CHAPTER 2

RECEIVERS

Purpose of an aerial

1. The first element in the process of receiving a radio message is the aerial. An aerial can vary from a length of wire supported off the ground to a complex array designed to select only certain frequencies, but whatever its shape, its purpose is to detect the tiny amounts of 'em' energy radiated from the transmitter.

How does an aerial work?

'Em' waves induce very small voltages

2. If an aerial in the form of a length of wire is placed into an electromagnetic field, tiny voltages are induced in it. These voltages alternate with the frequency of the 'em' radiation and are passed to the receiver circuitry for processing. The signal strength that the aerial inputs to the receiver is very tiny the order of 5 μ(micro) volts (0.000005 volts). Therefore the receiver circuits have to be extremely sensitive. The circuits must also isolate the wanted signal from all the unwanted ones being received, and this is achieved by using tuned circuits. A tuned circuit simply allows a single frequency to pass, thus filtering out all the unwanted signals. The best known version of a tuned circuit is the "crystal set" or "cat's whisker" as it was called in the 1920's and 30's.

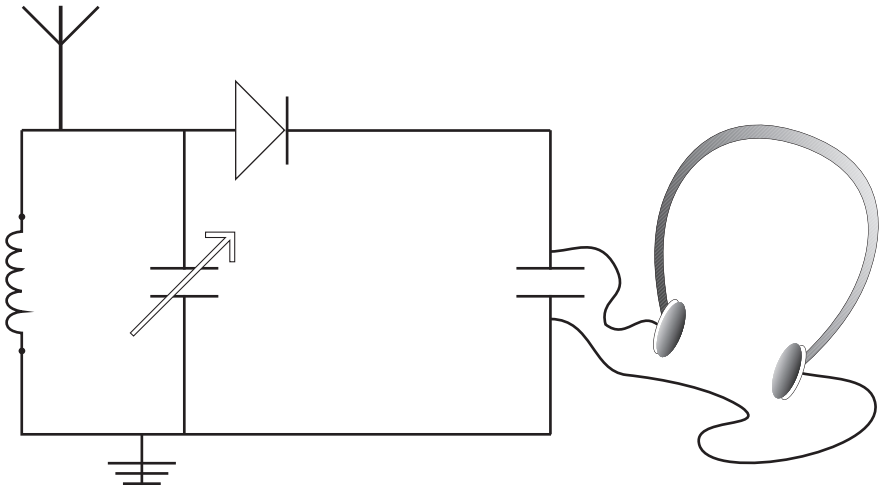


Fig 2-1: *The Crystal Set receiver*

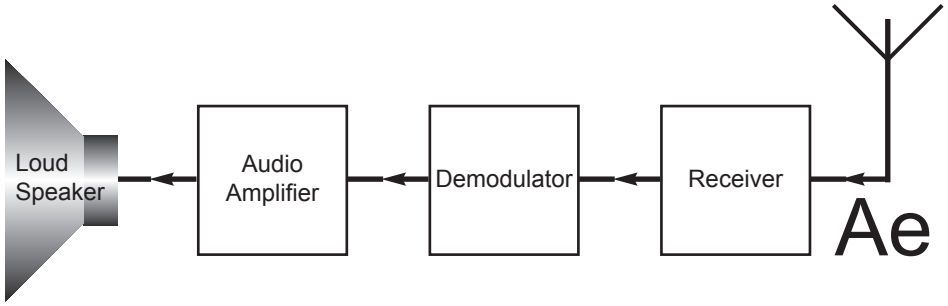


Fig 2-2: *A basic receiver layout*

Superhet Receivers

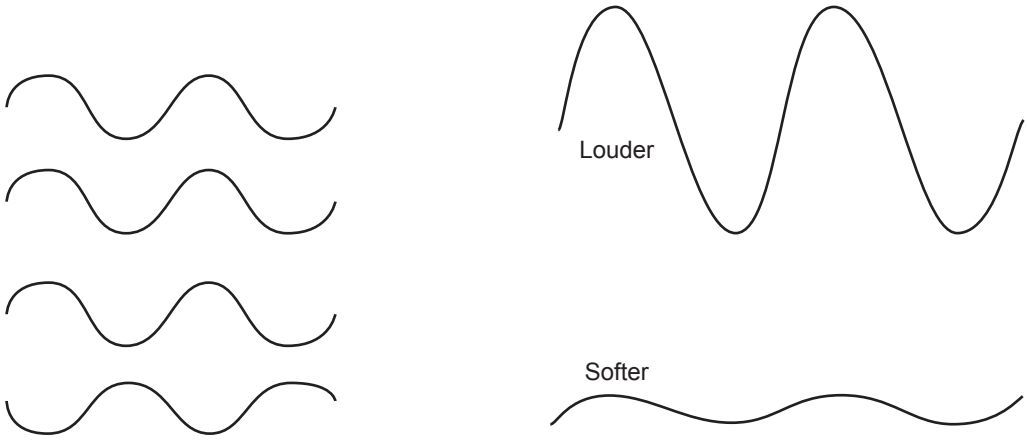
3. In those early models of receiver the problems encountered were noise (too much interference), poor amplification, limited selectivity, poor sensitivity (ability to remain on a station) and lack of fidelity (quality of sound).

Heterodyne receivers uses beats

4. To overcome some of these problems, the superheterodyne (superhet) receiver was developed. Heterodyne is the term used to describe the mixing of one frequency with a slightly different frequency to produce something called "beats".

5. If two notes of nearly equal frequency are sounded together, a periodic rise and fall in intensity (i.e. a beat) can be heard. You can sometimes hear this when a twin-engined propeller-driven aircraft flies overhead. If the pilot has not adjusted the engines to identical rpm, you hear a "wow-wow" instead of a steady note. The beat frequency is always the numerical difference between the two frequencies. For example, if an audio note of 48 Hz is sounded together with one of 56 Hz then the rhythmic beat of 8 Hz (56 - 48) would be heard.

