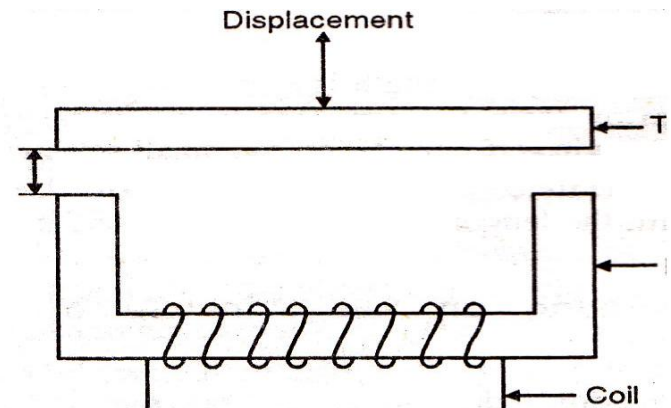


EIPC
NEE-403
Unit-1
TRANSDUCERS

VARIABLE RELUCTANCE INDUCTIVE TRANSDUCER

- Fig shows a variable reluctance inductive transducer.
- As shown in fig the coil is wound on the ferromagnetic iron. The target and core are not in direct contact with each other. They are separated by an air gap.
- The displacement has to be measured is applied to the ferromagnetic core

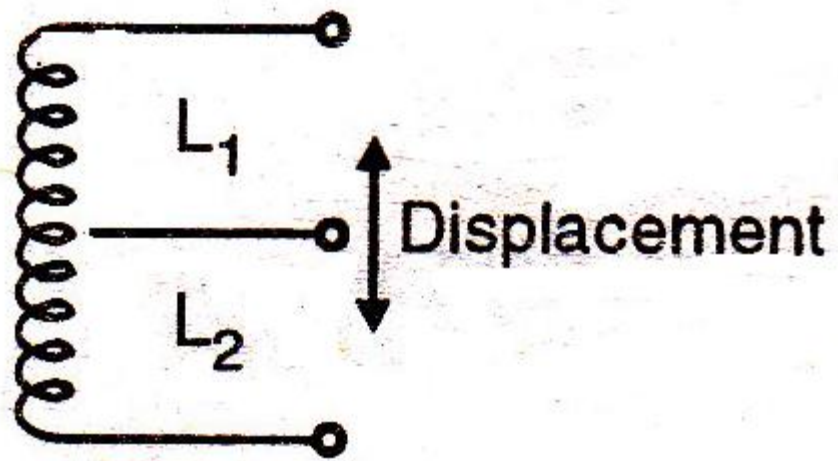


- The reluctance of the magnetic path is found by the size of the air gap.
- The self inductance of coil is given by
- $L = N^2 / R = N^2 / R_i + R_a$
- N : number of turns
- R : reluctance of coil
- R_i : reluctance of iron path
- R_a : reluctance of air gap

- The reluctance of iron path is negligible
- $L = N^2 / R_a$ $R_a = l_a / \mu_0 A$
- Therefore $L \propto 1 / l_a$ i.e. self inductance of the coil is inversely proportional to the air gap l_a .
- When the target is near the core, the length is small. Hence the self inductance is large. But when the target is away from the core, the length is large. So reluctance is also large. This result in decrease in self inductance i.e. small self inductance.
- Thus inductance is function of the distance of the target from the core. Displacement changes with the length of the air gap, the self inductance is a function of the displacement.

PRINCIPLE OF CHANGE IN MUTUAL INDUCTANCE

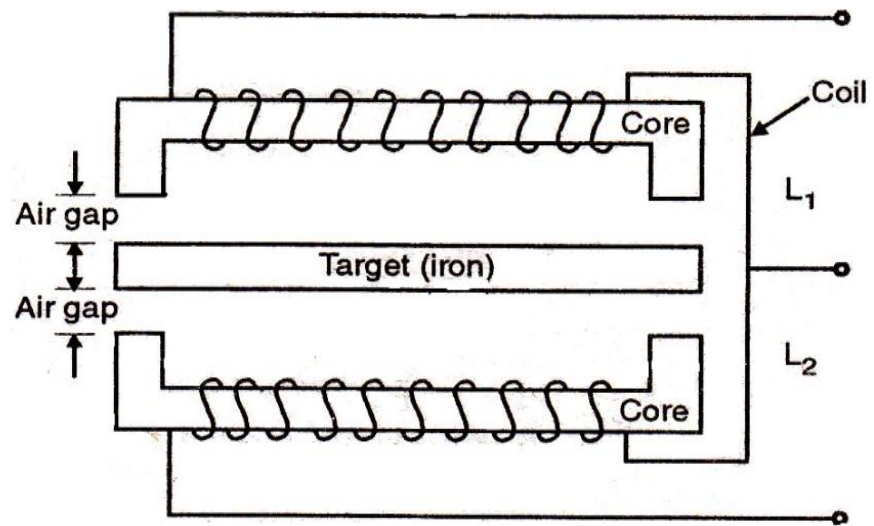
- Multiple coils are required for inductive transducers that operate on the principle of change in mutual inductance.
- The mutual inductance between two coils is given by
 - $M = K\sqrt{L_1L_2}$
 - Where M : mutual inductance
 - K : coefficient of coupling
 - L1: self inductance of coil 1
 - L2 : self inductance of coil 2
- By varying the self inductance or the coefficient of coupling the mutual inductance can be varied



