

* weight of xmer \Rightarrow (few grams to Tonnes)

* Most useful device ever invented.

The first P. System was D.C. but after practical installation of xmer in 1886 the Power System has been standardized into AC.

X-mer is the basic region for the wide spread of AC Power System. As it operates only on AC. the power is generated, x-mitted, distributed in AC.

Due to size & insulation constraints of a generator, the voltage levels of generation is 11kV. For the efficient & economical x-mission it will be stepped up & x-mitted over long distances. At high voltages & again step down at the consumer end for convenient utilization. using a xmer.

It is the most useful device ever invented. Apart from Power Systems it is widely used in instrumentation (C.T & P.T), electronics & communication, impedance matching in amplifiers, radio devices, Power F.

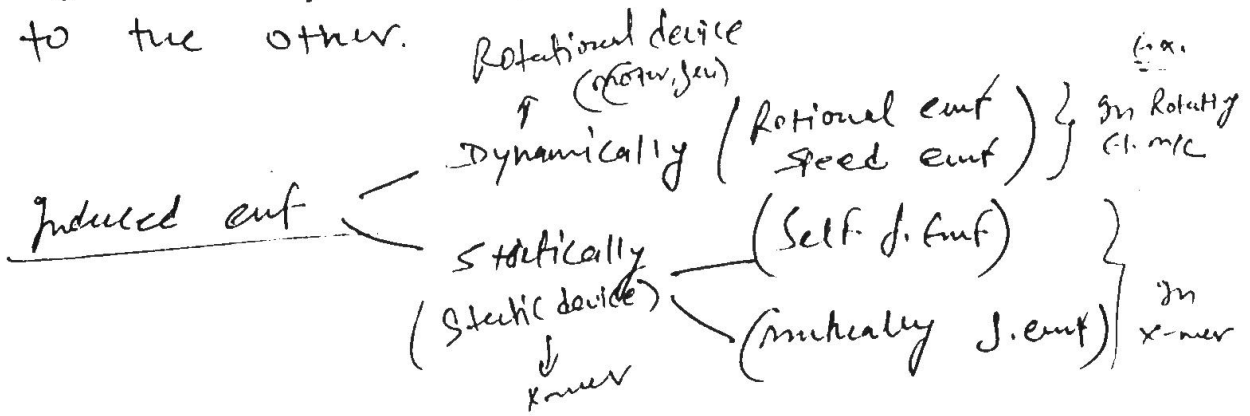
Based on the Application of Power System, it is basically classified as -

- ① Power x-over (EHV & HV ~~upto~~ from Gen. to Distribution Substation) 33/11 Kv.
- ② Distribution x-over (11 Kv/400 V) where the domestic customer are connected.

Definition

STATIC device which x-fers ^{el. energy} from one electrical ckt to other, without change in frequency.

It is basically used to change the magnitude of voltage or current from one level to the other.



Basically x-over consist of 2 coils or windings known as Primary & Secondary.

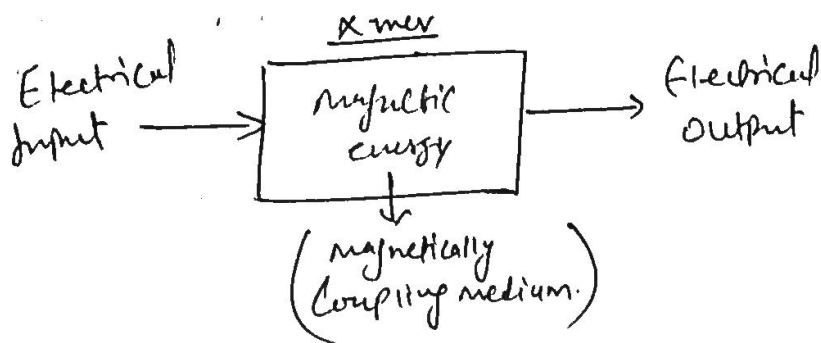
The winding where source is connected known as Primary, & where load is connected is known as Secondary.

Before connecting in service Primary & Secondary cannot be named bcoz the Primary of.

Step up xmer becomes Secondary ~~step~~ if the same xmer used as Step-down.