Fig 2-3: *Beat diagram showing softer and louder tones*



The same applies to radio waves, where the beat becomes an added frequency known as an intermediate frequency (IF). If a radio frequency (RF) signal with a frequency of 3,550 MHz is received and mixed with an IF of 3.551 MHz (1 KHz higher), a beat frequency of 1 KHz would be the result. This lower radio frequency can now be processed more effectively by the receiver's electronic circuits than the higher radio frequencies. The schematic at Fig 2-4 shows the components of a typical superhet receiver.

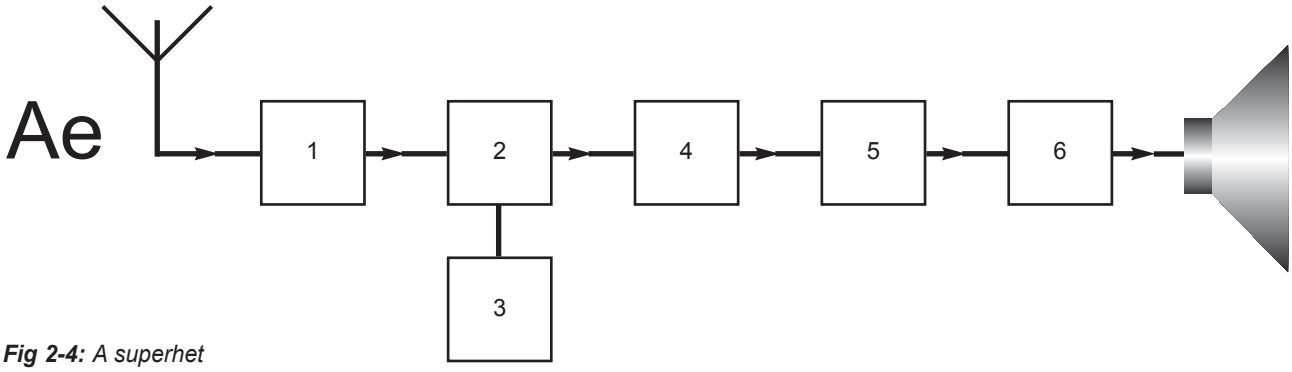


Fig 2-4: *A superhet receiver*

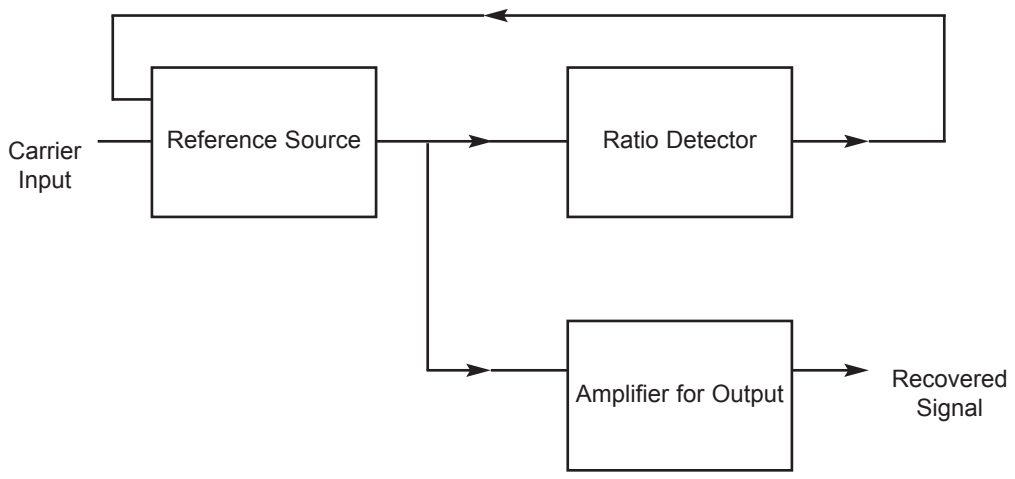
1	**RF Amplifier**	improves sensitivity and selectivity (not used on all receivers).
2	**Mixer**	changes the frequency, combines incoming with the Local Oscillator (LO) to give Intermediate Frequency (IF).
3	**LO**	produces a constant frequency (different from incoming).
4	**IF Amplifier**	usually 2 or more stages. Amplifies the mixer output (gives most of gain).
5	**Demodulator (detector)**	extracts the intelligence from the RF signal.
6	**Audio Frequency Amplifier**	increases the signal to required levels of output devices (speaker / headphones).

FM Receivers

FM receivers use discriminators

6. Reception on the AM bands is limited in both quality of reproduction and bandwidth availability. FM systems are less likely to be affected by "noise" and give increased signal performance. The FM receiver circuitry is similar to the AM system but uses a discriminator (also called a ratio detector) in place of a demodulator. The discriminator is a circuit which has been designed to detect small differences in frequencies. These differences are converted to a voltage output that represents the AF component input.

Fig 2-5: *FM signal recovery through use of a ratio detector*



Self Assessment Questions

Do not mark this page in any way! Write your answers on a separate piece of paper

1. What is the purpose of an aerial on a receiver?
   a. To convert the electromagnetic waves ('em') into tiny voltages
   b. To convert the electromagnetic waves ('em') into large voltages
   c. To convert the electromagnetic waves ('em') into very large voltages
   d. To convert the electromagnetic waves ('em') into a constant voltage

2. What does superheterodyne receivers make use of?
   a. Bleats
   b Boats
   c. Beats
   d. Bullets

3. What do FM receivers use to demodulate signals?
   a. Distractor
   b Modulator
   c. Discriminator
   d. Disputer