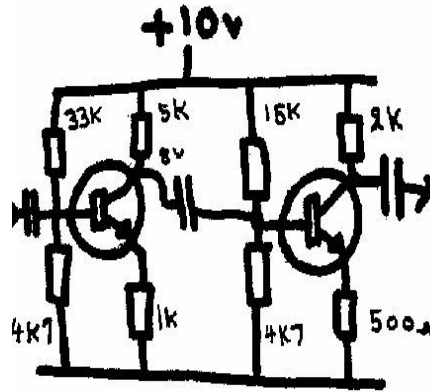


Two Stage Transistor Audio Amplifier

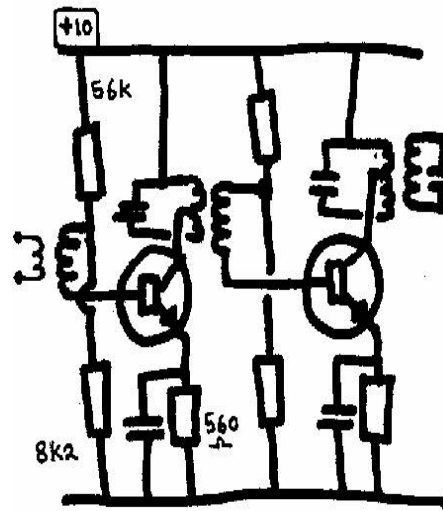
This circuit shows why it is necessary to include a coupling capacitor between the two stages. If there were a direct connection between TR1 collector and TR2 base then the second transistor would be destroyed due to incorrect biasing. The coupling capacitor passed the AC signal but blocks the DC voltage.



Tuned Two Stage Transistor Amplifier

Radio receivers use amplifiers that are designed for single frequencies or bands of frequencies.

The collector load resistor is replaced by a *double tuned transformer*. Note that the base bias is still determined by the base bias resistors that are then connected to the base via the secondary winding of the transformers.



The output impedance of the transistor, being very low, has to be matched to the tuned circuit by using a 'tap' on the primary winding.

This is the circuit of an I.F. (Intermediate Frequency) Amplifier.

Oscillators

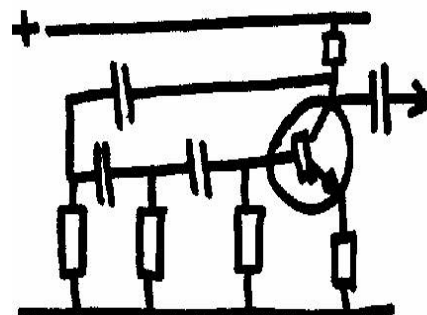
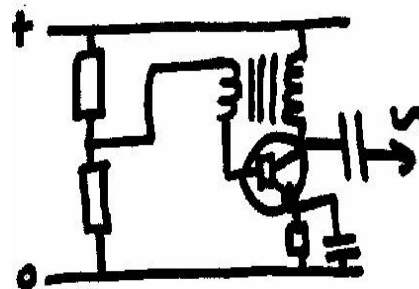
If a proportion of the output of an amplifier is fed back, in phase, to the input it is known as positive feedback. If there is just enough positive feedback then stable oscillation will occur.

IE *There will be an out put with no external input.*

An Audio Oscillator

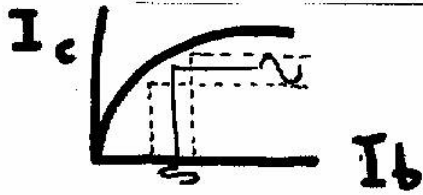
A transistor has an internal phase change of 180°

Therefore the feedback circuit must introduce another phase shift of 180°. A transformer can be wired to give this phase change. Each resistor/capacitor combination is designed to give a 60° phase change. Therefore three such RC combinations are used to give the required 180°.



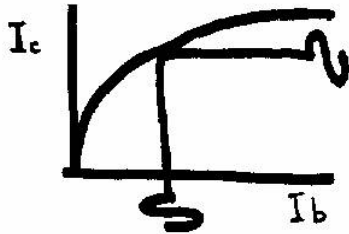
phase shift from collector to base.

Transistor Characteristic



This is dynamic curve that has been derived from transfer characteristics. Collector current is plotted against the Base current.

A transistor can be used in one of three Classes of Operation, depending on the bias condition that is chosen.



Class 'A'

Small signal audio Amplifiers use Class A . The base bias is set so that the whole of the input signal uses a central portion of the curve. If just a small part of the curve is used it will approximate to a straight line and give minimum distortion.

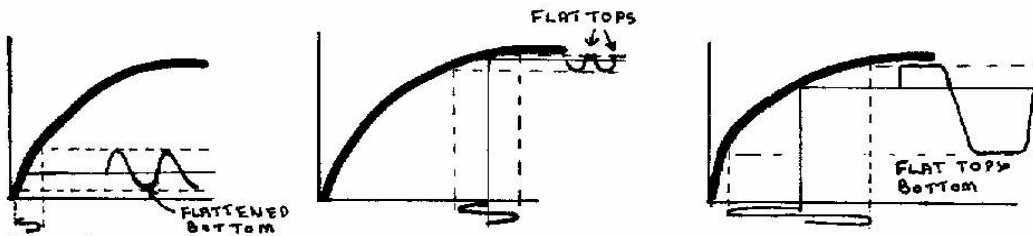
Causes of Distortion

Distortion has taken place if the output signal is not the same shape as the input signal.

The size will, of course, be different.

