frequency produced by tank ckt is determined by the value of L and c.
It should be remembered that the capacitor stores the energy in electric field in the form of electrostatic charge ($W_c = \frac{1}{2}CV^2$) whereas the inductor stores the energy in the magnetic field associated with inductor whenever current flowing through it. The fig. given below shows a tank circuit —

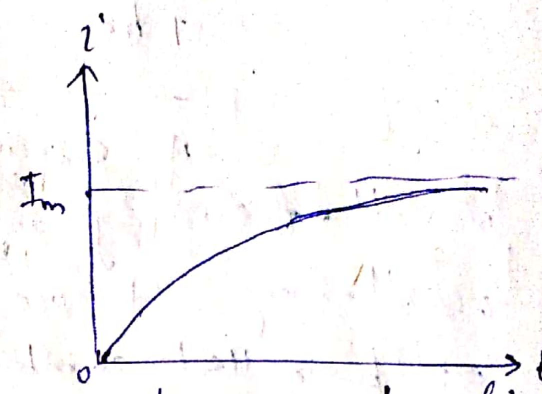


i) Let, capacitor is fully charged from an external d.c source. Here the switch S is open, hence capacitor does not discharge and corresponding to it no current flows through the ckt.

ii) Now, S is closed. As soon as S is made close, capacitor starts discharging through the inductor L. We know that inductor has a property due to which it opposes any change either dirn or magnitude of current flowing through itself. Hence the current through the ckt builds up slowly ~~the~~ and maxm current



Discharging proofile of RC- ckt.



charging proofile of LR ckt.

flows through the ckt when capacitor fully discharged. Thus, the electrostatic energy stored in capacitor ($W_c = \frac{1}{2} CV^2$) has been converted (or transfered) into the magnetic field energy stored in inductor ($W_L = \frac{1}{2} Li^2$).

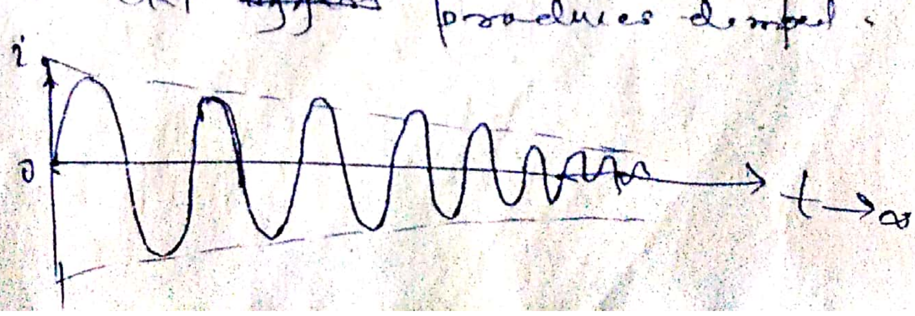
iii) When, the capacitor is completely discharged, the magnetic field begins to collaps. The back emf in the inductor keeps the current flowing in the same dirn. As a result the capacitor is now ~~charging~~ charged with opposite polarity. In this case, ~~the magnetic~~ energy associated with the magnetic field is now again converted into electrostatic energy. If, there is no dissipative resistance, the capacitor charge to the value of its initial condition.

And, again, when capacitor is completely charge and total energy in magnetic field associated with inductor is converted into electrostatic energy then capacitor again starts discharging in opposite dirn with respect to previous dirn.

The sequence of charging and discharging continues i.e interchanging ~~of~~ or oscillation of energy betn L and C is repeated again and again. The situation is similar to the phenomena of oscillating phenomena where the energy keeps on interchanging from potn energy to kinetic energy and kinetic energy to potn energy. So, the charging and discharging of capacitor through the inductor results in oscillating current and hence oscillations are set up ~~whose~~ in LC ckt, whose frequency is given by:

$$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$$

If there were no losses in tank ckt, then interchanging of energy ~~from~~ betn L and C would continue indefinitely. But we know that a practical inductor offers some resistance and dielectric medium of capacitor has some leakage, so, small part of the original ~~energy~~ imparted energy is used to overcome this losses. As a results, the amplitude of oscillation or oscillating current goes decaying and become zero as time tends to infinitely large or energy consumed as losses. So the practical tank ckt ~~offers~~ produces damped oscillation.



