Feedback and its Applications

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FEEDBACK

- **It is the process of taking part of the output signal and feeding it back to the input circuit.**
- **The fed back signal can be in phase with or out of phase with the original input signal.**
- **The amplifier that operates on the principle of feedback is known as feedback amplifier.**

TYPES OF FEEDBACK

1. Positive feedback (Regenerative)
2. Negative feedback (Degenerative)

If the original input signal and the feedback signal are in phase, the feedback is called as positive feedback.

However if these two signals are out of phase then the feedback is called as negative feedback.

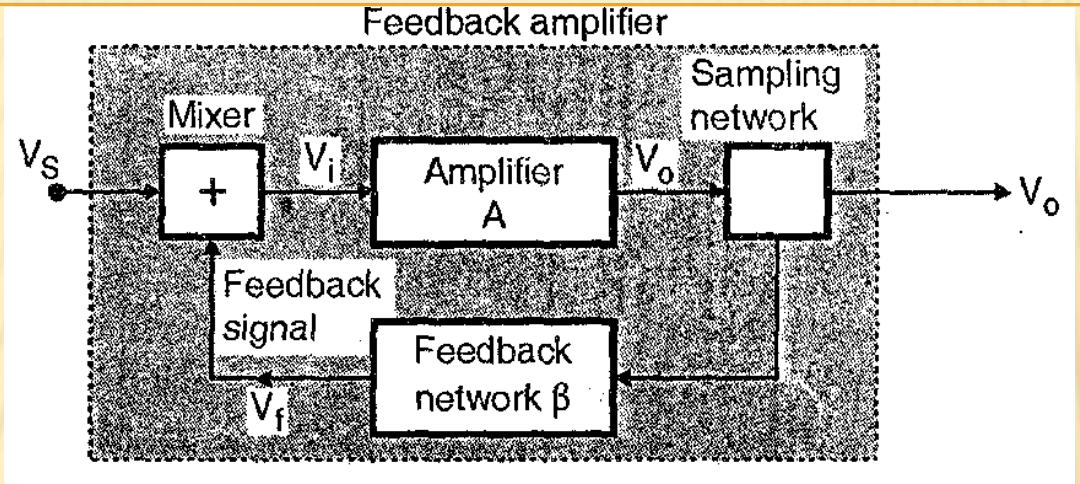
AMPLIFIER WITHOUT FEEDBACK

- The most important thing to understand from Fig. is that the output and input terminals of this amplifier are not connected to each other in any way.
- Therefore the amplifier of Fig. is an amplifier without any feedback,

Gain without feedback.

$$A = \frac{V_o}{V_i}$$

AMPLIFIER WITH FEEDBACK

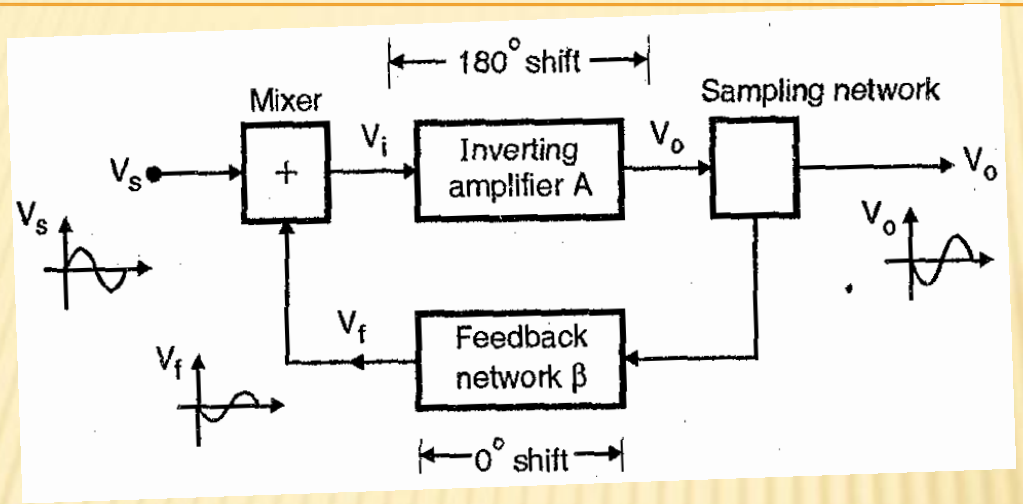


- Refer to Fig. Here the same amplifier with a gain A is being used along with a mixer network, sampling network and a feedback network.
- The voltage gain of the feedback amplifier is given by,