DIFFERENTIAL OUTPUT TRANSDUCERS

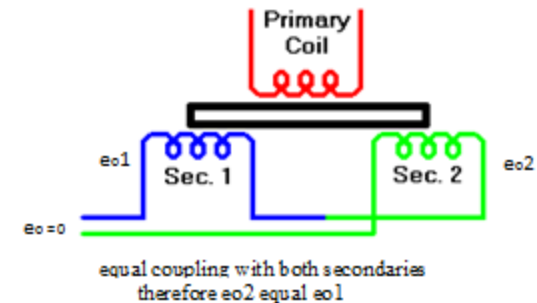
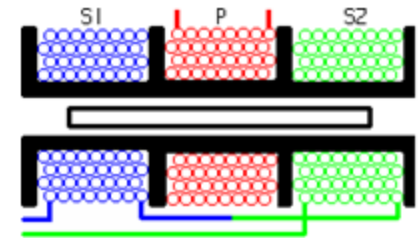
- Usually the change in self inductance ΔL for inductive transducers is insufficient for the detection of stages of an instrumentation system.
- The differential arrangement comprises of a coil that is divided in two parts as shown in fig a and b.
- In response to displacement, the inductance of one part increases from L to $L+\Delta L$ while the inductance of the other part decreases from L to $L-\Delta L$. The difference of two is measured so to get output $2\Delta L$. This will increase the sensitivity and minimize error.
- .

- Fig c shows an inductive transducer that provides differential output. Due to variation in the reluctance, the self inductance of the coil changes. This is the principle of operation of differential output inductive transducer



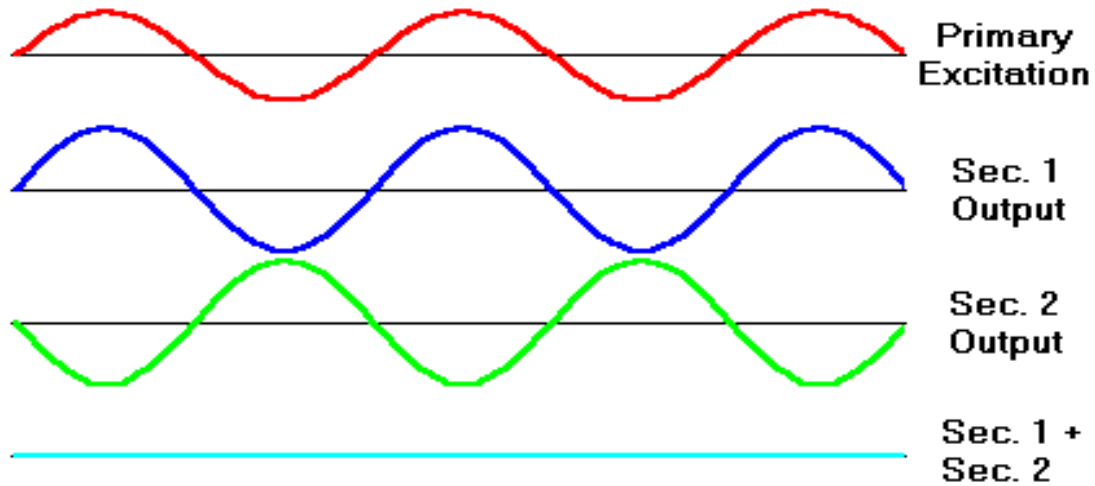
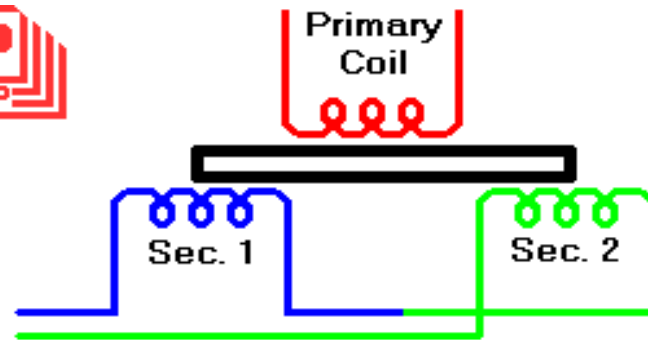
LINEAR VARIABLE DIFFERENTIAL TRANSFORMER(LVDT)