Difference betn amplifier and oscillator —

Amplifier	Oscillator
i) In an amplifier, the d.c power supplied is converted into a.c output power of the input signal frequency	i) While, in an oscillator d.c power is converted in a.c power without requiring any input signal.
ii) In amplifier, the frequency amplitude and waveform of output signal is controlled with input signal.	ii) While, the frequency, amplitude and waveform is controlled circuit itself. And frequency of generated power output is determined by passive elements used in ckt.

Difference betn alternator and Oscillator.

Oscillator	Alternator
i) An Oscillator is an electronic devices and it has no any rotating part.	i) While, An alternator is a mechanical device as it has rotating parts.
ii) It converts the d.c energy into a.c energy and freq. of output signal is determined by passive element of ckt.	ii) While, it converts the mechanical energy into electrical energy
iii) Oscillator produces the output a.c signal of very high freq (of MHz or GHz)	iii) While alternator produces a.c voltage of low frequency usually 50 Hz.

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iv> The operation of Oscillator is silent as it has no rotating part.	iv> The operation of alternator is noisy as it has rotating part.
v> There is no wear and tear losses	v> There exist some wear and tear losses.

Advantages of Oscillator over the alternator-

There are following advantages of Oscillator over the alternator —

i> Portable and cheap.

ii> Since Oscillator has no any rotating part, hence there is no wear and tear loss

iii> The operation of oscillator is silent.

iv> The frequency of oscillation may be varied conveniently.

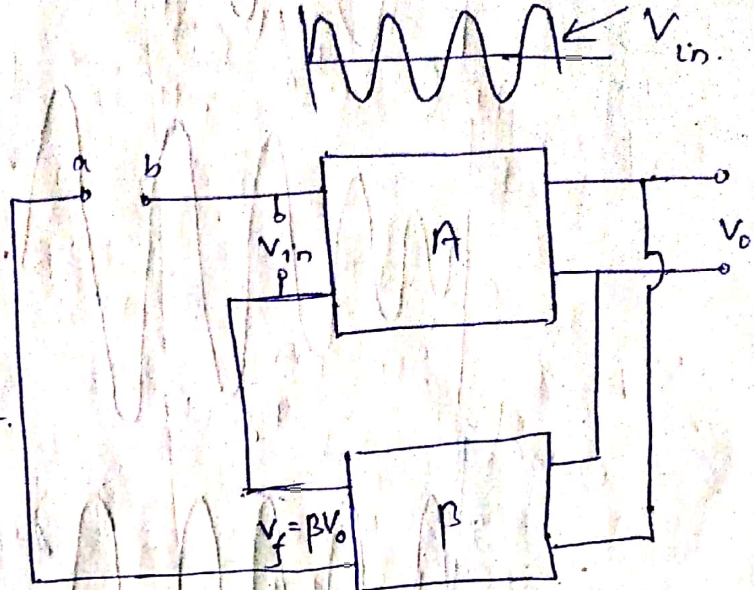
v> The voltage or current of any frequency adjustable over wide range can be generated

vi> The frequency once set remains constant for a considerable period of time

vii> High operation frequency due to the absence of moving part.

Operation of Oscillator

The operation of Oscillator can be understand with the help of the feedback ckt as shown in fig.



Let,

A = Gain of basic amplifier

Aβ = Close loop gain

β = Feedback factor.

V_{in} = Input signal.

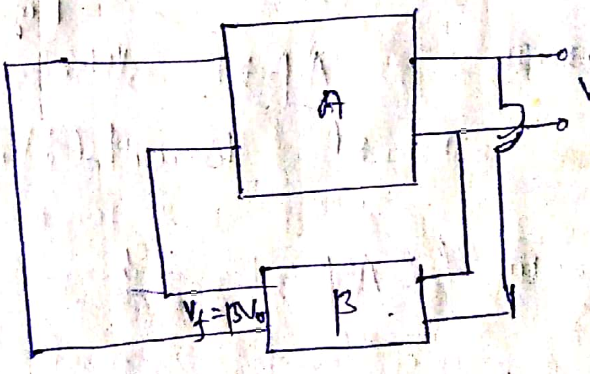
Since

$V_o = A V_{in}$.

Let, V_f is feedback voltage to the input

then,

$V_f = \beta V_o = A\beta V_{in}$.



Let,
(a – b) is connected after feedback and the input is disconnected from the terminal simultaneously.

