Unit→3

Lecture - 1

Transistor Biasing Circuits and Amplifiers

Q :- Explain the principle of +ve and –ve feedback is amplifiers . Describe how –ve feedback does improve the performance of an amplifier . Why is +ve feedback not often used to increase the gain of an amplifier ?

Sol : - **a) +ve feedback :-** When the feedback energy (voltage or current) is in phase with input signal and thus assists it , the feedback is said to +ve or regenerative.

$$\boxed{A_f = \frac{e_0}{e_s} = \frac{A}{1-\beta A}}$$

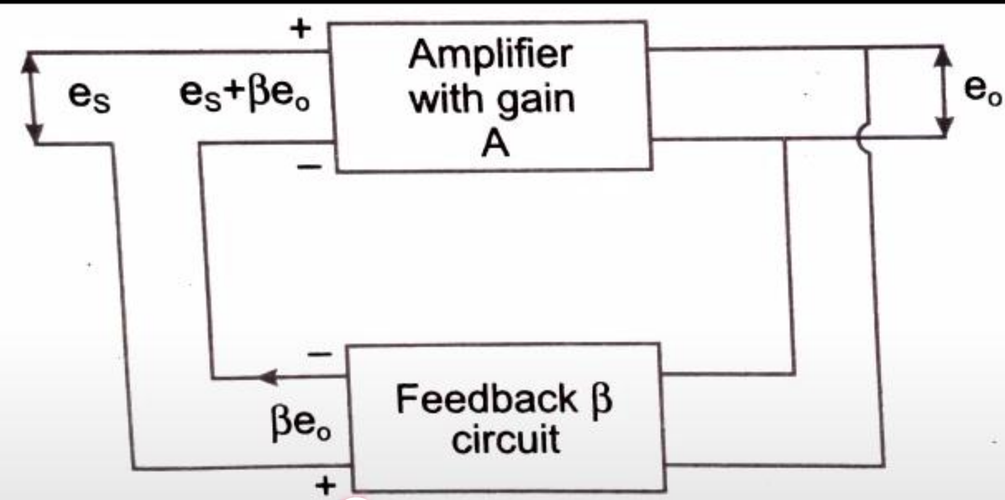

Fig. (a)

b) –ve feedback :- when the feedback energy (voltage or current) is 180 out of phase with the input signal and thus opposes it , the feedback is said to be –ve or degenerative.

$$A_f = \frac{e_0}{e_s} = \frac{A}{1+\beta A}$$

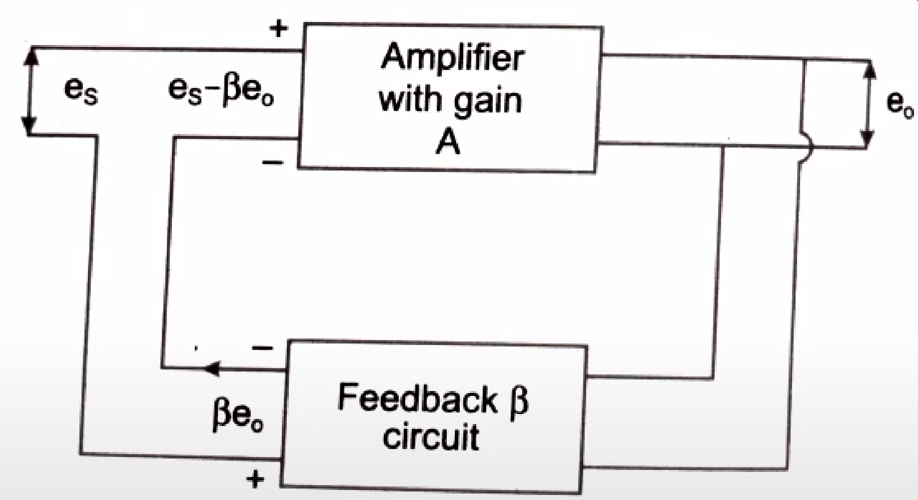

Fig. (b)

Advantage of –ve feedback :-

i) –ve feedback increase the stability of gain of amplifier.

ii) -ve feedback reduce non linear distortion.

iii) -ve feedback reduce frequency or attention distortion.

iv) -ve feedback reduce phase or delay distortion.

v) -ve feedback reduce input impedance.

vi) -ve feedback reduce output

i) –ve feedback increase the stability of gain of amplifier.

We know that gain of amplifier

$$A_f = \frac{e_0}{e_s} = \frac{A}{1+\beta A} \qquad 1$$

$$\beta A \gg> 1$$

$$A_f = \frac{A}{\beta A}$$

$$\boxed{A_f = \frac{1}{\beta}}$$

The gain of amplifier depends on the property of –ve feedback .

