METERS AND METER RATES.

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There are a few things of more importance to owners of electric light plants, or having a more potent influence for the financial success or failure of electric supply undertakings generally, than meters and meter rates; and all those interested in the satisfactory solution of the problem "how to increase profits from electric supply," should give the subject of this paper thorough and serious consideration. In these days of close competition in lighting, in common with all other industries, when we feel the need of constant study and investigation in order to find, if possible, means of reducing the cost of production, should we not devote ourselves with equal energy and perseverance to the task of increasing the earning-power of our plans? Upon this question, meter rates have a direct and important bearing.

It seems hardly necessary at this time to make a plea for the use of electric meters. Experience has established, beyond question, the fact that the use of meters increases the earning-power of a plant. A change from flat to meter rates invariably lowers the peak of the station load curve to such an extent, that the lamp installation may be doubled before the peak regains its previous value; the average earnings per lamp installed will be such as to show an increase in the total revenue, unless indeed the flat rates previously charged were so high as to confine the use of the lights to a narrow circle of long-hour consumers. The use of meters also places the owner of a plant in a position to compete successfully with gas and other illuminants for all classes of consumers, thereby facilitating the extension of his business. This cannot be done under a flat rate system, except by making all sorts of special rates, to meet special cases; a proceeding which is certain to produce dissatisfaction among consumers, and often works injustice to the supplier. No attempt will be made to give in this paper a history of the electric meter; not even to enumerate the many forms that have been produced in the process of evolution, to which we owe the modern recording meter. Too much valuable time would be taken up and no very useful purpose would be served by the recital, as far as this association is concerned. Those who feel any interest in the subject may be referred to a paper read by George W. Walker, before the American Institute of Electrical Engineers, May 21st, 1891. Later meters have been described and illustrated from time to time in the electrical press.

It is necessary to the full success and popularity of the meter system of charging for current, that the meters should be direct reading, in other words that the record of consumption should appear in plain figures on dials available to the consumer, as he has long been accustomed to in gas meters. The Canadian Electric Light Inspection Act prohibits the use of any but direct reading meters, therefore the choice of meters lies between the different forms of these meters, generally known as "motor meters." These meters are essentially electro-motors, operated by the current to be measured and whose rotating member actuates a train of registering wheels and dials. They may be divided into two general classes, namely:

First, those operating on the inductive principle, wherein an armature, consisting of a ring, disk or cylinder of metal, generally iron, is carried around by a rotating magnetic field. This field results from the current to be measured passing through a coil or coils of wire, and the current induced in a closed secondary coil, of low resistance, set at angle with the first; and, second, those embodying the well-known principle of the direct-current motor: a wire-wound armature rotating within a magnetic field. Meters of the first class are suitable for alternating currents only, and must be calibrated for the frequency at which they will be operated. They have no commutator nor brushes. Those of the second class may be used for either direct or alternating currents of any frequency. They have a commutator and brushes. That is their weak point, as dirt and moisture will affect the commutator, and the meter will in time run too slow unless it is cleaned occasionally, which is a troublesome proceeding, now that meters are sealed by the Government. They require delicate and careful handling. Meters of either class may be "current meters," recording in ampere-hours, or "energy meters," which register in watt-hours.

In meters of the first class, which are generally current meters, the torque is approximately proportional to the square of the current, and the speed is proportional to the torque. Such are the "Schallenberger," "Duncan," etc. In meters of the second class, generally energy meters, such as the "Thomson," the torque is directly proportional to the power applied and the speed is proportional to the torque.

All meter armatures left free to revolve, run so fast at high loads as to seriously impair the accuracy and durability of the meter, and means had to be provided to restrain their speed. This was done in two ways. Small vanes or air fans were attached to the end of arms rigidly fixed to the armature shaft. These fans lie at right angles to the direction of rotation, and the retardation is due to the resistance of the air against them, which is approximately proportional to the square of the speed, so that this device may only be used in those meters where the torque is proportional to the square of the quantity to be measured. The other way is to attach to the armature shaft a copper disk revolving between the poles of permanent magnets. These exert a drag on the eddy currents generated in the disk by its rotation in the magnetic field. This magnetic drag is proportional to the speed, and is employed in meters where the torque is proportional to the quantity to be measured. The majority of meters will not start with less than three per cent. of their full loads, and tend to run slow at light and high loads. This is a serious drawback, but there appears to be no effective remedy for it at the present time. In choosing a meter the first point to be settled is whether to use a "current" meter or "energy" meter. At first sight it would seem that the energy meter would best suit our purpose, as it records the actual expenditure of energy, but where energy is supplied at a constant voltage, the record of the current meter is proportional to the energy in volt-amperes. With alternating currents, and especially with inductive loads, the record will be slightly in excess of the energy, but will be proportional to the machine capacity employed, which is a perfectly reasonable charge against the consumer, since it is the maximum load in volt-amperes that determines the size of the plant and the fixed station expenses. The current meter has the advantage of simplicity, ease of adjustment and less cost. It lends itself admirably to the lamp hour-rate of one cent, as its record shows the lamp-hours. Rates may be varied to suit all conditions by a system of discounts from the one cent rate.

The desirable characteristics of a meter are: Initial accuracy, constancy, simplicity of mechanism and indicating dials, durability, ability to exclude dirt, insects, etc., and to withstand tampering. Examination and test will determine how far these characteristics are possessed by a meter, except those of constancy and durability, which can only be established by a test of time in regular practice. Both, however, depend on good design and workmanship, especially in the jewel-bearings, which should be of the best quality, accurately ground and thoroughly polished. The writer has for some years used the "Schallenberger" current meter, which has met all the conditions of actual service in quite a satisfactory manner with only ordinary care. He had some experience with a certain type of meter in which so much heat was developed at normal full load as to roast the varnish on the outside of the wire coils. It is needless to say that such a meter should, under no circumstances, be used.

The importance of a well-organized meter department and properly equipped meter room, wherein testing, adjusting and repairing of meters may be intelligently carried on, cannot be too strongly urged. This department should be given in charge to one man, who may be carefully instructed in his duties and educated to perform his work in an efficient and systematic manner. When meters are received from the factory they should be examined, tested and adjusted if required before they are sent for Government inspection. Records of these and all meter tests, of meters certified by the Government, installed or taken out, and of meters repaired, should be kept in the meter room in a day-book for that purpose where entries may be made from day to day, designating such meter by the serial number, size and make. There should also be a ledger, into which day-book entries should be posted. A page to be