Case-I If, $A\beta < 1$ then $A\beta V_{in} < V_{in}$.

i.e now the output $A\beta V_{in}$ is less than V_{in} and output signal die-out, as shown in fig – (a)

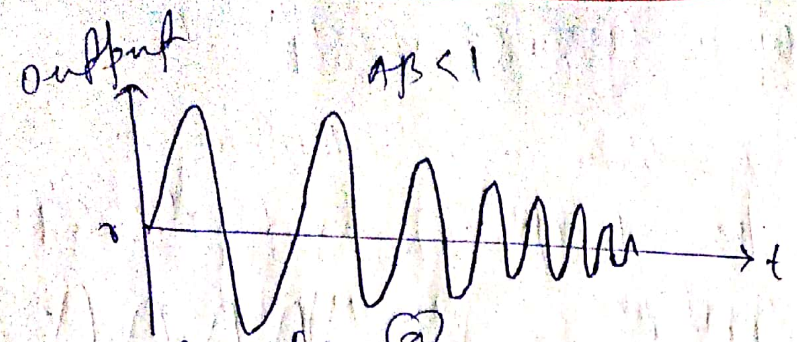


Fig- (a)

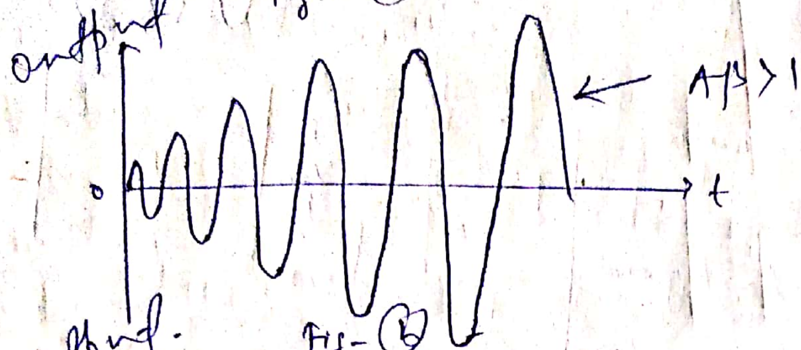


Fig- (b)

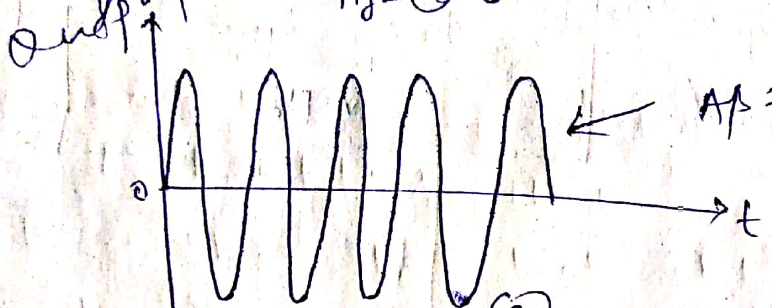


Fig- (c)

Case-II. If, $A\beta > 1$ then $A\beta V_{in} > V_{in}$ i.e output signal builds up as shown in fig-(b)

Case:-III If $A\beta = 1$ then $A\beta V_{in} = V_{in}$ i.e ~~frequency~~ output signal is a steady sinewave and frequency of oscillation sustains "$A\beta = 1$" is called Barkhausen criterion.

Hence certain condition must be ~~fullfil~~ fulfilled of frequency sustain. These Conditions are –

i> The loop gain of ckt i.e $A\beta$ must be equal (or slightly greater) to unity

ii> ~~The~~ phase shift around the ckt must be Zero. These two Cond^n are called ~~BRAKH~~ Barkhausen criterion.

There are two types of oscillators on the basis of nature of wave shape of generated signals —

i> **Harmonic oscillator** :– An oscillator that generates a sinusoidal waveshape or near to sinusoidal waveshape of finite freq. is called Harmonic oscillator

ii> **Relaxation oscillator** :– The oscillator that does not generates sinusoidal but square wave, triangular wave or shaw-tooth wave etc, is called Relaxation oscillator. Schmitt trigger is an example of Relaxation oscillator.

Difference betn Harmonic and Relaxation oscillator –

Harmonic osc.	Relaxation osc.
i> Generated waveshape are sinusoidal of finite freq.	i> Generated whaveshape are non-sinusoidal but square, triangular, shaw-tooth etc.
ii> Energy flow is always in one dirn from active to passive components	ii> While, energy is exchanged betn active and passive components.
iii> Frequency of oscillation is determined by feedback path	iii> Here frequency of oscillation is determined by basically charging and discharging time i.e, by time constant during energy exchange

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