Gain with feedback

$$A_f = \frac{V_o}{V_s}$$

AMPLIFIER WITH A NEGATIVE FEEDBACK



- The block diagram of an amplifier with a Negative Feedback Fig.

$$V_f = \beta V_o$$

Where V_f = Feedback signal (output of the feedback network)

$$\text{Feedback factor } \beta = \frac{V_f}{V_o}$$

TYPES OF NEGATIVE FEEDBACK:

- Depending on the type of sampling and mixing networks, the feedback amplifiers are classified into four categories:

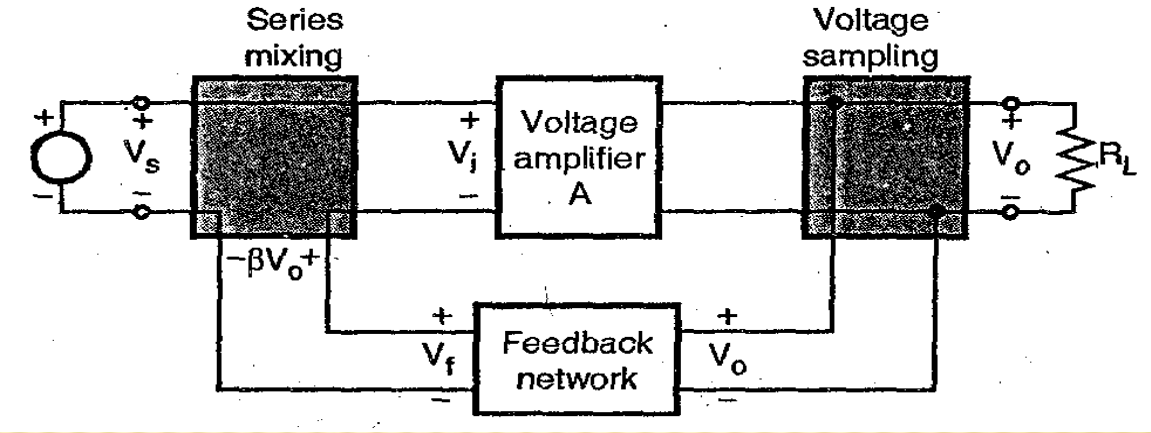
- Voltage series feedback
- Current series feedback
- Current shunt feedback
- Voltage shunt feedback

VOLTAGE SERIES FEEDBACK

Therefore,

voltage series feedback = voltage sampling + series mixing

The voltage series feedback is present in the voltage amplifiers.



A transistor amplifier which uses the voltage series feedback is the common collector or emitter follower amplifier:

