7.1 FM Receiver :

[ASKED IN EXAM - DEC. 97 !!!]

In the previous chapter we have learnt about the FM generation and transmission. Now let us see how to receive the FM signal and demodulate it. The Fig. 7.1.1 shows the block diagram of a FM receiver. The first thing that strikes us is its similarity with the AM receiver. The FM receiver also operates on the principle of "superheterodyning", as the AM receiver.

However eventhough the AM and FM receivers operate on the same principle and the blocks upto the IF amplifier are identical, the FM receiver is different from the AM receiver in the following way :

Difference between FM and AM Receivers :

(i) The operating frequencies in FM are much higher than in AM.

(ii) The FM receivers need the circuits like limiter and de-emphasis.

(iii) The FM demodulators are different from AM detectors.

(iv) The method to obtain the AGC is different in FM receivers.

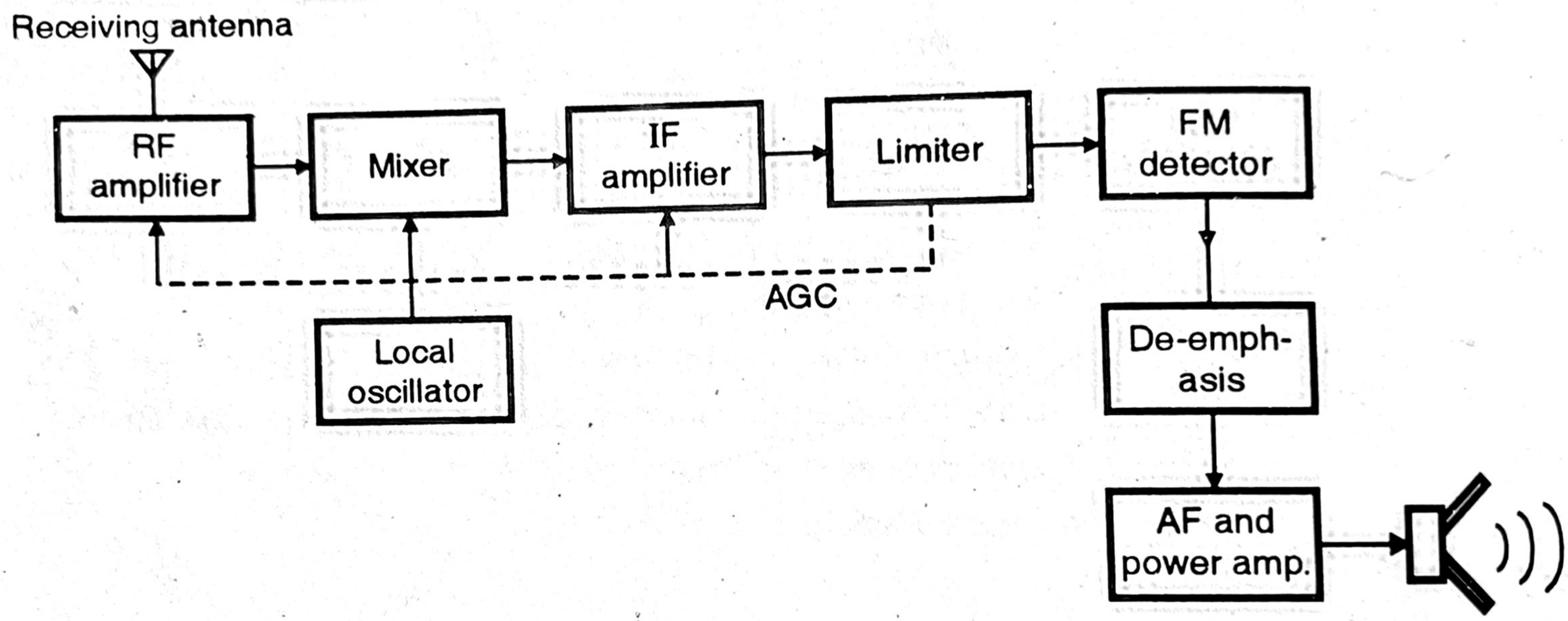

Fig. 7.1.1 : Block diagram of FM receiver

travelling, noise and other unwanted signals get added to it and change its amplitude. These unwanted amplitude changes in the received FM signal must be removed before the signal goes for demodulation. Otherwise distortion appears in the demodulated signal as the demodulators react to amplitude changes as well as frequency changes.