In –ve feedback gain does not change with transistor . So the amplifier will be stable.

$$d\,A_f = \frac{dA\times(1+\beta A)-d(1+\beta A)\times A}{(1+\beta A)^2}$$

$$d\,A_f = \frac{dA+\beta A dA-A\beta dA}{(1+\beta A)^2}$$

$$d\,A_f = \frac{dA}{(1+\beta A)^2} \qquad \text{--- 2}$$

On dividing 1 by 2

$$\frac{\mathrm{A_f}}{\mathrm{d\,Af}} = \frac{\frac{1}{\beta}}{\frac{dA}{(1+\beta A)^2}}$$

$$\frac{\mathrm{A_f}}{\mathrm{d\,Af}} = \frac{\mathrm{A}(1+\beta A)}{dA}$$

$$\frac{d\mathrm{A_f}}{\mathrm{A_f}} = \frac{dA}{\mathrm{A}(1+\beta A)}$$

ii) -ve feedback reduce non linear distortion.

The non – linear distribution arise due to the curvature of output characteristics of transistor . A large input signals non – linear distortion the –ve feedback reduce non – linear distortion and D_n harmonic without feedback,

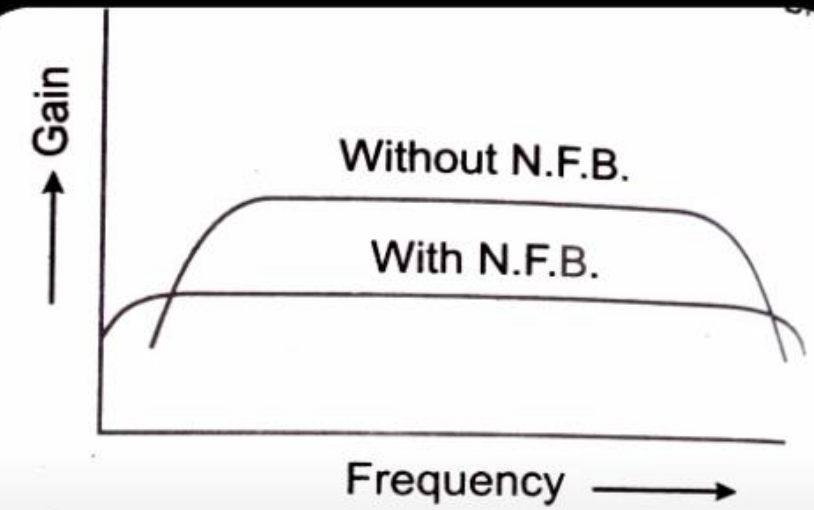

Fig. (c) Gain-frequency response curve of an *R-C* coupled amplifier with and without negative feedback.

$$D_n = \frac{e_n}{e_1} \quad \text{--- $\cdot\cdot$ --- $\cdot\cdot$ ---} \quad 1$$

Let e_n and e_n' be amplitude of n[th] harmonic βe_n and $\beta e_n'$.

$$e_n' = e_n - A\,\beta e_n'$$

$$\frac{e_n'}{e_n} = \frac{A}{1+\beta A} \quad \text{--- $\cdot\cdot$ --- $\cdot\cdot$ ---} \quad 2$$

Now ,

$$\frac{e_n'}{e_n} = \frac{e_n' \times e_1}{e_n' \times e_1}$$

$$\frac{e_n'}{e_n} = \frac{e_n' \times e_1}{e_n \times e_1}$$

$$\frac{e_n'}{e_n} = \frac{e_n' / e_1}{e_n / e_1}$$

$$\frac{e_n'}{e_n} = \frac{D_n'}{D_n} \quad \text{--- $\cdot\cdot$ --- $\cdot\cdot$ ---} \quad 3$$

From eq^n 2 and 3

$$\boxed{\frac{D_n'}{D_n} = \frac{1}{1+\beta A}}$$

iii) -ve feedback reduce frequency or attention distortion.

This distortion is due to the variation in the gain of an amplifier with frequency . $\beta A \gg> 1$, $A_f = \frac{1}{\beta}$ is independent of frequency then overall gain becomes independent of frequency over the range of frequencies for which this condition is satisfied .

$\beta A \gg> 1$ and β independent of frequency is not satisfied then also the application of negative feedback cases a reduction in the distortion of amplifier . Gain frequency response curve of an R-C coupled amplifier with and without the application of –ve feedback . The constancy of the gain is seen to have been increased considerable range with the application of –ve feedback although this is achieved at the cost of a reduction in the gain of the amplifier.