Q- Five 1 inch square plates are arranged in attached as shown. The plate spacings are 0.01 inch. The arrangement is to be used for a displacement transducer by observing the change in capacitance with the distance x. Calculate the sensitivity of the device in picofarads per inch. Assume that the plates are separated by air.

Solution:

The system of n such plates parallel to each other and alternately connected constitute parallel plate capacitor combination of n-1 capacitors connected in parallel. The charges are shown in figure. With n plates n-1 capacitors are formed and they are connected in parallel.

If the effective area of each plate is A and distance between each surface is d then the total capacitance of the system is

$C = (n - 1) \in_0 A/d = (n - 1) \in_0 Lx/d$

Here L is the side of each plate and x is the length overlapped.

Hence the rate of change of the capacitance with x is given by

$dC/dx = (d/dx)(n - 1) \in_0 Lx/d = (n - 1) \in_0 L/d$

$= (5-1)*8.85*10^{-12}*1*2.54*10^{-2}/(0.01*2.54*10^{-2})$ farad/m

$= 4*8.85*10^{-12}*1/(0.01)$ farad/m

$= 4*8.85*10^{-10}$ farad/m

$= 4*8.85*10^{-10}/39.37$ farad/inch

$= 9*10^{-11}$ farad/inch

$= 90*10^{-12}$ farad/inch

= 90 Pico farads per inch