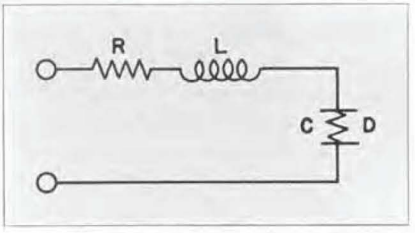

FIGURE 5. The residual impedances L and R are in series with the solid dielectric condenser having a capacitance C and dissipation factor D.

The fractional increase in capacitance varies as the square of the frequency. The increase in dissipation factor is

$$\Delta D = R\omega C \qquad (2)$$

But the actual value of resistance to be used is the a-c resistance at a given frequency, not the d-c resistance. The leads are usually of sufficient diameter so that all the current flows on the surface.[10] Under this condition the resistance increases with the square root of the frequency,

$$R = R_1\sqrt{f} \qquad (3)$$

where R_1 is the resistance at unit frequency, usually 1 Mc. Hence

$$\Delta D = 2\pi R_1' f^{3/2} C \qquad (4)$$

where R_1' is the value that the resistance would have at a frequency of 1 cycle, if the square law held to that frequency. Thus, the increase in dissipation factor varies as the three-halves power of the frequency.

Representative values of the residual impedances for the first four steps of a TYPE 380 Decade-Condenser Unit are 0.25 μh and 0.07 Ω at 1 Mc for the L, M, and N types and 0.35 μh and 0.01 Ω for the F type. The d-c resistance of the switch is only about 0.02 Ω, so the skin effect ratio at 1 Mc is 3.8. This corresponds to a No. 18 copper wire. The increases in capacitance and dissipation factor caused by these residuals are shown by the lines slanting upward on the right in Figure 4. The complete frequency characteristics of these decade condensers are the sums of the slanting lines for capacitance and dissipation factor, as shown by the curves in Figure 6.

[10] H. A. Wheeler, Formulas for the Skin Effect, *Proceedings of the Institute of Radio Engineers*, Vol. 30, Sept. 1942, pp. 412–424.

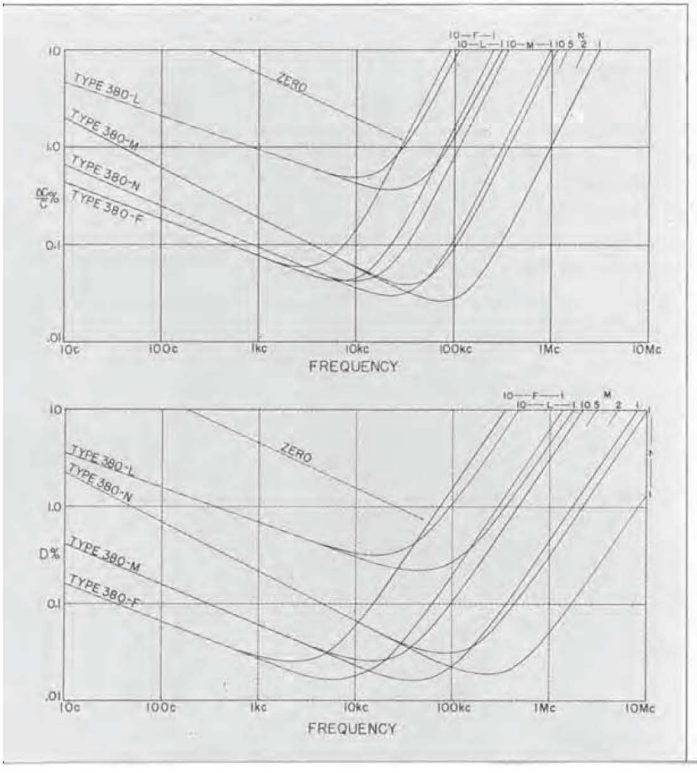

FIGURE 6. Frequency characteristics of TYPE 380 Decade Condenser Unit for switch positions 1 and 10, obtained by adding the components shown in Figure 4. The distribution of the curves for the other switch positions is shown for the TYPE 380-N Unit. The curves for the zero capacitance are shown in the upper left corner of each plot.