- AN LVDT transducer comprises a coil former on to which three coils are wound.
- The primary coil is excited with an AC current, the secondary coils are wound such that when a ferrite core is in the central linear position, an equal voltage is induced in to each coil.
- The secondary are connected in opposite so that in the central position the outputs of the secondary cancels each other out.



LVDT contd...

- The excitation is applied to the primary winding and the armature assists the induction of current in to secondary coils.
- When the core is exactly at the center of the coil then the flux linked to both the secondary winding will be equal. Due to equal flux linkage the secondary induced voltages (e_{o1} & e_{o2}) are equal but they have opposite polarities. Output voltage e_o is therefore zero. This position is called “null position”

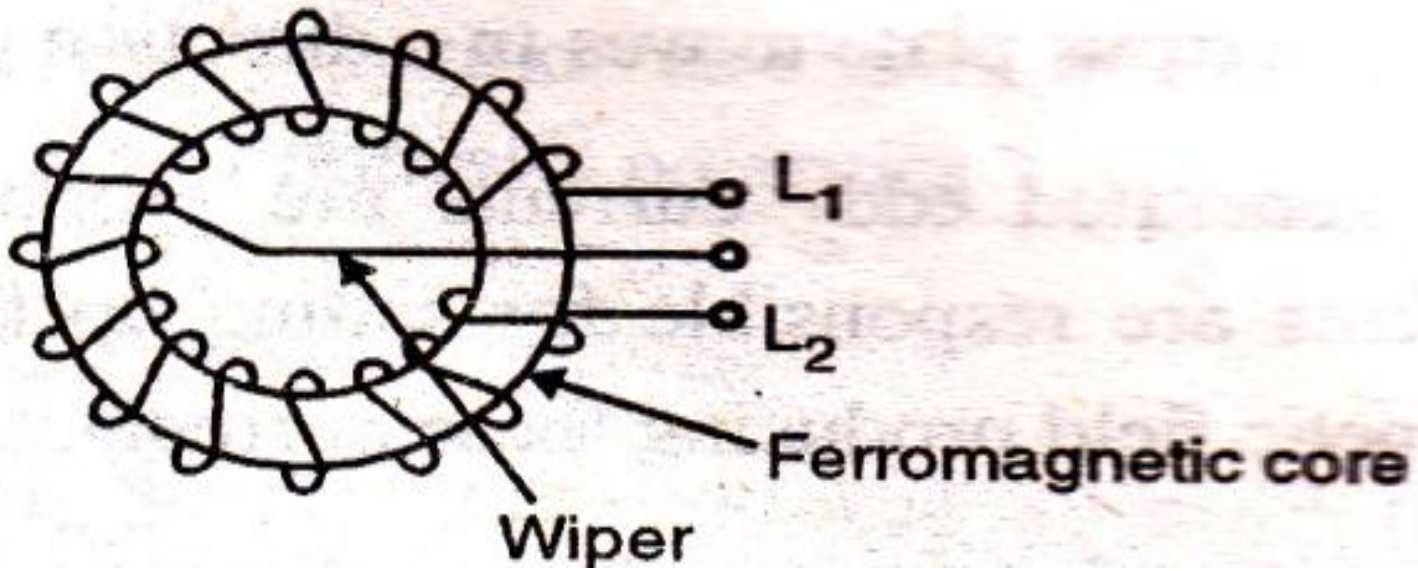


- Now if the core is displaced from its null position toward sec1 then flux linked to sec1 increases and flux linked to sec2 decreases. Therefore $e_{o1} > e_{o2}$ and the output voltage of LVDT e_o will be positive
- Similarly if the core is displaced toward sec2 then the $e_{o2} > e_{o1}$ and the output voltage of LVDT e_o will be negative.

RVDT

- RVDT stands for Rotary Variable Differential transducer.
- RVDT is rotational version of LVDT.
- The working principle and construction of RVDT is similar to LVDT except it has rotational motion.

RVDT



Thank You