WATER WORKS PUMPING MACHINERY.

By John Kennedy M. Inst. C.E.

The above is the title of a very able lecture recently delivered by John Kennedy, M. Inst. C. E., Chief Engineer of the Montreal Harbour Works, to the engineering classes of McGill University. Several of our leading engineers, Messrs. F. Shanly, W. B. Smellie, P. A. Peterson, L. Lesage, G. D. Ansley, shewed the great interest they feel in the training of the younger members of the profession by being present, and kindly promised to give their help in continuing the lecturing system inaugurated during the last season. The lecturer commenced by stating that

Waterworks pumping machinery may be conveniently considered under these heads. 1. Pumps; 2. Motive Power; 3. The Arrangement of these, with reference to each other and to their foundations.

Pumps for water works are almost exclusively reciprocating. Rotary pumps of various kinds have often been tried, but from their great tear and wear, leakage, waste of power, and cost of maintenance, they are unfit for constant use. An example worthy of notice as being near at hand, and as affording a full trial under favourable circumstances to one of the best forms of rotary pumps, was that at Ogdensburgh, N.Y. A set of three Holly rotaries was fitted up by the Holly Co. of Lockport about 15 years ago for the supply of the City at about 30 lbs. per inch for ordinary domestic use and about 80 to 100 lbs. for fires, but after a short time they were abandoned for the reasons stated, and reciprocating pumps substituted. The low first cost of rotary pumps has occasionally led to their use in water-works as reserves or fire auxiliaries, and they are well adapted to such use, but the desirability of having the reserve pumps of such kind as to be suited for regular use has almost universally led to the duplication of reciprocating pumps in preference to using rotary reserves.

Reciprocating pumps are conveniently classified as 1. piston, 2. plunger, 3. bucket-plunger. The piston, and the plunger are either single or double acting, and the bucket-plunger is single acting in feed, but double in delivery These types are sufficiently distinct in their ordinary forms and too well-known to need description, but they are sometimes so far varied in design as to be somewhat difficult to classify.

In dealing practically with pumps and especially with those of considerable size, and lifting 100 to 300 ft., as common in water-works, we soon find that the valves and the packing are the parts of chief importance and if these be right there is little else to give trouble.

Packing, strictly speaking, is some substance placed between the pump barrel and plunger, or between other stationary and moving parts to make a water-tight joint between them. Hemp and other soft substances compressed in a stuffing box, and metallic rings or sections, made elastic by springs. are most generally used. Instead of packing proper, bushings or similar devices, depending on the accuracy of their mechanical fit, are frequently used, and it will be convenient to consider both together. For single acting plungers and piston rods in which the packing is open to the air at one end, the old-fashioned hemp or flax, and common stuffing box is undoubtedly the best. The box should be capable of taking in 8in. to 12in. depth of yarn. and the packing should be loose enough to supply lubrication by a slight leakage of water.

For double acting plunger pumps, when the packing is more or less difficult of access and where leakage is of no importance, except as in Fig. 11, the loss of so much pumped water, the metallic bushing is frequently used, and is on the whole, to be preferred to packing. Clean water is a fair lubricator for two brass surfaces and for pumps of moderate size, brass plungers and brass bushings are therefore satisfactory. For large pumps where iron plungers are used for economy, brass or white metal bushings are used with good results. In all cases the bushings are made to be easily renewable; they are grooved with circumferential grooves to check the flow of water between them and the plunger. The depth of the bushing should manifestly bear some relation to the pressure of water and to the weight of plunger, in case it is a horizontal one and supported by the bushing—probably half to one diameter of the plunger is within the limits of ordinary practice for large pumps. For pistons, cupped leather, gutta percha, and various metallic and lignum-vitæ packings, made in sections and kept expanded by springs, in imitation of steam cylinder packings, have been often tried but without much success, and on the whole hemp or other fibrous packings is yet the most satisfactory for pump pistons. For the gland on the stuffing box there is in the piston a follower to press out the yarn and with this difference the packing of a piston and a plunger are alike.

The difficulty of access to pistons to tighten up or renew the packing has, in instances of good modern practice, led to the abandonment of packing and the substitution of deep pistons fitting accurately in the pump barrel and depending merely on their mechanical fit and on grooves cut round their circumference to prevent leakage, as in the case of bushings on plungers. The great 54 in. by 10 ft. pumps of the Chicago water-works and the new 30 in. by 4 ft. pumps of Hamilton, Ont., Fig. 9, are examples of vertical pistons or buckets, and the new Fairmount water-power pumps of Philadelphia are instances of horizontal pistons so treated. A depth of piston of half to three-quarters the diameter for vertical pumps and up to a full diameter for horizontal pumps is usual, and it is customary to make the periphery of the piston as a movable band or sleeve which can be easily changed when worn.

Pump valves.—The requisites in a valve are simply that it should let the water pass freely through it in one direction and entirely prevent it passing in the other. Perfection in action in these points together with durability constitute the excellence of a valve. Water may be retarded and the pump burdened by the valve being too small in area, thus increasing inertia and friction. Or the valve may be unduly heavy in proportion to its lifting area causing a material increase in pressure of water required to lift it; or the water-passages may be crooked and badly shaped. In all these cases the valve is faulty from not allowing the water to pass freely.

It may also be faulty from not closing quickly enough and thus allowing some water to return. This is a very serious evil not merely from the water wasted, but because of the shock produced by the sudden closing of the valve after the water above it has begun to move backward.

To obviate this shock is the great problem in valve designing and has led to almost infinite variety of forms. Time will not permit a description, however