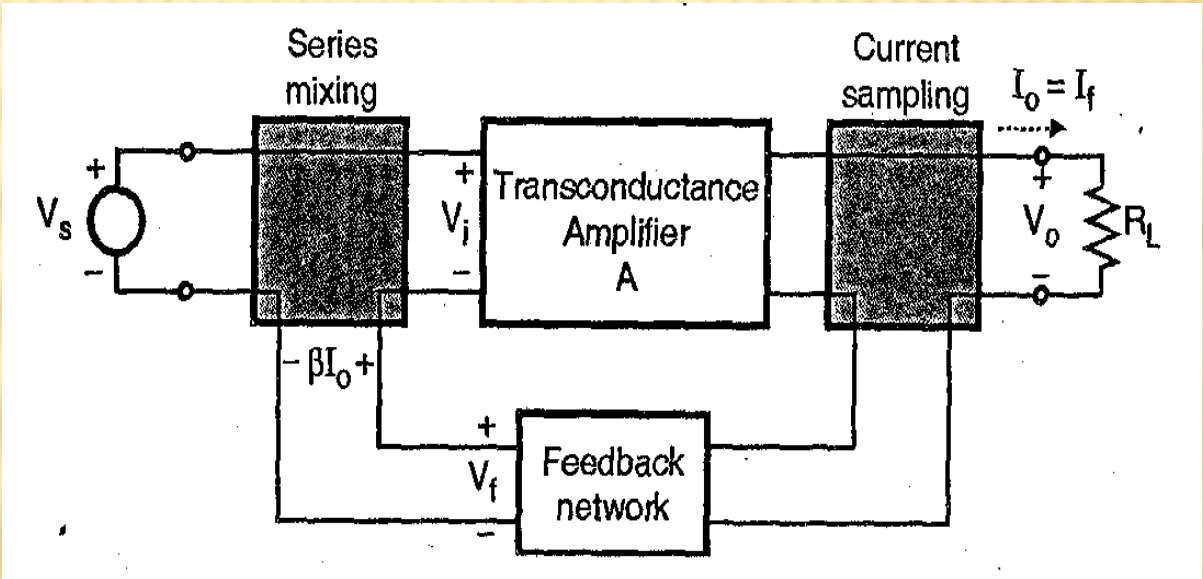
1. A common collector (or emitter follower) amplifier using BJT.
2. A common drain (or source follower) amplifier using FET.

CURRENT SERIES FEEDBACK

Therefore

Current sampling + Series mixing.

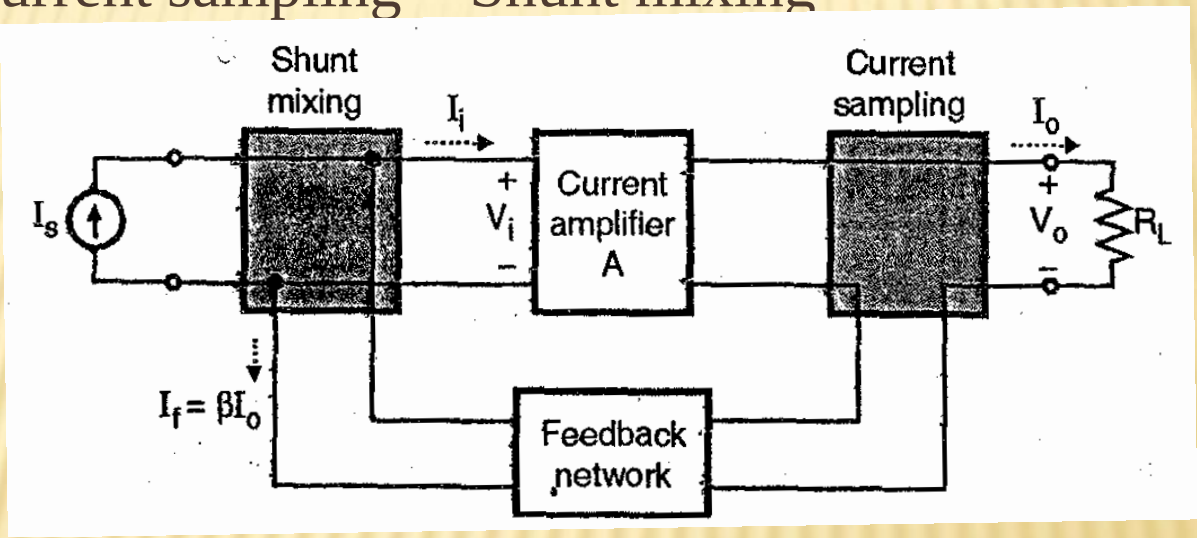
- Current series feedback is present in the transconductance amplifiers.



