

add it up he will be surprised, and the meter will generally be found to be not such a liar after all.

STATION METERS.

The practice of metering the output of the central station, which is becoming quite popular, is a move in the right direction. The data obtained through the use of station meters is not otherwise available. It is sure to lead to economies in the station, and will be of material assistance in making and re-adjusting rates.

METER RATES.

In making meter rates, it has been customary to copy the practice of the gas companies, sanctioned by long usage, of a single rate, with or without discounts off large bills. The conditions under which electric light generating plants operate are, however, very different from those of a gas plant. The gas plant is fully utilized, and works at the point of highest efficiency for as many hours as may be desired, storing the product that is not immediately required. For an electric light plant the contrary is the case.

Forced to run our plant from sixteen to twenty hours per day at a small percentage of its total capacity, which must be such as to meet the large demand which will be made upon it for a few hours every day, we find that the great bulk of our expenses are incurred, not in running the plant, but in getting ready to run.

The charges assumed for each consumer connected to our lines, in order to be ready to supply him, are fixed, whether the lights are to be used ten minutes or ten hours per day. The cost of supplying current after the first ten minutes is only from one-third to one-sixth of the fixed charges previously incurred.

It is easy to understand, therefore, that a consumer using his lights only a short time every day, which is likely to be during the period of highest load at the central station, may not be a source of profit and may sometimes be a source of loss.

Does it not seem reasonable that this consumer should pay such a meter rate that his yearly payments shall cover the fixed expenses made on his account according to the number of units held in reserve for him and subject to his call?

This rate being applied to all consumers for, say, the first hour of the use of their lamps, would fully protect the supply company from loss on account of fixed expenses, so that any additional current would only need to be charged with the variable expenses of running, and could be sold at such a low rate as would encourage the further use of current during the hours of light loads at the central station.

Such a method of charging for current naturally tends to lower the peak of the station load curve somewhat, but specially to build up, if not the lowest, at least the intermediate portions of it, and thereby to increase the earning power of the plant.

The above considerations have led managers of electrical supply enterprises to devise various methods of charging for current in harmony with the principle of differential treatment of consumers, according to their value to the supply company as a source of profit.

Mr. Arthur Wright, electrical engineer of the municipality of Brighton, England, who has devised a system of meter charges known as the "Maximum Demand System," wishing to show the injustice and loss involved in the old single rate plan, cites two cases, his worst and his best customers.

The first employed for his maximum requirements 177 h.p. of the generating and distributing plant, capitalized at \$36,066, costing, for interest, sinking fund and depreciation only, \$2,582. He used in one year the equivalent of all his lights, burning 61 hours, and paid, on the single rate plan, \$823.

The other employed 1.9 h.p. of the plant, capitalized at \$394 and costing \$27.70 annually. He used in one year the equivalent of all his lights, burning 2,004 hours, and paid \$288.

Thus the large consumer who paid \$823, and who would under the single rate plan be entitled to the larger discount, was actually a source of loss to the supplier to the extent of \$1,750; while the small consumer who paid \$288 netted the supplier a profit of \$260 on the capital charges, and the variable expenses were also much less in his case, as he received only 3,867 h.p. hours, while the large consumer used 10,797 h.p. hours.

These are extreme cases; yet if similar statistics were compiled from the records of electric supply companies in this country, many cases would no doubt be brought to light which would show the injustice to supply companies and long hour users of the single rate system of charging, in a manner almost as glaring as in the example just given.

The greatest difficulty in the way of these improved methods probably lies in the fact that customers, especially the short hour consumer, will not look at these things through our own glasses. He is not concerned about the unfavorable conditions under which our own plants are operating, and seriously objects to pay a larger average rate than his neighbor, no matter how conditions may differ. It is sometimes argued by advocates of differential rates that the supply company should leave these consumers alone and seek for business rather among the smaller but longer users; but it is well known to those who have had to fight opposition that it is advantageous to have the patronage of the large business houses and to light the more prominent buildings, mostly short hour consumers, on account of the advertising value of such installations.

Among the many systems proposed, the following are the most worthy of notice:

1. The Wright maximum demand system.
2. Differential meter rates based on the installation.
3. Two rate meters.
4. Fixed price per light to cover fixed charges wholly or in part and low meter rate.

The Wright system aims to charge the higher rate for the first hour's use of the maximum current used at any time during a given period without regard to the size of the installation.

