Inductors and Inductance

The basic **inductor** is composed of a length of wire formed into a coil. You have constructed one in the first phase of your crystal radio project. Some inductors have single layers (your radio coil) and others will have multi-layers. Some inductors have an air core (your radio coil) and other inductors will have core constructed of ferric material to increase the inductance and/or reduce the physical size of the coil. You can compare the coil you made for your radio to the coils used in a small transistor radio.

The basic function of an **inductor** is to **oppose any change in the current**. This property is called **inductance**. Think of Newton's first law of motion. You pick up one end of a heavy wheelbarrow and start pushing it. The initial force required to push it is much greater that the force needed to keep it moving. Like wise, the force required to stop the heavy wheelbarrow from moving is also much greater than the force needed to keep it moving. The wheelbarrow **opposes any change** to its' motion.

As a current flows through a wire, it sets up a magnetic field that starts to expand from the center of the wire. The transfer of energy to the magnetic field from the emf (**e**lectro**m**otive **f**orce – voltage) flowing through the wire represents work done. Placing a compass in close proximity of the wire and observing the deflection of the needle of the compass by the magnetic field easily illustrates this concept.

As the magnetic field (the magnetic lines of force) expands outward, the field also induces emf in the conductor itself. This self-induced voltage is always ***opposite*** in direction to the flow of current and thus called **counter emf**. A single wire though will usually have an insignificant effect on the value of inductance.

In figure 1 the magnetic fields of the two loops do not interact but the total inductance is doubled over a single loop of wire.

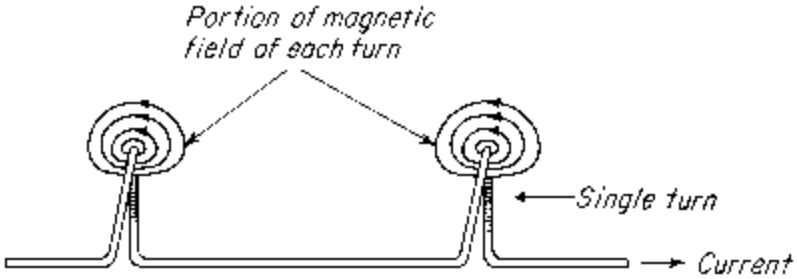

Fig 1. Fields surrounding two widely sparated turns

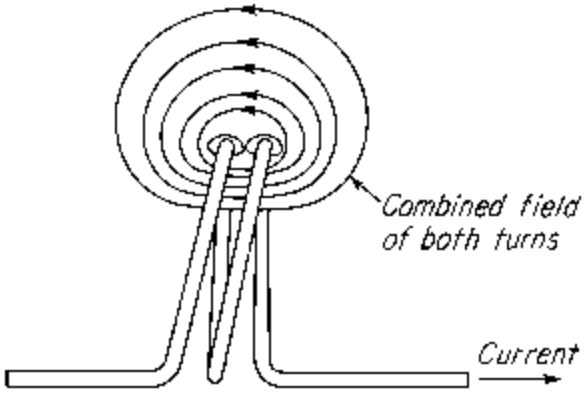

Fig. 2 Part of the field surrounding two close-wound turns

In figure 2 the two loops are wound next to each other with the same current but now there is twice the number of magnetic lines cutting each turn. Four times the counter emf is developed. If there are 3 turns, then there will be three times the number of lines of force to cut the three turns. 3 x 3 = 9, thus 9 times the counter emf is developed. This action led to the development of the formula you use to calculate the inductance of the coil for your crystal radio.

The symbol for **inductance** is **L** and the **Henry** (**H**) is the unit for inductance. One Henry is the amount of inductance required to generate one volt of induced voltage when the current is changing at the rate of one ampere per second.