CURRENT SHUNT FEEDBACK:

- This is a combination of current sampling and shunt mixing. The block diagram of a feedback amplifier with current shunt feedback is shown in Fig.

Current sampling + Shunt mixing



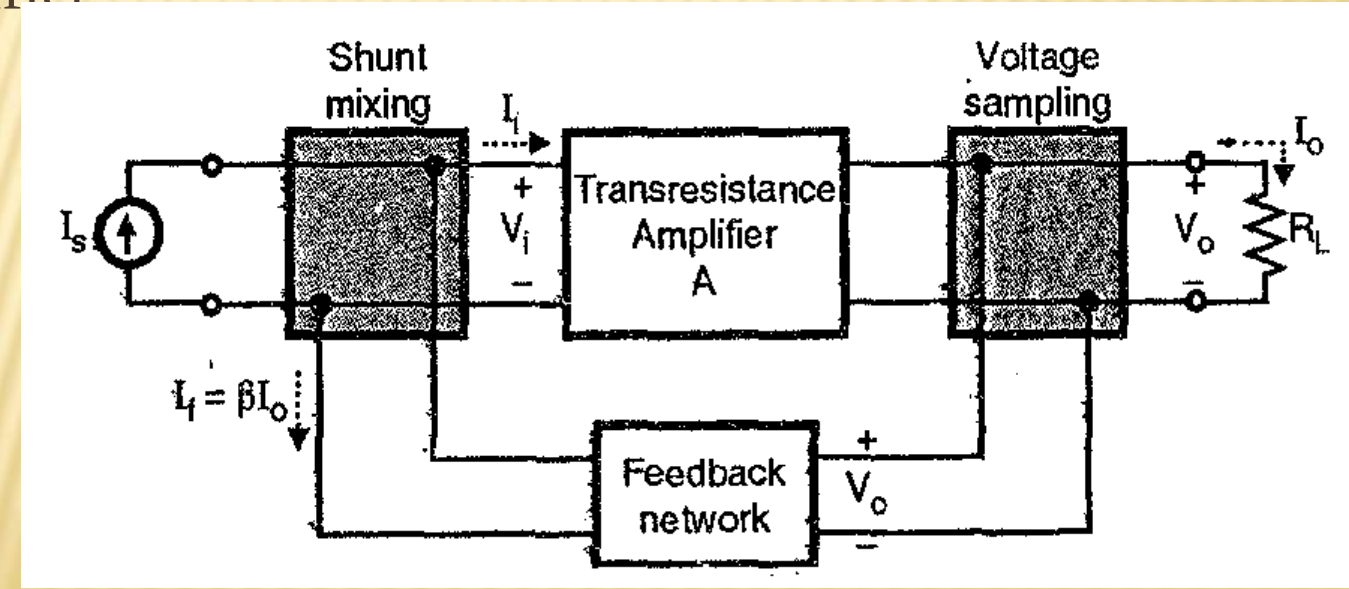
- Current shunt feedback is present in the current amplifiers.

VOLTAGE SHUNT FEEDBACK

- The block diagram of an amplifier with voltage shunt feedback amplifier is shown in Fig.

  Voltage Shunt Feedback = Voltage Sampling + Shunt Mixing.

- The voltage shunt feedback is present in the transresistance amplifier



ADVANTAGES & DISADVANTAGES

Advantages

- Negative feedback stabilizes the gain of the amplifier.
- Input resistance increases for certain feedback configurations.
- Output resistance decreases for certain feedback configurations.
- Operating point is stabilized.

Disadvantage

- Reduction in gain.

Applications of negative feedback

- In a1most all the electronic amplifiers.
- In the regulated power supplies.
- In amplifiers (amplifiers having a large bandwidth)

Positive Feedback

- Positive feedback : If feedback signal is applied in such a way that it is in phase with the input signal and thus input signal increases, then it is called as positive feedback.

The application of positive feedback is in oscillators.

