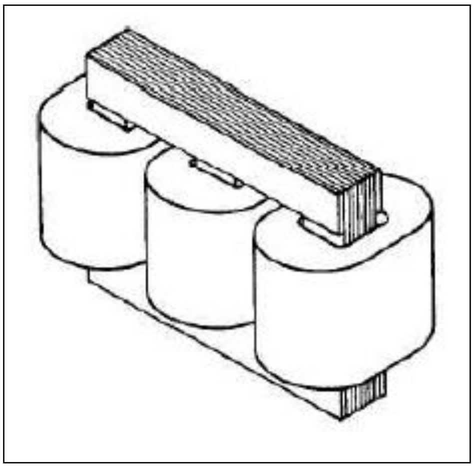
Types of Transformers

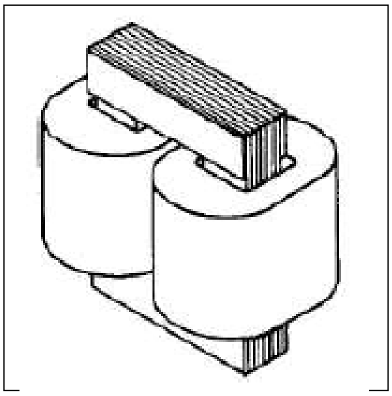
10-1Transformers classify according to their construction

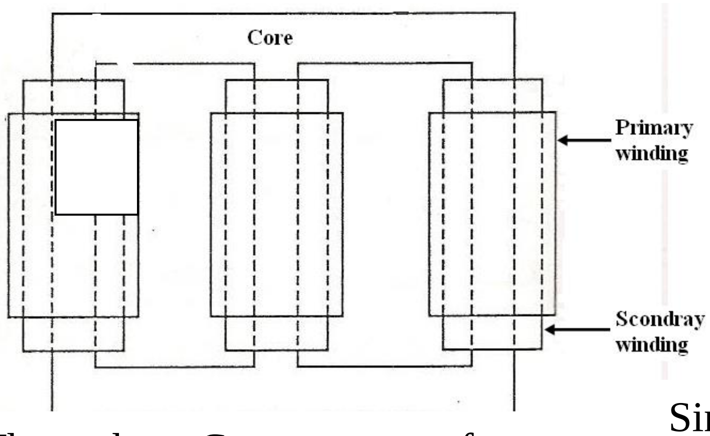
Depending upon the manner in which the primary and secondary are wound on the core, transformers are of two types viz., (i) core-type transformer and (ii) shell-type transformer

1- Core form. In the core form, the windings are wrapped around the core (the windings surrounded the core considerably.

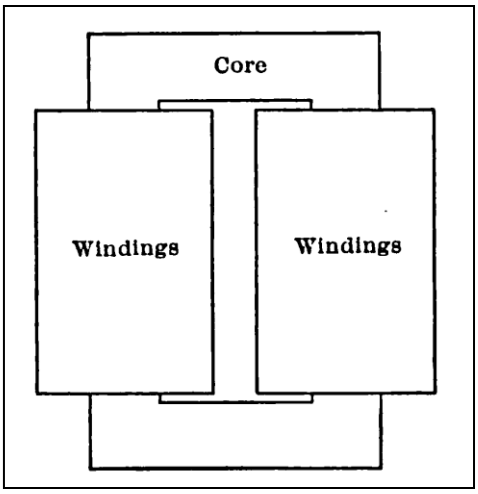
Core construction is desirable when compactness is a major requirement. Figure (10-1) illustrates core type configurations three-phase transformers





