is billed in addition to this a fixed amount per kilowatt hour, which we will call the energy charge. Power rates may apparently differ from this in form, but to be equitable they must be reducible to this basis, and a rate which is not reducible to it is not equitable. In order that this form of rate, or its equivalent, may be put in force it is necessary that the consumer's load factor be known in each case. His average load may, of course, be determined by an integrating watt meter. His maximum load, however, must be determined in order to establish the load factor. Usually the most accurate way of determining this maximum is by means of a meter, such as the Wright Demand meter, or a recording instrument.

Notwithstanding the fact, that the number of equitable rates in force is constantly increasing, I could cite actual cases of rates in force to-day, varying from the equitable basis referred to above to the other extreme of the flat rate of a fixed amount per month per lamp connected. It may be interesting to mention several of these cases with a view of analyzing them, and determining how nearly they approach the equitable basis.

These analyses will, I believe, be made clearer by using the curves shown on Figs. 1 and 2 as illustrations. On each sheet the curves relating to steam operation are shown by the solid lines and those referring to hydro-electric plants by the dotted lines. In Fig. 1 the curves are plotted between per cent. load factor and cost per horse-power per year, curve A representing the fixed charges of a steam plant; curve B, the variable expenses; curve C, being a summation of A and B. Curve D represents the fixed charges of an hydro-electric plant; curve E, the variable expenses; curve F being a summation of D and E. All of these curves may be reduced to curves as shown on Fig. 2, which is plotted between per cent. load factor and cost per kw. hour, the cost per kw. hour, at any load factor being equal to the cost per horse-power per year at the same load factor, divided by 8760 and multiplied by 0.746, multiplied by the load factor. Thus, curve A, Fig. 2, is deduced from curve A, Fig. 1, the other curves in Fig. 2 being obtained in the same manner; the factor 8760 is the number of hours in a year. It should be understood that the values shown by these curves have been taken arbitrarily, and are not intended to represent any specific case, nor should any meaning be attached to the relative costs of steam and hydro-electric plants as shown by these curves.

1. Water Power.—A primary charge of a fixed amount per kw. per year of the maximum kw. plus a fixed rate per kw. hour.

This coincides with the rate basis referred to. The maximum is taken as the average of the ten highest fifteen minute averages occurring during the year.

2. Steam.—Same as 1, except that the maximum is determined as follows: The highest one hour average of every peak throughout the year is noted, and the highest average that can be obtained by averaging any six consecutive peaks is taken as the maximum.

3. Steam.—Different rates per kw. hour specified for various load factors. Such a basis of rates could be fixed for the steam plant illustrated in the curves by specifying the costs per kw. hour shown on curve C, Fig. 2, for various load factors, plus a profit.

This form of rate could be reduced to the general form by reducing curve C, Fig. 2, to curve C, Fig. 1, and separating this into curve A, Fig. 1, and B, Fig. 2.

4. Water Power.—A fixed rate per horse-power per year times the maximum one hour peak. Such a rate is reasonably equitable for a water power plant. It would be quite so if curve F, Fig. 1, were horizontal; that is, if all expenses were fixed.

5. Water Power.—A reservation charge of a fixed rate per horse-power of motors connected per month, plus a fixed rate for power per kw. hour.

This offers no inducement to the purchaser to improve his load factor, as would be the case were the reservation charges based on the maximum load instead of the rated capacity of motors installed. It is not fair to those customers who operate a number of motors, each of which may at times operate up to its rating, but where the simultaneous operation of all of the motors at their rated capacities would never occur.

6. A Fixed Rate per Kw. Hour.—This rate is not a just one, as no consideration whatever is given to the customer's load factor.

7. Steam.—$0.15 per kw. hour for the first 30 hours of the maximum demand, plus $0.10 per kw. hour for all in excess of the first 30 hours' use per month of the maximum demand. This is equivalent to:—

(1) The maximum kw. x 30 hours at 15c. per kw. hour, plus

(2) The total kw. hours minus (the maximum kw. x 30) at 10c. per kw. hour.

The Wright Demand meter records the maximum amperes (at 115 volts) during the month; (1) then becomes equal to the Max. Amp. x 0.115 x 30 x 0.15 = Max. kw. x 4.5, and the customer's bill is, therefore, 4.5 x Max. kw. plus 0.10 x (total kw. hours — 30 x Max. kw.) = 4.5 x Max. kw. plus 0.1 x total kw. hours — 3 x Max. kw. = 1.5 x Max. kw. plus 0.1 x total kw. hours; or, in other words, he is billed at $1.50 per month per kw. of the maximum peak plus a charge of 10c. per kw. hour, which is the same as the general form of rate referred to.

8. Water Power.—A reservation charge of a fixed amount per kw. per month times the maximum kw. plus a charge for power made up of a fixed amount times load factor times maximum kw.

If such a rate were adopted for the water power plant illustrated by the curves, the reservation charge should be approximately $2.79 per kw. per month

$$= \frac{\$25.00 \text{ per H.P. per year}}{12 \times 0.746}$$

the figure $25.00 being taken from curve D, Fig. 1), and the monthly charge for power would be $5.00, plus a profit times load factor times maximum kw. The figure $5.00 is the variable expense per horse-power per year at 100 per cent. load factor as illustrated by curve E, Fig. 1. The company's revenue would have been the same if their monthly power charge had been made equal to $0.00076 per kw. hour, plus a profit times the number of kw. hours' output for the month, since the figure $0.00076 is taken from curve E, Fig. 2, which gives the equivalent costs per kw. at various load factors of the costs per horse-power per year shown by curve E, Fig. 1.

Hence, this rate is directly reducible to the general form of rate previously referred to. The maximum in this case is arrived at by taking the average of the maximum two minute peaks for all the days in the month.

It is evident from the above that the equitable basis of rates or its equivalent offers an inducement to the purchaser of power to improve his load factor. The battery application that I have been leading up to is that of a storage battery installed by the purchaser of power to reduce his maximum demand, and consequently his annual primary charge. From his point of view, the battery proposition to be attractive