The maximum current is indicated by the "demand indicator," an instrument invented by Mr. Wright, which is installed in series with the main current wherever a recording meter is used. It consists of a "U" shaped glass tube with a bulb at each end, partly filled with colored sulphuric acid and hermetically sealed. A strip of platinoid is wound around one of the bulbs. The current is made to pass through the platinoid strip, which becomes heated and the air within the bulb expands, driving the liquid up the other leg of the "U" shaped tube until it reaches the other bulb, when it overflows down into a branch tube, which is graduated to indicate, by the height of the liquid within it, the maximum current that has passed through the instrument; the expansion of the air being proportional to the heat developed, therefore to the square of the current. When this instrument has been read it may be re-set by tilting it until the liquid runs out of the branch tube. The cost of this indicator is about ten dollars.

In Brighton, England, where the system has been working very successfully for about three years, the rates charged were in 1898 fourteen cents per kilowatt hour for the first hour's daily use of the maximum current recorded on the Wright meter, and three cents per kilowatt hour for any additional consumption. It will be seen what inducements are offered to long hour users. This was found to be equivalent to an average rate of 6.64 cents per kilowatt hour.

The system may be modified to suit local conditions; thus the higher rate may be applied to less or more than one hour's daily use, and again this quantity may vary according to season. The Chicago Edison Co., who use this system, charge for fifteen hours' use of the maximum demand per month in summer at one cent per lamp hour. For the six winter months the rate is applied to forty-five hours' use per month. Additional consumption is charged at half rates. The Edison Electric Illuminating Co., of Boston, make the hours' use to be charged at the one cent rate vary from month to month. The hours are ten in July to fifty in January.

Whatever may be said against the Wright system, there is no doubt that the use of it or some other differential system would enable us to better compete with gas in the case of such long hour consumers as drug stores, hotels, etc.

The demand indicator will not record demands lasting less than fifteen minutes, but a consumer may require an unusual number of lights on some special occasions, and he is unwilling to have his bill increased by an amount out of reasonable proportion to the privilege required. In cases like that, experience has shown that it is necessary to read the indicator before and re-set it after this unusual demand, and to take no account in the bill of this special maximum. This proceeding in a large city would involve considerable expense and trouble and complicate the system somewhat.

When the indicator has been read and re-set there is no record left of the indication except in the company's books which may lead to disputes with consumers difficult to adjust.

A device intended to combine with an ordinary recording meter the advantages of a demand indicator has been put on the market by Mr. Edward Halsey, of Chicago. It can be applied, it is said, to any meter using magnetic drag as a retarding device. The armature shaft is divided horizontally in two parts and they are connected by a ratchet coupling. The upper part carrying the armature has a pointer rigidly attached to it, and the lower part carries the copper retarding disk, which is graduated. The pointer normally stands at zero over the copper disk. The operation is as follows: As the demand increases the speed of the shaft and the magnetic drag also increase. The lower part of the shaft lags behind the upper part by an angle dependent on the torque or the energy passing through the meter, the ratchet coupling maintains the angle between the parts when the current is afterwards reduced, and the position of the pointer over the copper disk may be read as the maximum demand.

Another method of charging, probably ante-dating the Wright system, and aiming at the same results, consists in charging the higher rate on the first hour, more or less, of daily use of all the lights installed.

While this method removes the necessity of the extra meter or indicator it is open to several objections.

It puts a large burden of charge on the short hour consumer and discourages the installation of lights with the probable effect, that the consumer will install electric lights where the daily use of them will warrant this proceeding and employ gas or some other illuminant for the lights that are seldom used. While this may cause no direct loss to the supply company, it is not conducive to the popularity of electric lighting, which would be considered somewhat of a luxury.

It is not as equitable as the Wright system, inasmuch as our fixed charges are not governed by the total installation as much as by the maximum demand, and two consumers with equal installations may show great differences as to their maximum demand on the station. The system for instance does not discriminate between a consumer using say thirty lights (all his lights) one hour and another using ten out of his thirty lights three hours.

Residence lighting which should be specially encouraged, would be discouraged by this system.

The expense and difficulty of ascertaining the number and candle-power of the lights installed would be considerable. Constant checking would be required, involving frequent domiciliary visits by the inspector, and there would always be uncertainty as to data so obtained.

Still another variation of differential rates is found in the use of the two-rate meter of the General Electric Company. This