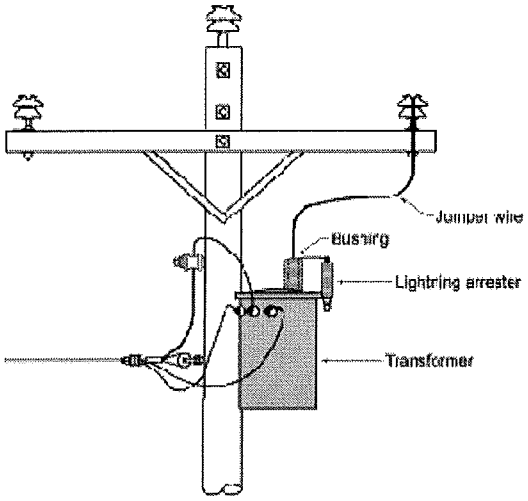
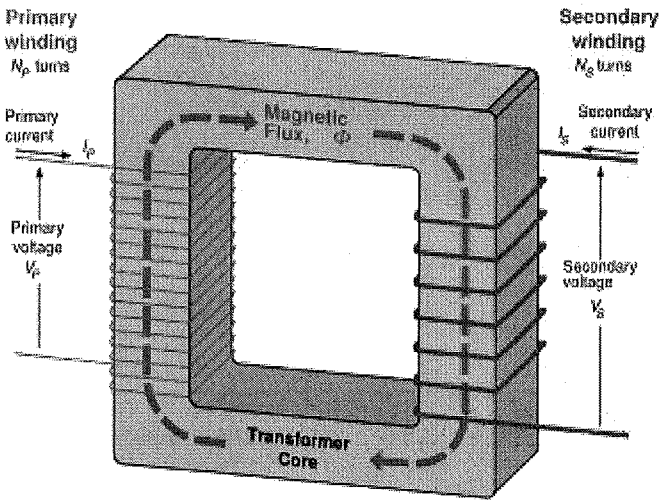
Physics 12 Section 21-7
Transformers; Transmission of Power



1. A transformer is a device that increases or decreases AC voltage. It has three basic parts: a primary coil, a secondary coil, and an iron core.



2. An alternating current goes into the primary coil producing a magnetic flux in the iron core. The iron core transfers the magnetic flux to the secondary coil. The secondary coil produces an induced EMF to counter the introduction of the magnetic flux in the iron core.

$$V_s = \frac{N_s \, \Delta\Phi}{\Delta t}$$

and the radio draws 400mA. Calculate the number of turns in the primary, the current in the primary, and the power transformed.

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$N_p = \frac{N_s V_p}{V_s}$$

$$N_p = \frac{30 \times 120V}{9.0V}$$

$$N_p = 400 \text{ turns}$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

$$I_p = \frac{I_s N_s}{N_p}$$

$$I_p = \frac{0.40A \times 30}{400}$$

$$I_p = 0.030A$$

$$P = I_s V_s$$

$$P = 9.0V \times 0.40V$$

$$P = 3.6 \text{ W}$$

A similar changing magnetic flux occurs in the primary coil when the current reverses direction. The process is very close to 100% efficient.

$$V_p = \frac{N_p \, \Delta\Phi}{\Delta t}$$

Combining the two above equations results in

$$\frac{V_s}{V_p} = \frac{\dfrac{N_s \, \Delta\Phi}{\Delta t}}{\dfrac{N_p \, \Delta\Phi}{\Delta t}}$$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

3. The amount of power transformed is also close to 100% efficient.

$$P = I \times V$$

$$I_p V_p = I_s V_s$$

$$\frac{V_s}{V_p} = \frac{I_p}{I_s}$$

Combining this with the previous derived equation we get:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

Example p635: A transformer for home use of a portable radio reduces 120V AC to 9.0V AC. The secondary coil contains 30 turns