The main causes of distortion are:

- Incorrect bias point
- Input signal too great



Bias too low

Bias too high

I/P signal too big

Most 'small signal' amplifiers use Class 'A'. In this class current flows even if there is no input signal.

The current is flowing for the whole (100%) of the cycle.

Class 'B'

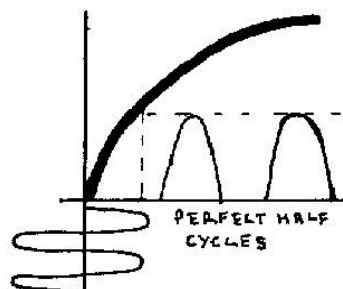
In Class 'B' the transistor is biased at the cut-off point.

This results in an output signal that consists of just one half of the input cycles.

The other half cycle is cut off.

The collector current only flows for 50% of input cycle.

A single transistor used in this manner would give a distorted output is no longer the same shape as the signal.



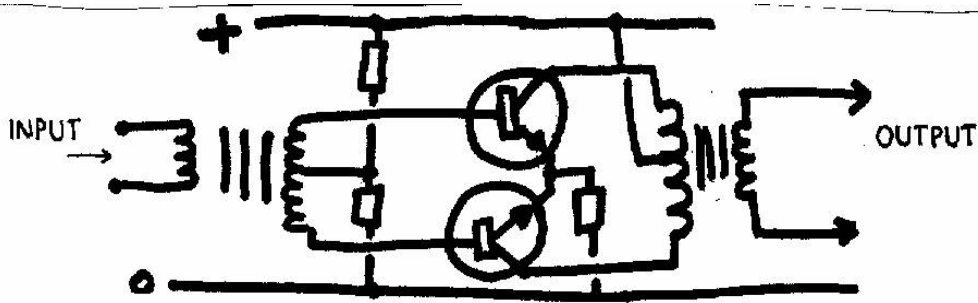
input

Class 'B' Push-Pull Amplification

An advantage of Class 'B' operation is that much larger signals than can Class 'A' but it requires two transistors. In order to give a distortion free output, one transistor amplifies the positive half cycles and the other transistor amplifies the negative half cycles.

Such an amplifier is known as a push-pull amplifier.

The input signal is split by a centre tapped transformer amplified by two transistors and then re-combined by an output centre tapped transformer



SPLITTING
TRANSFORMER

PUSH
TRANSISTOR

COMBINING
TRANSFORMER

This type of amplifier is usually used for audio output stage to drive a loud speaker.

It has the advantage that the current taken from the supply is proportional to the 'volume' of the signal. When there is no signal at the input, no current will flow as both transistors will be cut-off.

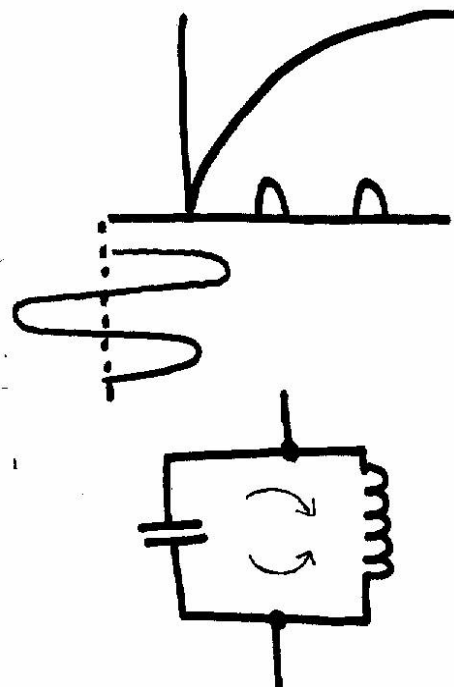
Class 'C'

In this class of operation the transistor is biased well beyond cut-off. Only the peaks of the input signal will cause turn on the transistor and cause collector current to flow. The collector current will flow for less than half a cycle. Less than 180°.

As the output signal is very different from the input signal, it may seem to have no practical use... wrong!

It is widely used in radio frequency amplifiers. Such amplifiers use tuned resonant circuits as their collector load and they only need pulses of signal. Its operation can be compared with a child on a swing. It is only necessary to give a regular push to keep it going.

There is no need to keep hold of the swing and physically move back and forth with it.



You will have to consult other lessons or books (RAE Manual or BR68) to answer some of the following questions.

QUESTIONS

- 7.1 What is the purpose of the 560Ω resistor in the *Tuned Two Stage Transistor* on page 1 ?
- 7.2 In an *audio* transistor amplifier, what would be the typical value of:
(a) Inter stage coupling capacitor. (b) Emitter de-coupling capacitor
- 7.3 In which *Class of Operation* is the first amplifier in this lesson , being operated ?
- 7.4 Why is it necessary for a Class "A" licence holder to have passed the Morse test ?
- 7.5 Is the Amateur "4 Metre Band" in the HF, VHF or UHF band ?
- 7.6 Which *Class of Operation* is used in a "push-pull" amplifier ?
- 7.7 If there is not *signal input* to a push-pull amplifier, give typical value of collector current.
- 7.8 Explain simply how a "frequency multiplier stage" works .
- 7.9 What is the formula that give the resonant frequency of a series circuit containing L and C ?
- 7.10 Why is it necessary to have more accurate frequency measuring equipment when operating near to the edges of an Amateur Band ?
- 7.11 What action should be taken before repairing equipment that has high voltages present during normal operating conditions ?
- 7.12 What is the wavelength of 146MHz ?
- 7.13 There is an Amateur Band that has a lower frequency limit of 21MHz. What is the upper frequency limit of this band ?
- 7.14 Do you use any equipment that contains valves ?