The amplitude limiter will remove all the unwanted amplitude variations from the received signal and it is always placed before the FM detector as shown in the block diagram of Fig. 7.1.1. The typical circuit diagram of the amplitude limiter is as shown in Fig. 7.1.3.

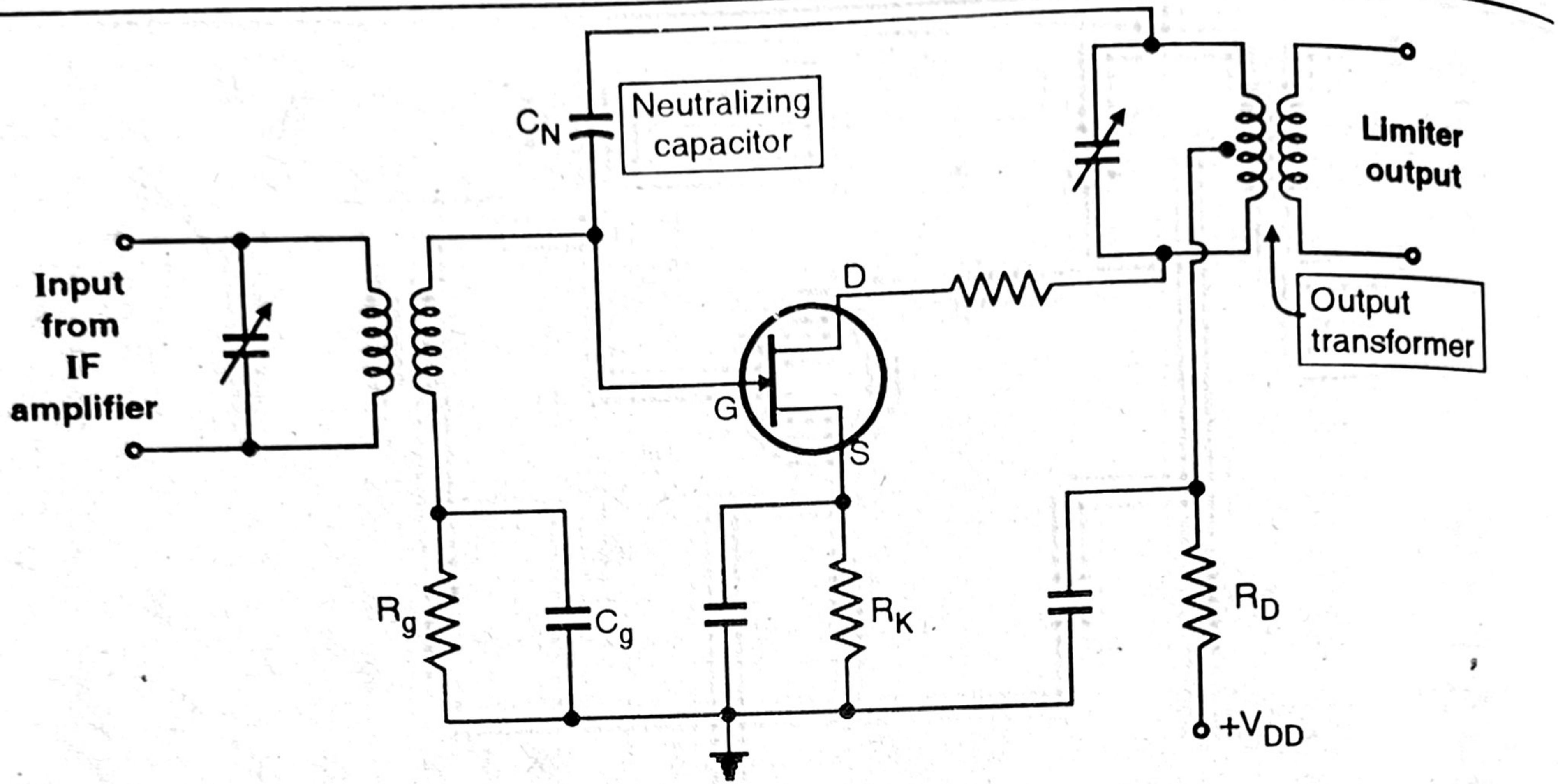

Fig. 7.1.3 : Amplitude limiter circuit

Operation of limiter circuit :