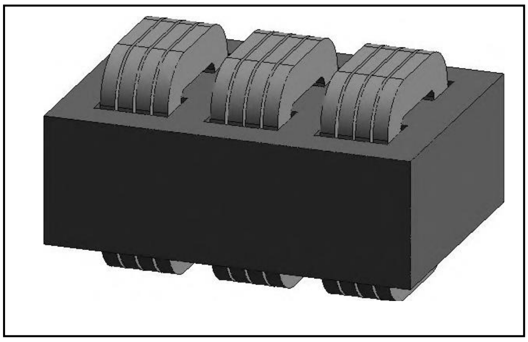


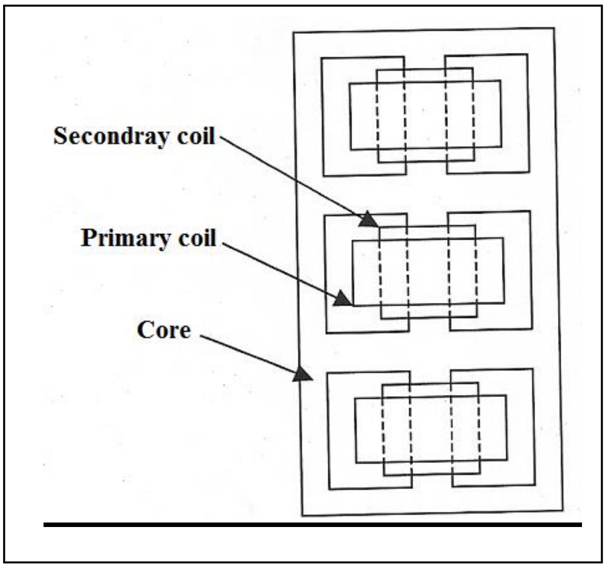
Three phase Core type transformer

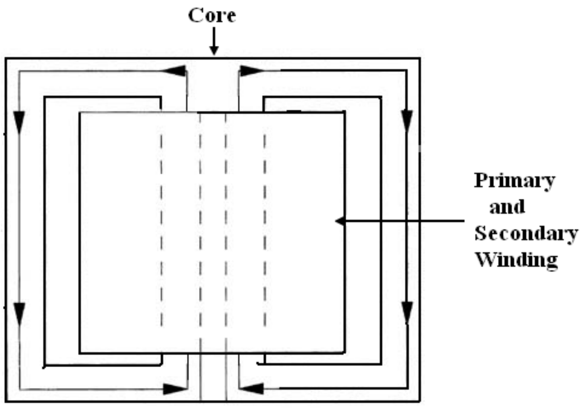


Single phase Core type transformer

2-Shell form transformers completely enclose the windings inside the core assembly(the core surround the windings). Shell construction is used for larger transformers, although some core-type units are built for medium and high capacity use. Shell construction is also more flexible, because it allows a wide choice of winding arrangements and coil groupings.







Three phase Shell type transformer   Single phase Shell type transformer

10-2 Transformers classify according to their Applications

Applications of Transformers

There are four principal applications of transformers viz.

(i) power transformers (ii) distribution transformers

(iii) Autotransformers (iv) instrument transformers

(i) **Power Transformers**.

They are designed to operate with an almost constant load which is equal to their rating. The maximum efficiency is designed to be at full-load. This means that full-load winding copper losses must be equal to the core losses. A power transformer has two or more windings wound on a laminated iron core. The transformer is used to supply stepped up and stepped down values of voltage to the various circuit in electrical equipment.

(ii) **Distribution Transformers**.

These transformers have variable load which is usually considerably less than the full-load rating. Therefore, these are designed to have their maximum efficiency at between 1/2 and 3/4 of full load.

A distribution transformer has two windings wound on a laminated iron core. The transformer is used to supply stepped down values of voltage to the various circuit in electrical equipment.

(iii) **Autotransformers.**

An autotransformer has a single winding on an iron core and a part of winding is common to both the primary and secondary circuits. Fig. (10-3) shows the connections of a step-down autotransformer and the connections of a step-up autotransformer. In either case, the winding **ab** having N_1 turns is the primary winding and winding **bc** having N_2 turns is the secondary winding. Note that the primary and secondary windings are connected electrically as well as magnetically. Therefore, power from the primary is transferred to the secondary conductively as well as inductively (transformer action). The voltage transformation ratio **a** of an ideal autotransformer is

$$\mathbf{a} = \frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

An autotransformer requires less copper than an ordinary 2-winding transformer. Autotransformers are used for starting induction motors (reducing applied voltage during starting) and in boosters for raising the voltage of feeders.

