Experiment 9.2

To find capacity of condenser using flashing and quenching of a Argon bulb.

or

To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.

Apparatus Required:

A condenser of unknown capacity, 3 condensers of known capacity, resistance of the order of few mega-ohm, an Argon flashing bulb, DC power supply, one way keys etc.

Theory:

The growth of charge in RC circuit is given as $q = q_0 (1 - e^{-t/RC})$ ...(i)

If V_0 is the potential corresponding to the maximum charge q_0 and V corresponding to instantaneous charge q, then

$q_0 = CV_0$ and $q = CV$ $\therefore$ $V = V_0 (1 - e^{-t/RC})$ ...(ii)

If a neon/argon bulb is placed in parallel with the condenser and a supply voltage is increased starting from zero, at striking potential (V_S), the bulb begins to flash and glow, as soon as the neon lamp flashes it begins to conduct charge through it. The condenser is short circuited and begins to discharge. It continues to do so until the extinction or quenching voltage V_e is reached and bulb stops glowing and hence stops conducting.

The condenser then again begins to charge till the flashing potential V_S is reached again and it begins to glow again thereby becoming conducting. This process is repeated.

If t_1 is a time taken by the voltage to fall from V_S to V_e and t_2 is the time taken by the voltage to rise from V_e to V_S then time between two consecutive flashes will be $(t_1 + t_2)$.

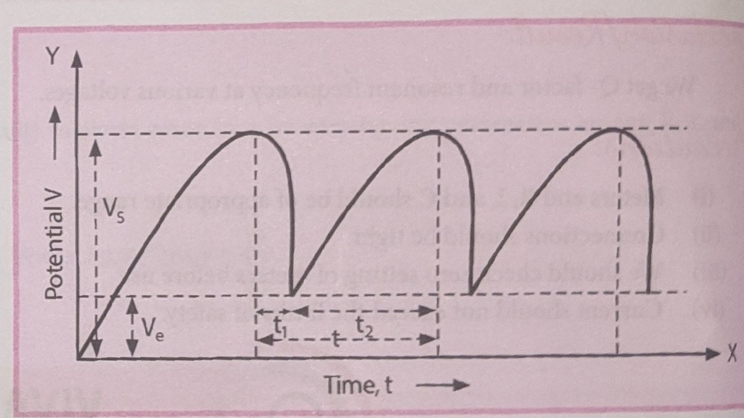

Fig. 9.6.

From equation (ii), we get

$$V_e = V_s\left(1 - e^{-t_1/RC}\right)$$

or $t_2 = -CR \log_e (V_e / V_s)$

Also $$V_e = V_s\left(1 - e^{-t_2/RC}\right)$$

or $t_2 = -CR \log_e [1 - (V_e / V_s)]$

As $t = t_1 + t_2$

Therefore, $t = -CR \log_e (V_e / V_s) - CR \log_e [1 - (V_e / V_s)]$ or $t = KC$

where $K = -R \log_e (V_e / V_s) - R \log_e [1 - (V_e / V_s)]$

Thus, graph between t and C will be straight line.

Procedure:

Step 1. Make circuit diagram as shown in Fig. 9.7.

Step 2. Connect condenser C_1 by inserting key K_1 and switch on the power supply. Adjust DC supply voltage so that bulb start flashing and quenching. Note flashing and quenching time of 20 flashes. Switch off power supply without disturbing voltage setting knob.

Step 3. Put plug in key K_4 so that unknown condenser C_0 is in parallel with C_1. As C_0 and C_1 are in parallel, therefore, total capacity

Step 4. Now, repeat the experiment with capacity C_2, $(C_2 + C_0)$, C_3, $(C_3 + C_0)$. Then, repeat the experiment with known capacities $(C_1 + C_2)$, $(C_1 + C_2 + C_3)$, $(C_1 + C_3)$, $(C_1 + C_2 + C_0)$, $(C_1 + C_3 + C_0)$ and $(C_1 + C_2 + C_3 + C_0)$ each time taking the time for 20 flashes.

