$$M = \frac{19543.5 + 341.1 \times 65 + \frac{1}{2} \times 2.25 \times (65)^2}{200} \times 100$$

$$- 9147.6 = 14086.5 \text{ kip-feet.}$$

Employing the more extensive table this becomes,

$$M = \frac{46468.125}{200} \times 100 - 9147.6 = 14086.5 \text{ kip-feet.}$$

Where the right-hand support falls in between the points an even foot apart, results sufficiently accurate may be obtained by interpolation.

In testing for maximum shears and moment, where a portion of the uniform load is on the span, a saving of time is also effected by being able to read directly from the table the total load on the span for any assumed position of the loading.

CENTRIFUGAL PUMPING MACHINERY.

By William Perry.*

A centrifugal pump is constructed on the principle of an ordinary fan or blower, having a number of blades connected, which are called an impeller. The form of the blades has considerable to do with the efficiency of the pump. The impeller, when set in motion, and the case being primed, the suction or inlet pipe being critically tight, with a perfect retaining valve, the force with which the water flows out will be equal to the centrifugal force, which force is dependent on the velocity of the revolving impeller. The water flowing to the centre or inlet of the pump forms a vacuum, which brings the water from the required source, providing the lift is not over 25 feet. I have run a 6-inch centrifugal pump with a 27-foot lift, and it did good work, but the intake or suction pipe was good or the impeller would run away and leave the water. A centrifugal pump will lift by suction equal to a reciprocating pump. The proportioning of the centrifugal pump is of the utmost importance, and to-day is being greatly improved upon, and what some years ago was supposed to be an impossibility is in fact a reality to-day. It will be interesting to trace back fifty years.

I have a memo where Appold's centrifugal pump (discarge 1-inch in diameter, making 6,500 r.p.m.) discharged 10 gallons per minute, while a 12-inch, having the same velocity, discharged 1,440 gallons a minute. This was considered good work. To-day a 1-inch centrifugal pump will discharge 20 gallons and a 12-inch 4,000 gallons per minute.

The first patent turbine pump, a combination of centrifugal pumps, was taken out by Prof. Osborne Reynolds in 1875. Immediately following this Mather & Platt, of Manchester, built the first Mather & Reynolds turbine pump for the Owens College, Manchester, England (now Victoria University). This pump can be seen in operation to-day. The Gwinne pumps have been greatly improved upon. The turbine, a combination of centrifugal pumps, are built from two to six stages, and will raise water from 10 to 2,000 feet. Two turbine pumps were recently built by Mather & Platt for the McGill College, Montreal, for experimental purposes to deliver 1,000 Imperial gallons per minute.

The construction of the centrifugal pump is simple, consisting of one single shaft, on which the impeller is stationary. No valves or springs are used in connection with the same to get out of order. A few years ago 50 feet elevation was considered the limit for a centrifugal pump, but with the turbine 15,000 gallons per minute is raised 300 feet and over, and, considering the cost of foundation and buildings, the centrifugal turbine, from improvements which are being made, will be about the most economical pump for pumping large quantities of water for fire protection, waterworks systems. The centrifugal turbine pump was of little interest until the introduction of the same by Mather & Platt, but with high-speed motors and steam turbines the conditions of fifty years ago have materially changed. The cost of installation and maintenance is considerably reduced.

Friction in the suction and discharge lines of a centrifugal pump is very often a serious matter, and the power consumed in overcoming it is liable to become an expensive element in the cost of operation. In designing or arranging a centrifugal pumping system, the total capacity being fully understood, it is very important to arrange pipes having the proper diameter to be used for the suction and discharge main. Without causing excessive friction, taking into consideration larger or smaller diameters of pipe will seldom equal the cost of coal consumed in pumping. I have had a very wide practical experience in the line of pumping machinery, and would say it has led me to the conclusion that thousands of dollars are lost by overcoming friction head in pipes, short-turn elbows, tees, etc., which, under capable designing, could be avoided.

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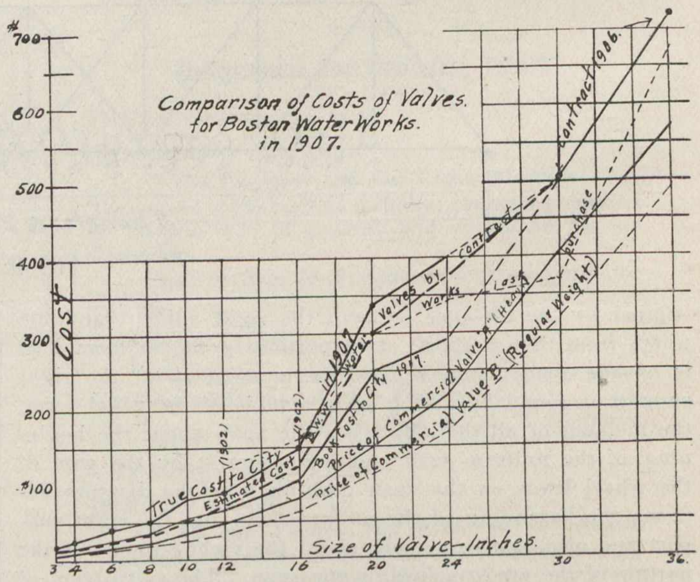
THE OPERATION OF A MUNICIPAL MACHINE SHOP

In their recent report to the Boston Finance Commission, Messrs. Metcalf & Eddy, consulting engineers of Boston, present some interesting facts regarding the operation of a machine shop maintained by the Boston Water Department.

At this shop are manufactured the gate valves, hydrants and small brass goods used by the department, such as



corporation and sidewalk cocks, etc., and all emergency and repair work requiring the facilities of a machine shop is done.

Formerly the organization was a comparatively small one, but it has increased from time to time until the annual cost of the work done in the shops during the years 1906 and 1907 amounted to about $38,000 for articles manufactured, and to about $4,000 for repairs made.

The rough castings are made for the city by contract, and only the work of finishing and assembling is done in