OSCILLATORS INTRODUCTION

- An oscillator is an amplifier, which uses a positive feedback and without any external input signal, generates an output waveform of a desired frequency.
- An oscillator is basically a waveform generator which generates an output waveform, which oscillates with constant amplitude & constant desired frequency.

TYPES OF OSCILLATIONS

- **Damped oscillation**
- **Undamped or sustained oscillation**

The electrical oscillation whose amplitude goes on decreasing with time are known as damped oscillation.

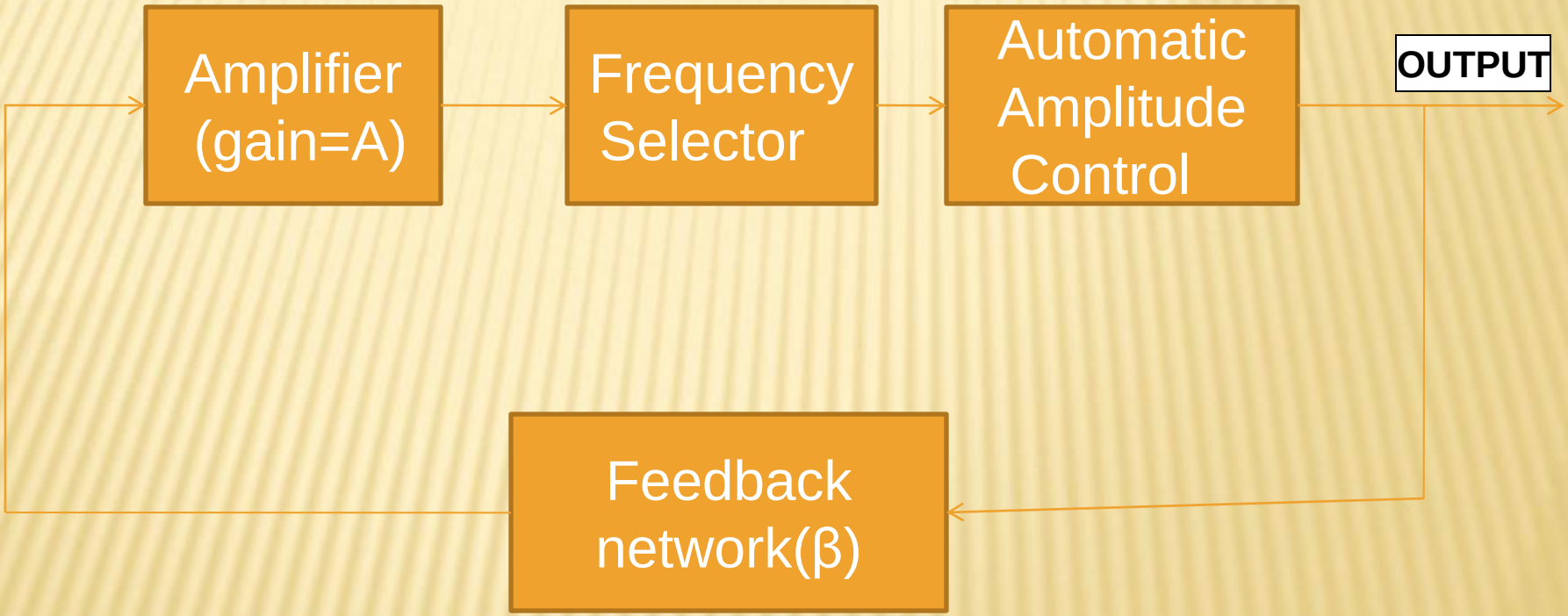
The electrical oscillations whose amplitude remains constant with time are known as undamped oscillations.