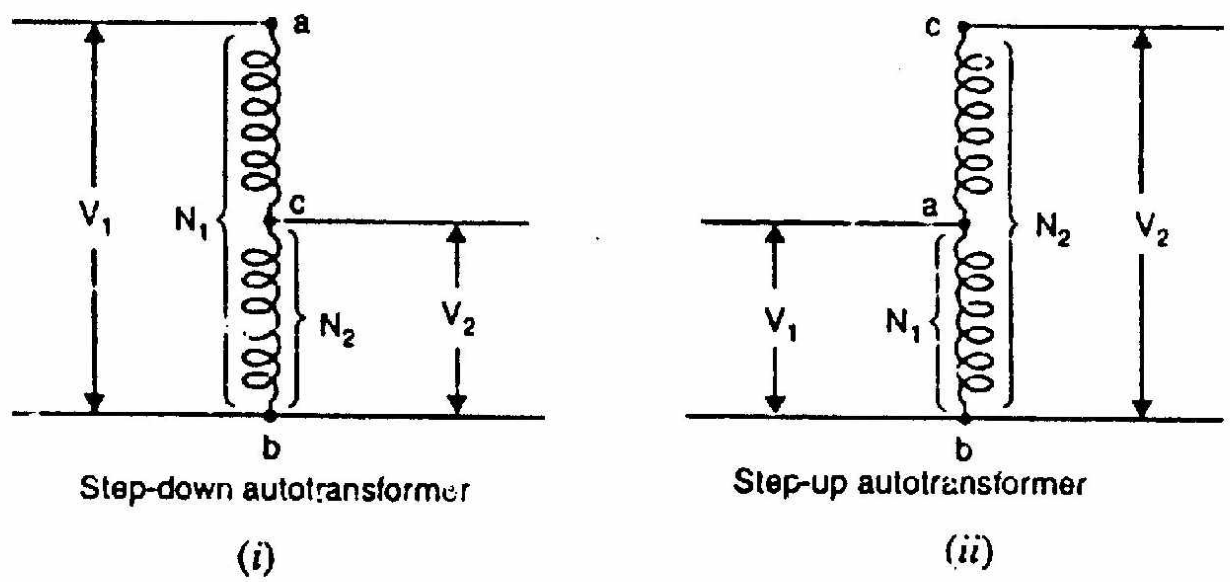


Fig.(10-3 the connections of Autotransformer

(iv) **Instrument transformers**.

Current and voltage transformers are used to extend the range of a.c. instruments.

(a) Current transformer

A current transformer is a device that is used to measure high alternating current in a conductor. Fig. (10-4) illustrates the principle of a current transformer. The conductor carrying large current passes through a circular laminated iron core. The conductor constitutes a one-turn primary winding. The secondary winding consists of a large number of turns of much fine wire wrapped around the core as shown. Due to transformer action, the secondary current is transformed to a low value which can be measured by ordinary meters.

$$\text{Secondary current, } I_S = I_P \times \frac{N_P}{N_S}$$

For example, suppose that IP = 100 A in Fig. (10-4) and the ammeter is capable of measuring a maximum of 1 A. Then,

$$N_S = N_P \times \frac{I_P}{I_S} = 1 \times \frac{100}{1} = 100$$

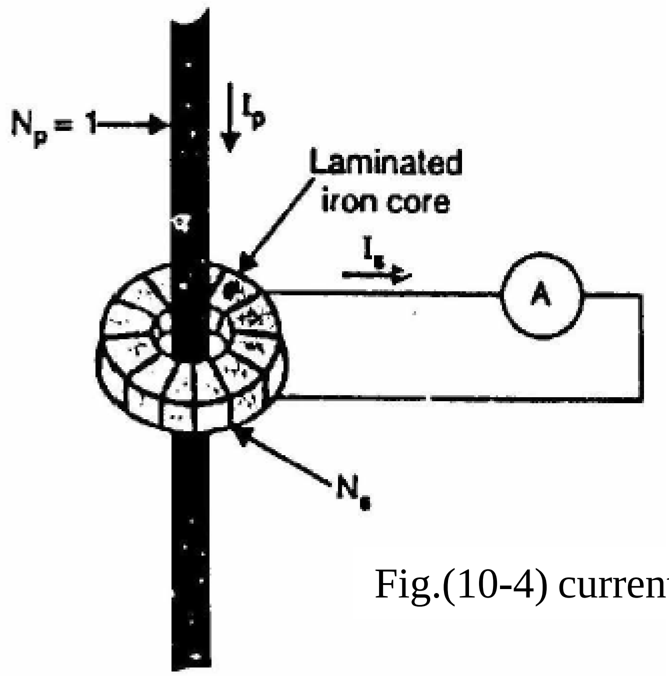


Fig.(10-4) current transformer

(b) Voltage transformer

It is a device that is used to measure high alternating voltage. It is essentially a step-down transformer having small number of secondary turns as shown in Fig.(10-5). The high alternating voltage to be measured is connected directly across the primary. The low voltage winding (secondary winding) is connected to the voltmeter. The power rating of a potential transformer is small (seldom exceeds 300 W) since voltmeter is the only load on the transformer.

$$V_P = V_S \times \frac{N_P}{N_S}$$

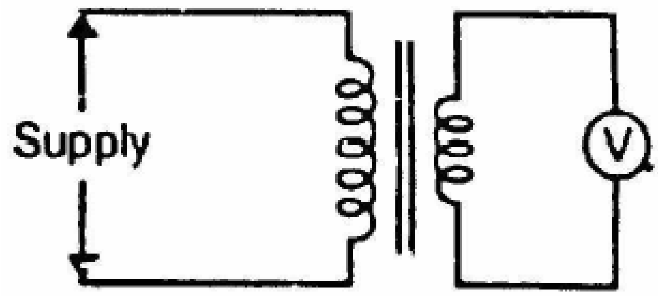


Fig.(10-5 Voltage transformer

(v) **Audio-frequency transformer**

A transformer used in audio-frequency circuits to transfer AF signals from one circuit to another.

(vi) **Radio-frequency transformer**

A transformer used in radio-frequency circuits to transfer RF signals from one circuit to another.

(viI) **Impedance-Matching Transformer**

A transformer used to match the impedance of the source and the impedance of the load. The mathematical relationship of the turns and impedance of the transformer is expressed by equation:

$$\frac{N_P}{N_S} = \sqrt{\frac{Z_P}{Z_S}}$$