(i) The parallel combination of $R_g - C_g$ provides leak type bias to the gate of FET. Due to this a negative voltage is developed across the capacitor. This voltage increases with increase in the size of the input. Thus the gate terminal becomes more and more negative with increase in the input.

(ii) As a result of this the gain of amplifier reduces with increase in the size of input. This will maintain the output voltage constant. But this amplitude limiting action will take place over a limited range of input signal, as shown in Fig. 7.1.5.

(iii) Refer to the transfer characteristic of the limiter in Fig. 7.1.4. It shows that with increase in the input signal size, the peak amplitude of output current remains constant but the output current flows for a shorter period.

(iv) These current pulses are applied to the output tank circuit to produce the full sinewave output as we did in collector modulated class C amplifier circuit.

(v) In order to increase the effectiveness, the limiter circuit is operated at reduced supply voltages.

(vi) The limiting action starts at point "X" in the limiter characteristics in Fig. 7.1.5. Before this point there is no limiting. This point is therefore called as the "lower threshold of limiting". In the "Limiting range" the limiter output will remain constant. Beyond the point "Y" the output decreases even with increase in the input. The reason is that the angle of output current reduces so much that very less power is fed to the output tank circuit.

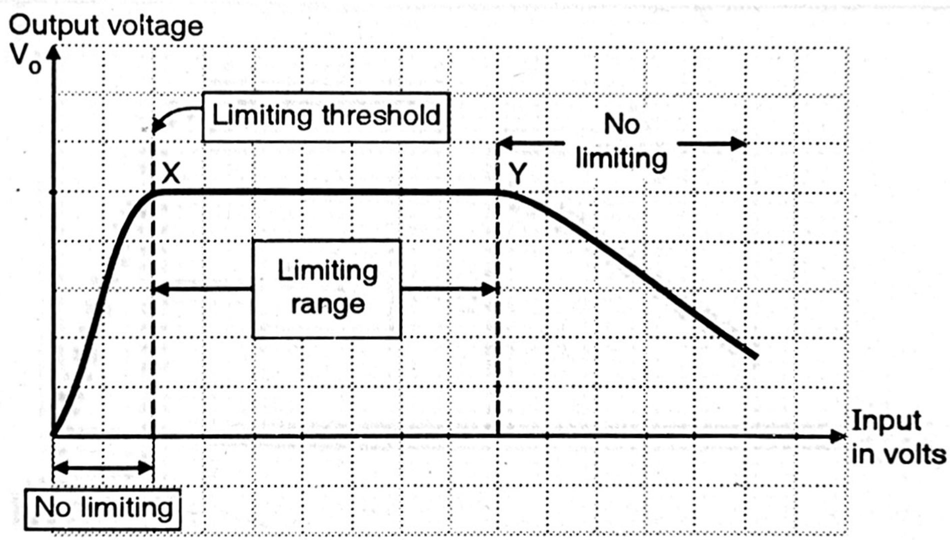

Fig. 7.1.5 : Response of the limiter circuit

7.3 Automatic Frequency Control (AFC) :

[ASKED IN EXAM - MAY 97, MAY 99, DEC. 2001]

In the FM receivers, the local oscillator frequency stability is a great problem. The drift in frequency may take place due to temperature changes or aging of the components etc. So in order to correct the frequency of the local oscillator automatically the AFC is used. The block diagram of AFC system is as shown in Fig. 7.3.1.