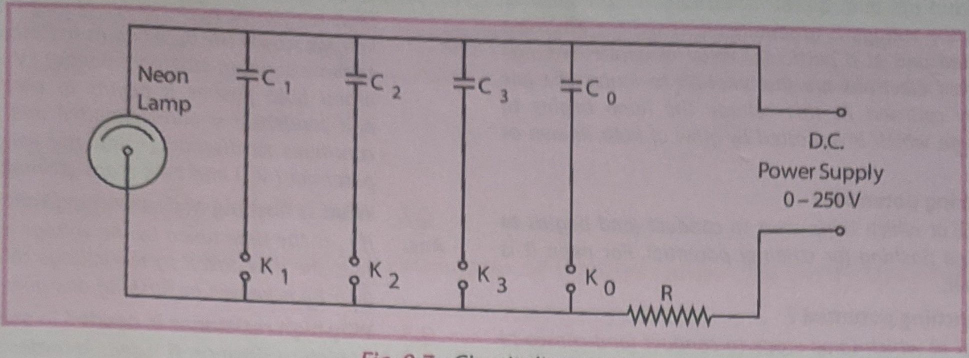

Fig. 9.7. Circuit diagram

Observations:

S. No.	Known capacity without C	Time for 20 flashes		Flashing and quenching time	
		C_0	With C_0	Without C_0 (t)	With C_0 (t_0)
1.	C_1				
2.	C_2				
3.	C_3				
4.	C_1+C_2				
5.	C_1+C_3				
6.	$C_1+C_2+C_3$				

Calculations:

Plot graph between C & t and C & t_0. The graph will be parallel lines as shown in figure. Draw lines ABC, DEF and GHK parallel to x-axis. Also draw lines BL, CM, EN, FP, HQ and KR parallel to y-axis. The unknown capacity is given as

(a) C_0 = CM – CL = ... μF

(b) C_0 = CP – CN = ... μF

(c) C_0 = CR – CQ = ... μF

Mean C_0 = ... μF

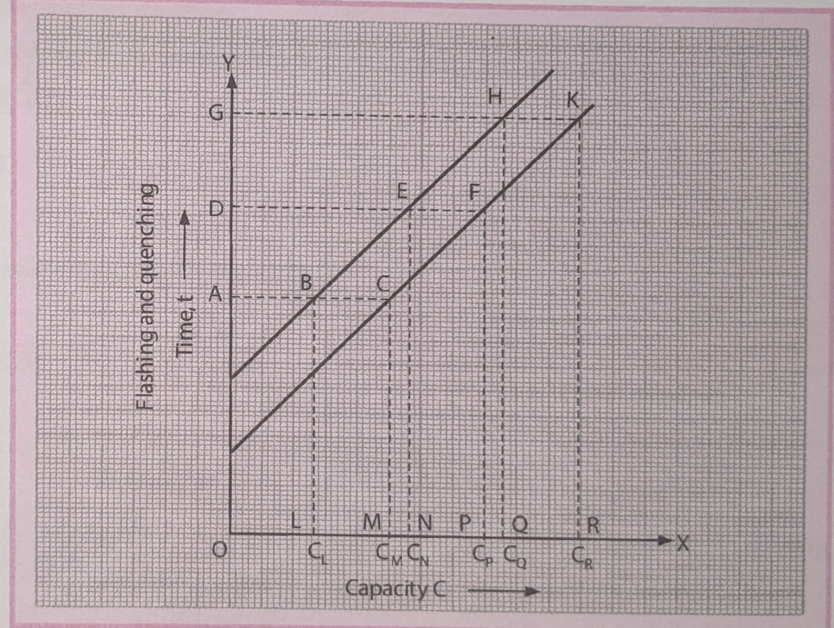

Fig. 9.8. Graph between C & t and C & t_0.