Generally the windings are called as High vty wdg or low vty wdg.

It is not electromechanical energy conversion device but electromagnetic energy conversion device.



The energy x-fer is through magnetic coupling medium. & it happens without any rotating parts.

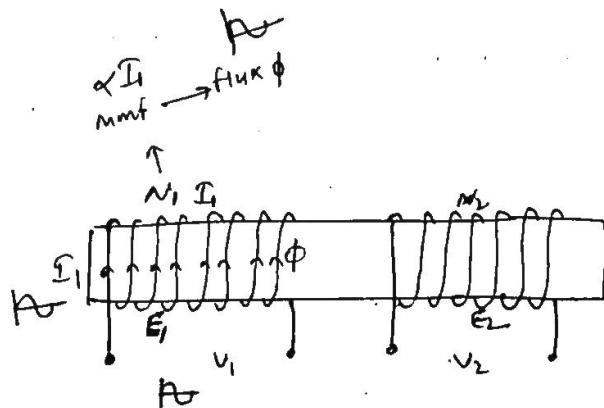
Consequently it has the highest possible efficiency of all electrical machines. (large ratings well designed xmer efficiency is 99%). As it has no mech. losses Bcoz of no rotating parts. It has less maintenance & repair.

Principle of Xmer

$$E_1 = -N_1 \frac{d\phi}{dt} \text{ self. } E_1 \propto N_1$$

$$E_2 = -N_2 \frac{d\phi}{dt} \text{ mutually } E_2 \propto N_2$$

If $N_1 > N_2$ then $E_1 > E_2$ step down
 If $N_1 < N_2$ then $E_1 < E_2$ step up



The basic principle is according to Mutual Induction.

M.I. is proposed by Farady.

"When a time varying flux links with the stationary conductors a statically induced emf is produced."

Consider two coils wound on a common core having N_1 & N_2 turns. When an alternating voltage is applied across first winding, an alternating current flows in N_1 turns produces an mmf $N_1 I_1$ which results in alternating flux. It links with N_1 turns & induced self induced emf E_1 and also links with N_2 turns & induced mutually induced emf E_2 .

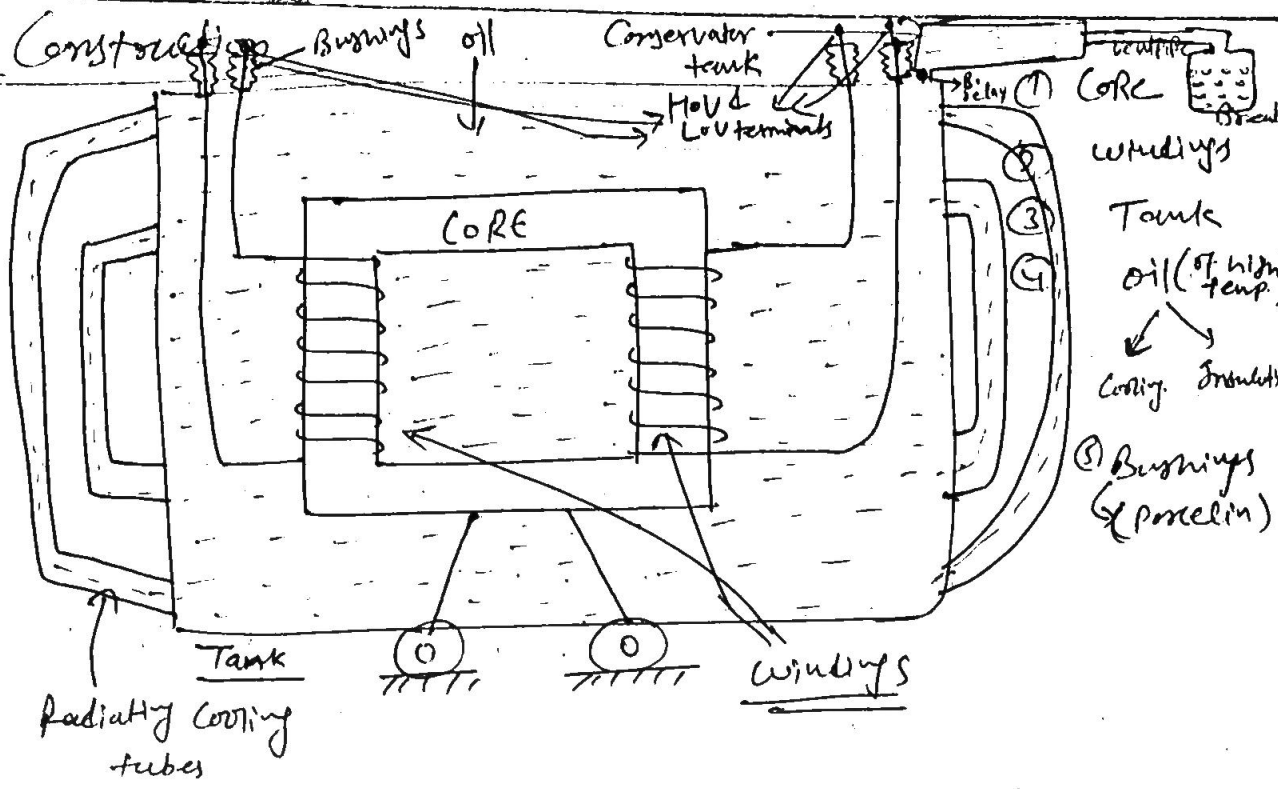
They are directly proportional to the no. of turns in windings. According to Lenz's law "the resultant opposes its cause". therefore the self & mutually induced emf will oppose their cause V_1 . therefore E_1 & E_2 are in phase with each other.

