A pipe line built without regard to increased demand in future may result in very high pumping costs or building of another line in the near future. A line built to give economical cost of pumping ten or twenty years in the future, may be very expensive on account of high interest charged on the investment. Since in many instances it is necessary to vary the rate of pumping throughout the day, the size of pipes should be so chosen that average cost will be economical. It may be economical in some cases to pump at a definite rate for several hours each day until sufficient water is pumped to meet the demand for the entire day. Interest and depreciation continue, however, when line is not in use.

Knowing definitely the cost units, the cost may be shown best by curves, but for a basis from which to draw curves for any cost units, values are best shown by tables.

The accompanying table is prepared to show cost of delivering water at uniform rates of flow through pipe lines. The pumping cost is taken at ten cents per million gallons, one foot high. Friction is computed by the formula of Flamant as given by diagram in "Public Water Supplies," by Turneaure and Russell. The cost of pipe is taken at $30 per ton for class B cast-iron pipe, and interest plus depreciation on the pipe line is taken at 6%.

When pumping costs are low, pumping a little above the most economical rate does not greatly increase the total cost per million gallons. However, by choosing the next larger sized pipe, the cost could, in many cases, be greatly decreased.

Costs for pumping part time at uniform rate may be computed from the table. For example, pumping through a 10-inch pipe line at a rate of one million gallons a day, an average of eight hours a day, the cost of pipe line per million gallons would be three times that given in the table, or $3.63. Operation if cost is 10 cents per million gallons 1 foot high, would be $2.10 as given,—total $5.63. Pumping for eight hours at a rate of 500,000 gallons a day and for 16 hours at a rate of 1,000,000 gallons a day, the cost would be 1/6 of a million at $2.84=47 cents, plus 2/3 of a million at $3.31=$2.20; a total of 833,000 gallons at a cost of $2.67, or $3.20 per million gallons.

For various unit costs of pumping, corrections may readily be made. For cost of pipe delivered to station within one or two miles of construction work other than $30 per ton, the cost may be closely approximated by varying the cost on the pipe line and the 6% on investment proportionately, as the cost of iron is a large part of the cost and generally when pipe is high, labor is also high. Actual cost of pipe line chosen for table may readily be found, as 6% of the cost is given.

Cost of pumping as affected by differences in elevation, uncertainty of future demands and many other problems to be considered in waterworks installation are not considered in this paper.

At a recent meeting of the Associated Boards of Trade of Ontario, a resolution was passed recommending that the Department of Railways and Canals should begin work at an early date on plans and surveys for the construction of a canal and river system from Lake Ontario to Montreal of capacity equal to that of the new Welland canal. Other resolutions called for the extension of the T. & N.O. Railway from North Bay to Parry Sound and for the early beginning by the Dominion Government of work on the French River development as the start of the Georgian Bay canal system.

Hon. N. W. Rowell states that no announcement will be made regarding the personnel of the new Federal Department of Public Health until after Sir Robert Borden's return to Canada. During the discussion in the House of Commons of the bill creating the new department, Capt. (Dr.) Manion asked that the minister in charge of the department should not be a medical man, claiming that as a doctor he could say that the ordinary medical man has very little knowledge of public health. The object of the new department was stated broadly in the preamble to the bill to be the "social welfare" of the people.

INSTALLATION, CARE AND MAINTENANCE OF WATER WHEELS

By D. W. Rounds
S. Morgan Smith Co., York, Pa.

INCIDENTALLY the writer will preface this paper by saying that he has had to do, as erector, with a greater number of water wheels than has any other man in the United States, hence has accumulated a varied fund of experience from the mechanic's point of view; also, obviously, from the engineering and design viewpoint.

The proof of a water wheel is its operation, and only by their records in operation can we improve water wheels or any other machines.

In the crucial test of any water turbine unit, the valves or gates stand out as the most important feature, not excepting the runner itself. This fact is gradually dawning upon us as the demand for speed regulation becomes more exacting. Some time, not far distant, as we improve the wheel gates, we will actuate them by an all-electric apparatus, discarding the hydraulic governor entirely. This is both economical and entirely feasible.

Must Have Straight Shaft

In erecting, we must ever have in mind that the shaft coupling is a weak place, a spot where any error will become apparent. There are often errors in alignment, or what is more frequently encountered if it be a cast coupling or one keyed on the shaft, is the imperfect fitting of the key, so that in driving it distorts the coupling. To show maximum power on the switchboard, we must have a straight shaft. A shaft will run equally well at any angle between the level or vertical, provided it is straight. We set shafts vertically or horizontally because we have instruments designed for these two positions.

In setting a vertical water wheel, suspend it by its thrust bearing and, if coupled properly, the shaft will assume the vertical position more accurately than by any other method and without instruments and with no possibility of error. This method is applicable to any size, large or small.

In the popular mind, the electrical part of a unit can do no wrong. The water wheel can, and is looked upon as an anarchist, a disturber of peace and the source of all our earthly woe. Perhaps this is true, but there are others.

An excessive end thrust is developed in a horizontal shaft. It is apparent in the thrust bearing, so is chargeable to the water wheels, but with careful analysis it is seldom found there. More often it is found in the relative position of the rotor to its armature. Again, a slight "wabble" may be observed in a vertical shaft. It is apt to increase with time. This may be traced to an unbalanced condition electrically, or to the fact that the rotor is not in running balance although it may be in static balance.

Careless Inspection Causes Trouble

In one feature, at least, the water wheel stands prominently alone; it is in a class by itself in that it inspires in the mind of the operator that it needs no attention till it breaks. No other machine on earth or under the earth, receives so little care as the water wheel. Perhaps the engineers are responsible for this neglect, as they insist that water wheels shall be installed in wet places. No other machines are put there. But despite these disagreeable surroundings, the water wheel is inspected regularly. The reports show that the flume is opened and that a lantern and a man's head have been thrust in. Perhaps the man himself gets through the hole, looks about in the darkness of the slimy, noisome place, assures himself that the water wheel is really there, and reports accordingly. Later something happens; confusion reigns as the power goes off. Surely the water wheel was in good order; report shows that everything was screwed up tight; so the burden is shifted to the manufacturer.

The erector need not necessarily be a mechanic, but at all times and in all ways he must be a diplomat, for he is ever between the devil and the deep sea. Great, paternal