SIMPLE INDUCTANCE FORMULAS FOR RADIO COILS*

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It is the purpose of this brief paper to present two simple formulas which the writer has found very useful for computing the inductance of the simple types of radio-frequency coils.

The new formulas are patterned after an empirical formula derived by Professor L. A. Hazeltine some years ago, for the

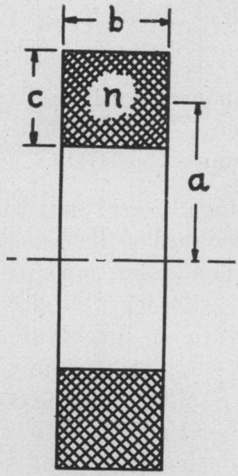

Fig. 1

inductance of a multi-layer coil. This formula follows, for dimensions in inches, according to Fig. 1:

$$L=\frac{0.8a^2n^2}{6a+9b+10c} \text{ microhenries} \quad (1)$$

This formula is correct to within about 1 per cent when the coil has approximately the shape shown in Fig. 1, such that the three terms in the denominator are about equal.

The new formulas were derived empirically from the inductance formulas and curves in Circular 74 of the Bureau of Standards. The corresponding coil formulas of this circular, however, either rely on tables or include expressions which are inconvenient to compute. For this reason there was a need for more convenient

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formulas, even with the loss of some accuracy, for use in the laboratory. The formulas to be given are easy to remember and can usually be computed with one setting of the slide rule.

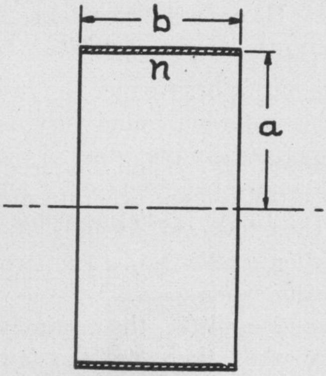

Fig. 2

One formula (derived in August, 1925) gives the inductance of a single-layer helical coil, in terms of the dimensions in inches, according to Fig. 2:

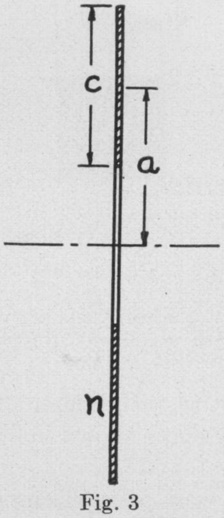

Fig. 3

$$L = \frac{a^2 n^2}{9a + 10b} \text{ microhenries} \tag{2}$$

This formula is correct to within 1 per cent for coils with $b > 0.8\,a$.

The other formula (derived in December, 1927) gives the inductance of a single-layer spiral (or helical) coil, in terms of the dimensions in inches, according to Fig. 3 (or Fig. 2):

$$L=\frac{a^2n^2}{8a+11c}\left(\text{or }\frac{a^2n^2}{8a+11b}\right)\text{microhenries} \qquad (3)$$

This formula is correct to within 5 per cent for coils with $c>0.2\,a$. (or $2a>b>0.2\,a$).

In general, formula (2) should be used for helical coils, whenever $b>a$, since (2) is more accurate under this condition. For shorter helical coils, however, formula (3)—in parentheses—is more accurate, when $a>b>0.2a$. The two formulas (2) and (3) give the same value when $b=a$.

In both formulas (2) and (3), the accuracy may be less than the stated accuracy when there are too few turns, when the spacing between turns is too great, or when the skin effect and distributed capacity are important factors.