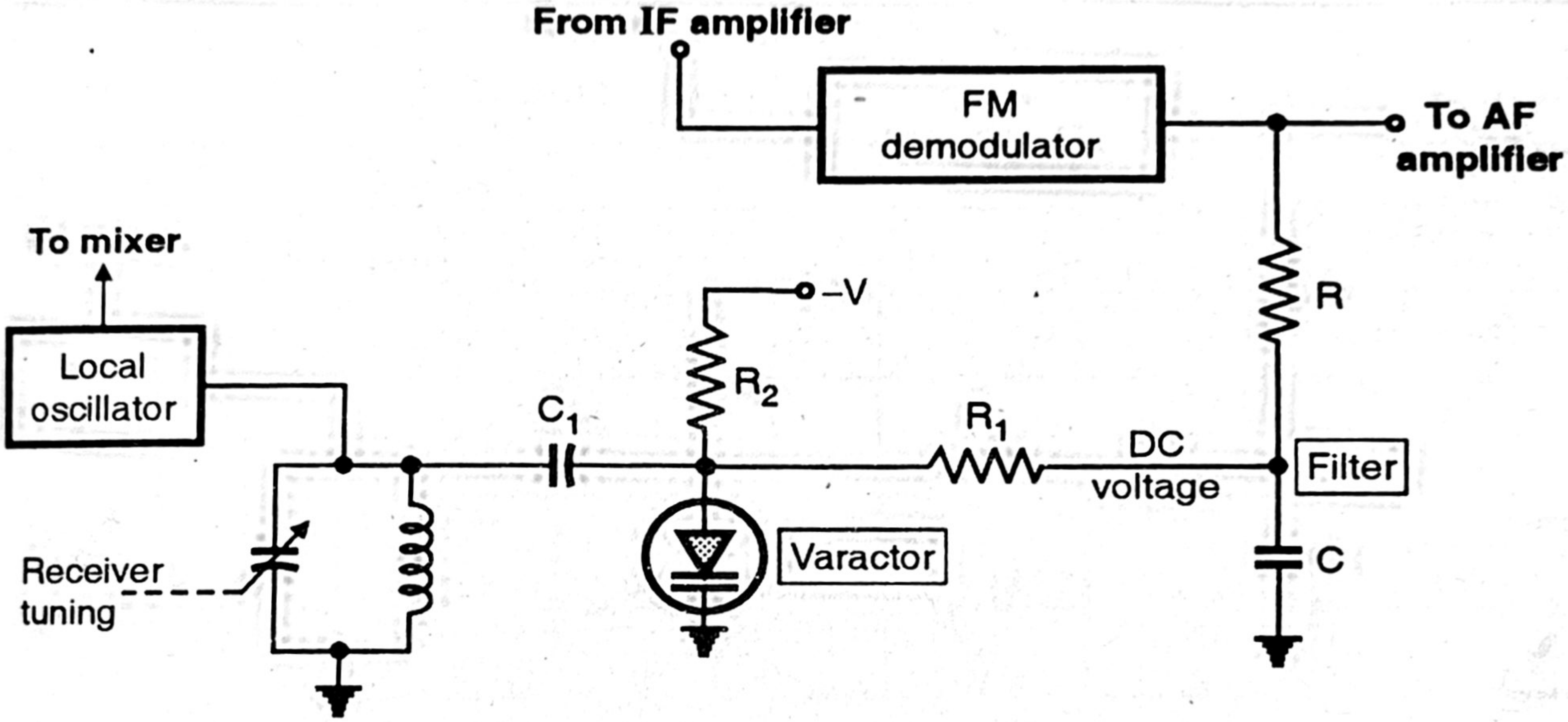

Fig. 7.3.1 : Automatic frequency control (AFC)

Operation :

In AFC some of the signal from the output of demodulator is filtered to get a dc voltage. This dc voltage is then used to control a varactor diode. As shown in Fig. 7.3.1 the dc bias applied to the varactor will vary with the drift in frequency. It can be positive or negative. This dc voltage will then vary the capacitance of the varactor diode, which is connected across the oscillator tank circuit. Thus the local oscillator frequency will be changed automatically to reduce the error to zero.

If the LO frequency increases above the desired frequency, then IF will increase. This produces a positive dc voltage at the output of the demodulator. This will cause the capacitance of varactor diode to increase and the local oscillator frequency to decrease.

7.4 Capture Effect in FM Receivers :