THE ANALYSIS OF AN A. C. CIRCUIT CONTAINING R, L, and C

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The usage of the term, power factor, referring to alternating currents, is becoming increasingly common. Not only are motors recommended in terms of their power factor, but now the advertisements of certain brands of the newly popularized fluorescent lamps also refer to their high power factor. It was this latter fact that suggested a demonstration experiment in the beginning course of physics to make the analysis of an A. C. circuit as simple and clear as possible.

Fig. 1 shows the circuit used. The values of R, L, and C are so chosen that the current may be made exactly 1 ampere by adjusting R, a slide wire rheostat. This greatly reduces the later computations. The voltage leads of the wattmeter and the voltmeter leads are left free to be placed across the different parts of the circuit, as well as across the circuit as a whole. By joining these leads in pairs the manipulation of the experiment is facilitated.

Typical data are indicated below the figure. They include the power in watts, the voltage, and the current for R, L, C, and the entire circuit.

Fig. 2 shows the computations performed on the data. From the relation $W = VI \cos \theta = VI \times$ power factor, $\cos \theta$, the power factor, is first calculated. then $\sin \theta$ is found from trigonometric tables. The values of $V \cos \theta$ and $V \sin \theta$ are next computed. The vector diagram shown in the lower half of the figure is drawn to scale. A check of the work is provided by summing the appropriate vectors to find the resultant voltage. Its magnitude and phase angle in respect of the current should match within the limits of experimental error the values observed and computed for the circuit taken as a whole.

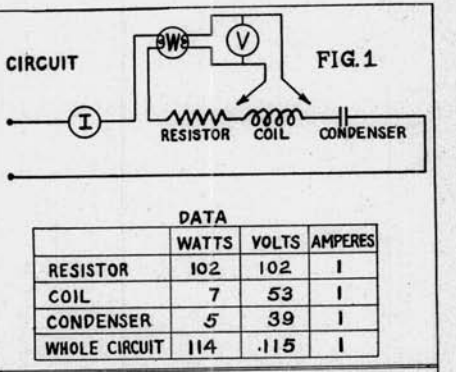

FIG. 1

DATA

	WATTS	VOLTS	AMPERES
RESISTOR	102	102	1
COIL	7	53	1
CONDENSER	5	39	1
WHOLE CIRCUIT	114	115	1

COMPUTATIONS

	W	V	Z	$\cos\theta = W/VI$	$\sin\theta$	$V\cos\theta$ R	$V\sin\theta$ X
RESISTOR	102	102	102	1.000	0	102	0
COIL	7	53	53	.132	.991	7	52
CONDENSER	5	39	39	.154	.988	6	38
WHOLE CIRCUIT	114	115	115	.991	.133	114	15

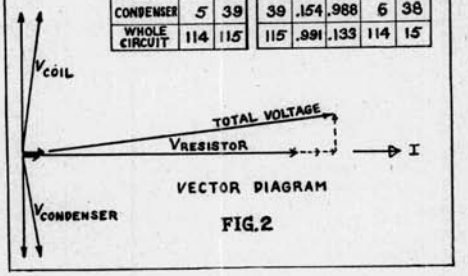

FIG. 2

If desired these data can also be used to analyze the impedence of L and C into reactance and resistance, so that the inductance and capacitance and power factors can be computed.

This experiment is followed by an individual experiment performed by each student, in which he measures the D. C. resistance and the A. C. impedance of an inductance coil. From these he computes the reactance, inductance and power factor of the coil.