Conditions for oscillations

BARKHAUSAIN Criterion

1. The loop gain $|A\beta| = 1$.
2. The phase shift around the circuit must be 360 or 0 degree.

BASIC BLOCK DIAGRAM OF TRANSISTORIZED OSCILLATOR



- **Oscillation circuit** it is basic tank circuit (LC circuit) which is used to produce frequency of oscillation

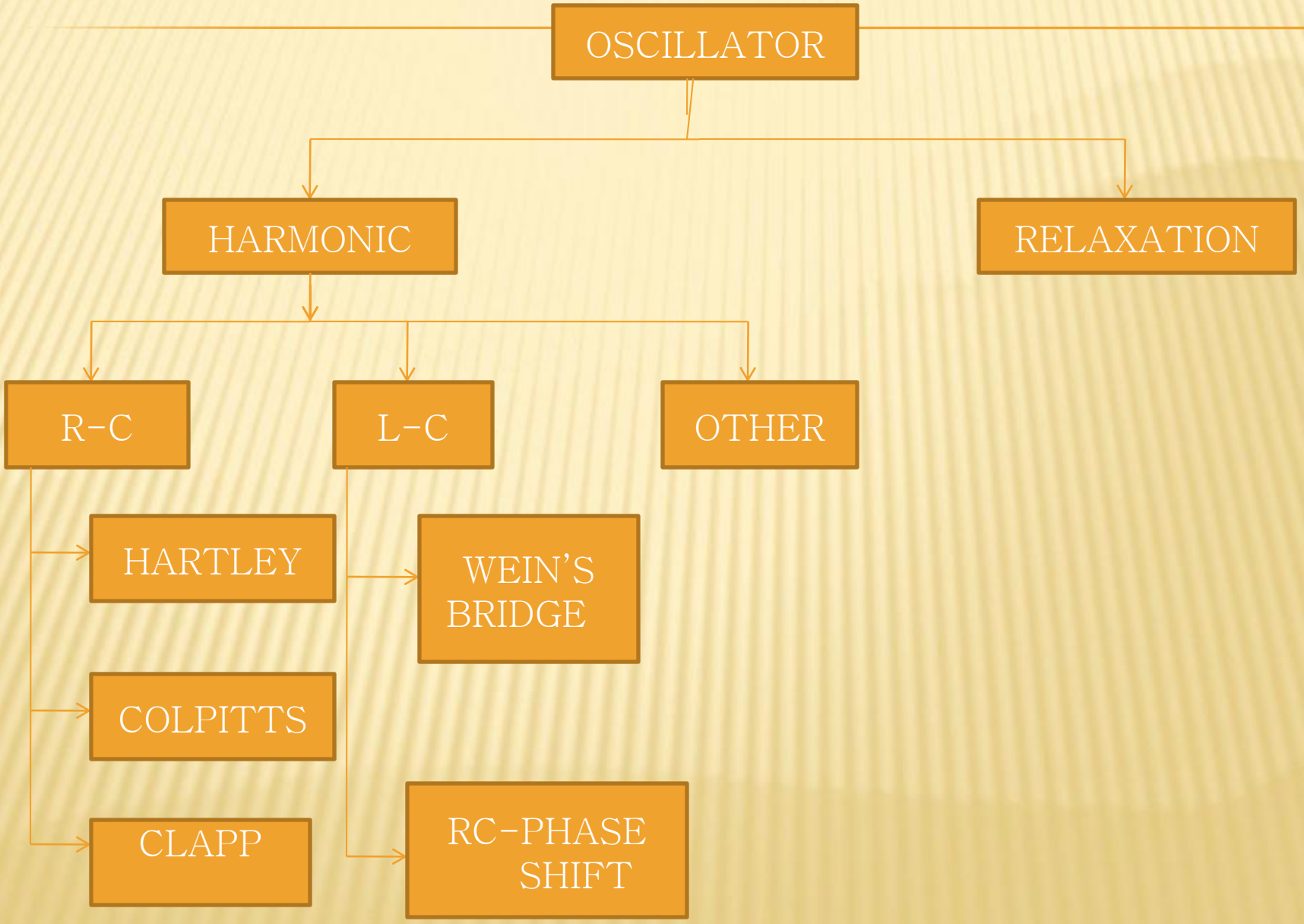
$$f = 1/2\pi(LC)^{1/2}$$

- **Electronic amplifier** receive dc power from battery & convert into the ac power for supply to the tank circuit.

