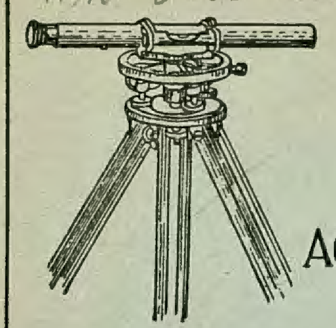

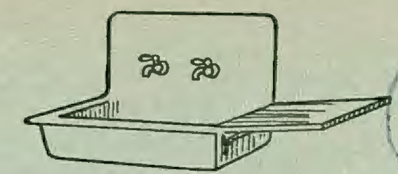

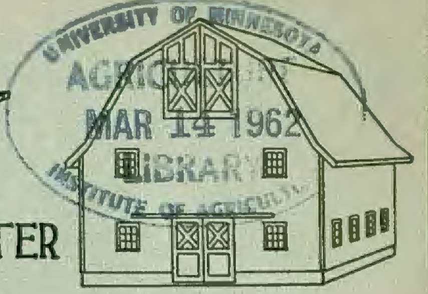

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WIND POWER ELECTRIC PLANTS

J. ROMNESS

Wind power electric service is not a new source of power on Minnesota farms. Some plants which are now in operation were installed about twenty years ago. These first machines were equipped with a rose or fan type of wheel which was connected to a high speed generator either by means of gears or by a belt which passed over a rim on the outside of the wheel. Because of the low efficiency of the old types and their inability to operate in low velocity winds, many improvements have been made in the newer types of machines. The original cost of these first machines was also very high in comparison with the cost of gasoline engine driven plants of the same capacity.

Most of the recent machines are equipped with a two or three blade propeller of the aeroplane propeller type. They are designed to start generating in wind velocities as low as six and seven miles per hour, however, the full rated output requires a considerably higher velocity.

In order to get a fair estimate of the possible amount of energy available with plants of this type, and also the average monthly consumption, the Minnesota Experiment Station has obtained kilowatt hour consumption records on four farms. The plants investigated were all made by different manufacturers and had been in operation at least one year when the meters were installed. The machines are herein designated as Plant A, B, C, and D. Plant A is equipped with a 1,000 watt generator and propeller type of wheel. The average monthly consumption over a period of one year was 35.5 kilowatt hours. During the month of August the lowest consumption of 18 kilowatt hours was recorded.

Plant B is of the same capacity as Plant A. The average monthly consumption was 31 kilowatt hours. Plant C is equipped with a 2,500 watt generator. The consumption averaged 81 kilowatt hours per month. Plant D is a 1,500 watt capacity machine. The average consumption per month over a period of four months was 57 kilowatt hours. The load on Plants A, B, and C consisted mainly of lighting and small power loads such as the washing machine, cream separator and other pieces of equipment requiring up to ½ horse power. In the case of Plant D the load was largely used for water pumping. In addition to the energy data, operating records have been obtained from forty plant owners either by direct interview or in response to a questionnaire. With one exception all the systems are equipped with 32 volt generators. Twenty-seven have a capacity of 1,000 watts, nine of 1,500 watts, and four of 2,500 watts. The operating costs were, as one would expect, very low. Most of the machines require but two changes of oil per year. Two of the machines had been damaged in a wind storm and required considerable outlay for repairs, but the average repair cost per year for all plants was $1.53. A similar investigation of gasoline driven electric plants gave an average fuel and repair cost of $30.15 per year. No estimate can be given as to the probable life of a wind driven plant, but with the few moving parts as found on the present improved types the annual depreciation should be very small.

The foregoing estimate of maintenance does not include battery depreciation, which is the largest item of expense in connection with any individual lighting plant. Because of the uncertainty of wind velocities the battery capacity should be larger with a wind driven plant than with one operated with a gas engine. The average battery life of fifteen batteries which had been replaced was found to be 6.1 years. Most of the batteries had a capacity of at least 240 ampere hours based on an eight-hour discharge period.

Since the life of batteries is determined largely by the number of charge and discharge cycles, the battery life can be increased with proper care and planning. The battery is connected into the circuit so as to float on the line. That is, when the generator is delivering a current and an appliance is connected the battery takes the excess or supplies the deficit of the current necessary to operate. If the large power units such as the electric iron, pump motors, and other appliances requiring large input are operated when the wind is blowing sufficiently to generate there will be very little drain on the battery. When it is possible a large water storage reservoir should be provided to hold several days' supply to carry over periods of low winds.

Users of small amounts of electric energy will find that the energy cost due to battery depreciation is very high. Considering the case of Plant B, where only 31 kilowatt hours were consumed per month, if we assume the cost of the 280 ampere hour battery to be $150.00 or $25.00 per year, the rate per kilowatt hours is 6.7 cents for battery depreciation.

The amount of energy available from a fully charged battery depends upon the rate of discharge. A 240 A.H. battery will, if completely discharged in eight hours, deliver 7.68 kilowatt hours. If the discharge takes place at an intermittent rate over a period of two or three days the available energy may be increased by as much as 40 per cent.

The size of the battery to be installed would be determined somewhat by the length of periods of insufficient wind to operate the generator. The various plant owners estimated the maximum period of no operation from two days to two weeks. An average of all was six days. A fully charged 240 A.H. battery discharged over this period would therefore supply a possible average of 1.5 kilowatt hours per day.

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