The basic requirement in a X-mtr, is a core & wdg. The core couples both the windings magnetically, and all the flux should be confined within the core. (It should not leak). which affects the performance of the X-mtr.

The Permeability of the core material should be as high as possible.

for high value $(\mu_r = 1)$





⑥ a Porcelain (Silica) Crystals
 (Impregnated with Cobalt-chloride) → (Blue ⇒ whitish pink)

Oil ('Askanals')
 Pyroclasts

X-mer oil - It significantly affects the performance of the x-mer. It provides two functions.

- ① It act as measure insulation.
 - ② Provides Cooling
- Made up of fractional distillation of Petroleum Condenser oil.

Conservator tank The x-mer tank is extended for about 10 to 15%. In order to adjust the varying pressure. During varying load condition It is connected to a vent pipe & glass chamber. Known as breather.

It consist of: Silica gel crystals. & there original colour is Blue, there function is: to absorb any moisture content from the air flowing into X-ray through breather.

They turnout whitish pink colour. under Damp (wet) Condition.

Which indicates for the replacement. lifting & low vty winding terminals. are brought out of the tank. through porcelain bushings.

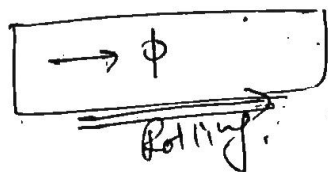
There are radiating tubes or cooling tubes in order to circulate oil through them. for cooling purpose. ~~any~~

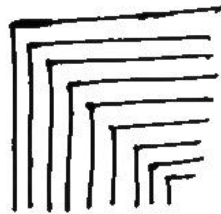
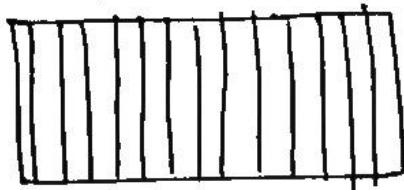
Fins & projection also provided for cooling purpose. as the air circulates on them naturally.

CORE: Basic fun. \rightarrow ^{Provide} high permeability. at good mechanical

To enhance the permeability of core further. Cold Roll grained orientation is done.

The laminations are given a orientation in the direction of flux path in order to improve permeability. the initial core's were hot rolled grained orientation which has less permeability than CRGO.





0.4 mm. thickness of lamination

Joint \Rightarrow Stacked or Inbrication

The tendency of lamination to change, their physical dimension, when an alternating flux flows through it.

This is the reason for a noise in x-mev.

The lamination should not be tightly or loosely held. any air gap requires large magnetizing current to sustain the flux. As the lamination's core thin eddy current loss reduce. but they should not be below (0.35 mm) thickness.