A very important bridge used for the precision measurement of capacitors and their insulating properties is the Schering bridge. Its basic circuit arrangement is given in Fig. 11.26. The standard capacitor C_3 is a high quality mica capacitor (low-loss) for general measurements, or an air capacitor (having a very stable value and a very small electric field) for insulation measurement.

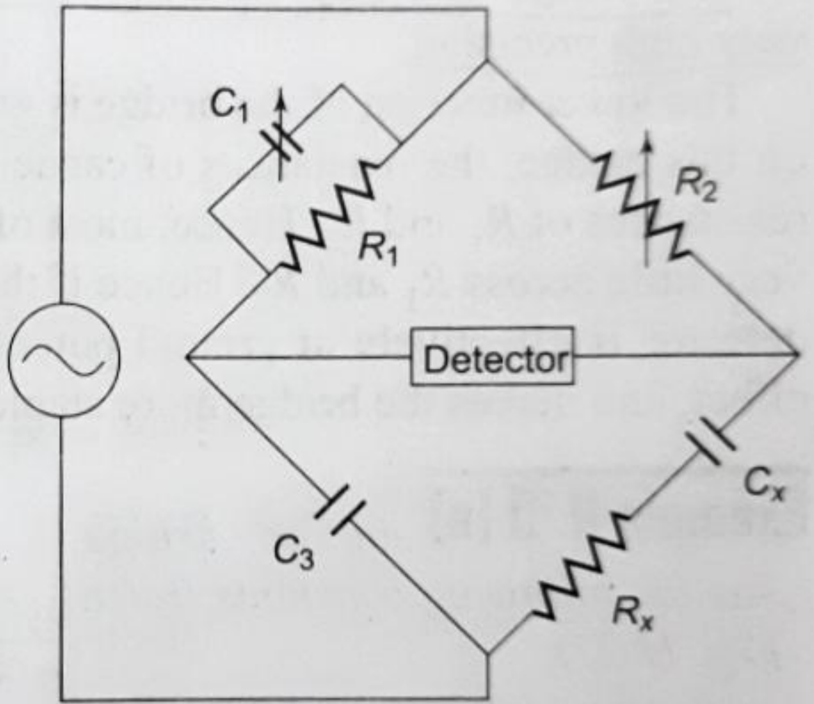

Fig. 11.26 Schering's bridge

For balance, the general equation is

$$Z_1 Z_x = Z_2 Z_3$$

$$\therefore \quad Z_x = \frac{Z_2 Z_3}{Z_1}, Z_x = Z_2 Z_3 Y_1$$

where

$$Z_x = R_x - j/\omega C_x$$
$$Z_2 = R_2$$
$$Z_3 = -j/\omega C_3$$
$$Y_1 = 1/R_1 + j\,\omega C_1$$

as

$$Z_x = Z_2 Z_3 Y_1$$

$$\therefore \quad \left(R_x - \frac{j}{\omega C_x}\right) = R_2 \left(\frac{-j}{\omega C_3}\right) \times \left(\frac{1}{R_1} + j\omega C_1\right)$$

$$\left(R_x - \frac{j}{\omega C_x}\right) = \frac{R_2(-j)}{R_1(\omega C_3)} + \frac{R_2 C_1}{C_3}$$

Equating the real and imaginary terms, we get

$$R_x = \frac{R_2 C_1}{C_3} \qquad [11.20(a)]$$

and

$$C_x = \frac{R_1}{R_2} C_3 \qquad [11.20(b)]$$

The dial of capacitor C_1 can be calibrated directly to give the dissipation factor at a particular frequency.

The dissipation factor D of a series RC circuit is defined as the cotangent of the phase angle.

$$D = \frac{R_x}{X_x} = \omega C_x R_x$$

Also, D is the reciprocal of the quality factor Q, i.e. $D = 1/Q$. D indicates the quality of the capacitor.