- **Feedback network** it is supplied output part to tank circuit to the electronic amplifier.

- **Frequency Selector:** Oscillator must be able to provide oscillation of any desired frequency , therefore frequency selector is provided.
- **Automatic Amplitude Control:** If for any reason, the amplitude of oscillations in the output increases, it may continue to increase on account of feedback. Therefore to overcome this problem an automatic amplitude control unit is provided.

TYPES OF OSCILLATORS


OSCILLATOR
HARMONIC
RELAXATION
R-C
L-C
OTHER
HARTLEY
COLPITTS
CLAPP
WEIN'S BRIDGE
RC-PHASE SHIFT

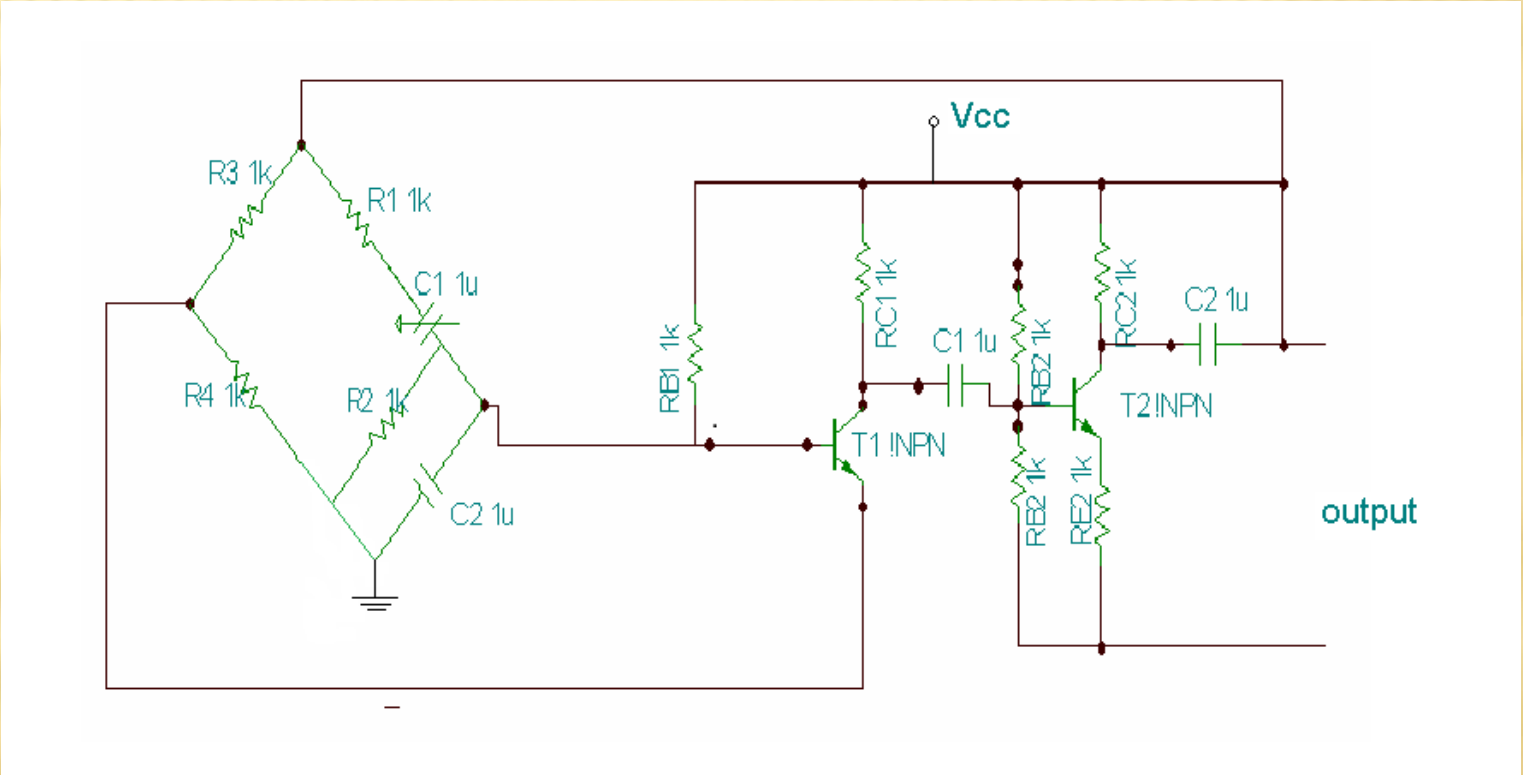
HARMONIC OSCILLATOR

- The harmonic oscillator produces a sinusoidal output. It means energy is transformed from active to passive components mostly and consume by them.

Wein bridge oscillator

- It’s output is free from distortion and it’s frequency can be varied easily. However the maximum frequency output of a typical wein bridge oscillator is only about 1MHz.
- At all other frequency the bridge is off –balance (the voltage feedback and output voltage do not have the correct phase relationship for sustained oscillation).
- So bridge circuit can be used as feedback network for an oscillator provided that the phase shift through the amplifier is zero .

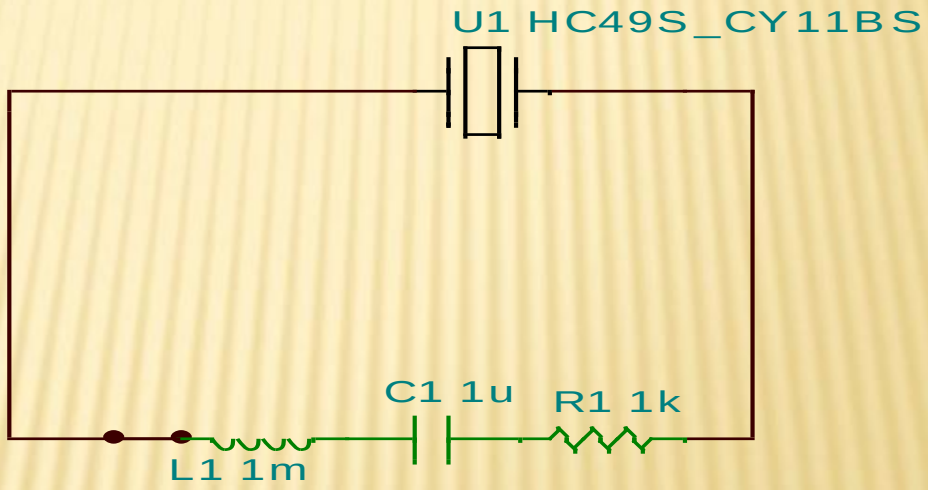
Circuit Diagram of Wein Bridge Oscillator



crystal oscillator

- A crystal oscillator is an electronic circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material (ex. –quartz,rochellesalt) to create an electrical signal with a very precise frequency.
- This frequency is commonly used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters.

Basic circuit diagram for Crystal Oscillator



Relaxation Oscillator

- A **Relaxation Oscillator** is an oscillator in which a capacitor is charged gradually and then discharged rapidly. It's usually implemented with a resistor, a capacitor, and some sort of "threshold" device such as a neon lamp, diac, uni junction transistor, or Gunn diode .

MERITS OF OSCILLATOR

- Portable and cheap in cost.
- An oscillator is a non-rotating device. Consequently, there is no wear & tear & hence longer life.
- Frequency of oscillation may be conveniently varied.
- Frequency once set remain constant for a considerable period of time.
- It operates at a very high efficiency since there is no wastage of energy due to friction.

OSCILLATORS V/S AMPLIFIER

Amplifier	*oscillator*
1. Negative feedback is applied.	1. Positive feedback is applied.
2. It strengthens the input signal without any change in frequency.	2. It strengthen the input signal causing change in waveform.
3. Require an external wave signal to be applied.	3. It just require a dc signal.