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The Kilowatt-Hour Meter in a Student Experiment

GRANT O. GALE

In our general physics course for non-science students, we have for some years given the students a chance to "experiment" with electrical equipment usually found in the home, and to make it more real, we have arranged a panel to simulate a house with the main entrance switch, fuse block, kilowatt-hour meter, and two branch fuse blocks; one going to an ordinary group of switches and outlets, and the other to a lamp to be controlled by two three-way switches. Regular commercial fixtures, switches, flush receptacles, etc., are used throughout. The student is given a pair of pliers, screwdriver, roll of tape, etc., following a lecture on safety precautions such as tight connections, soldered joints, conduit, etc. The wiring is then done by the students and in so far as time permits, they are allowed to use the trial and error method as the circuit is well protected by fuses.

The only quantitative part of the experiment is a determination of the constant of the kilowatt-hour meter. It is my feeling that this is a much neglected member of the family of electrical measuring instruments. We have students study the Wheatstone Bridge and the reflecting galvanometer (not to mention the age-old tangent galvanometer) and yet chances are that for the majority of non-science students, the only electrical instrument they will ever have access to is the kilowat-hour meter at home.

Assuming a constant input voltage of 110-115, the student could conceivably determine the constant of the meter at home by loading the circuit with lamps of known wattage; measuring the time of revolution of the disk. The following data was taken by a student in the laboratory. The load was determined by means of a voltmeter-ammeter because of poor voltage regulation.

Data:	**Load in Watts**	**Time for five revolutions**
	68.0	88.5
	159.2	41.2
	240.0	27.7
	278.4	20.9
	340.8	16.5
	404.5	13.8
	465.0	12.3

Sample Calculation of the Meter Constant

(Note: Most of the new meters have this constant stamped on the face of the meter so that the student may check his value.)

$$68 \text{ watts} \times \frac{88.5}{3600} \text{ hours} = 5 \text{ revolutions}$$

$$\frac{68 \times 88.5}{5 \times 3600} = .334 \text{ watt hours per revolution.}$$

By means of this constant and (or) data, it is possible to determine unknown loads, etc. The student may even be curious about why the disk turns at all since it has no brushes and why it doesn't coast when the lights are turned off. It is an excellent introduction to eddy currents and split phase motors.

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