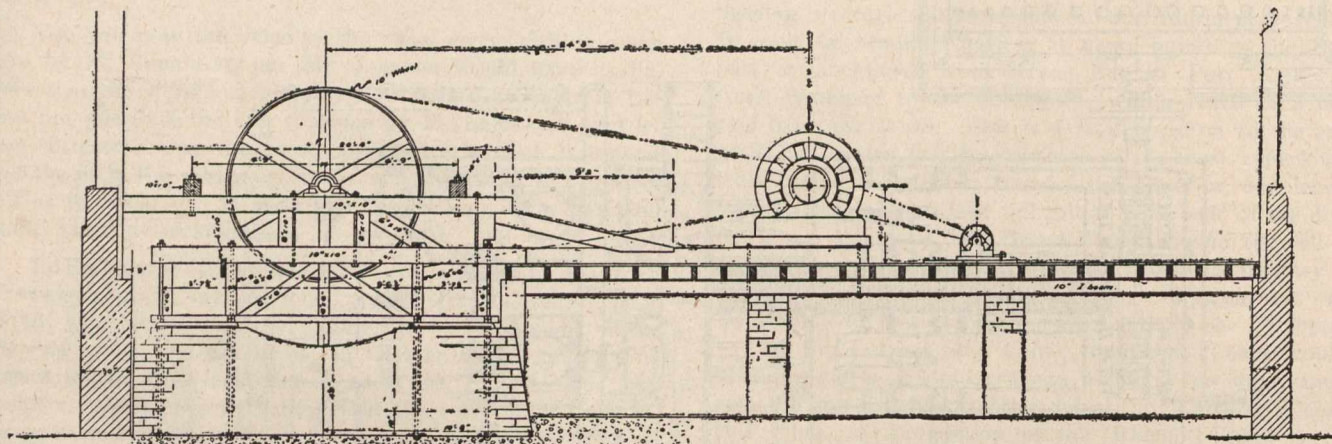


quarter inch, when a tangential force equal to 150-h.p. at 100 revolutions per minute of the jack shaft was applied. This was, of course, due to spring in the crank shaft. When the stresses on the gears are considered in relation to the resultant of the three-crank effort curves, it is at once apparent that there is, during every revolution, a fluctuating load between these gears. This is brought about by the outside cranks, whose load is, from the nature of things, not shared equally at all times by each gear as with the centre crank. Taking this, together with the unavoidable spring in the crank shaft, it was apparent that there would always be a certain amount of hammering or pounding between these wooden wheels and their respective pinions. The writer was then satisfied that with this arrangement such large mortise wheels could not be made to work. The builders, however, claimed the trouble to be due to the unsteady support of the pulley end of the pinion shaft, which, being supported on timbers built up on a foundation about 7 feet below, was not of course the most rigid holding. Considerable oscillatory motion of this end of the jack shaft occurred. By turning the wooden wheels around, and running with one pair, the pump was kept in operation until the permanent motor arrived. When this was installed it was at once clear, even to the builders, that the gearing arrangement would not work, and it was forthwith abandoned in favor of that now running. This consists of a single pair of gears—the face being widened to 24 inches—a machine cut cast-iron wheel, and, at first, an all raw hide pinion.



Montreal Water and Power Co., Temporary Drive, Clarke Ave. Station.

It having been observed that the gears ran better when the working pair was in the pit next the motor, it was thought that a jack shaft of large diameter would tend to smoothen operation. Furthermore, with a two bearing support for the pinion shaft as would obtain, it was decided to abandon the spherical bearings and substitute stiff bearings of a greater length. Accordingly, a 10-inch pinion shaft with bearings of 3.9 diameters (approximately) was installed. The particulars of this pair of gears are as follows: One machine-cut spur cast-iron gear 24-inch face, 179 involute teeth, $3\frac{1}{2}$ -inch circular pitch, pitch diameter 199.42 inches, or 16.61 feet.

The all raw hide pinion has a 26-inch face, 24 teeth, 26.7 inch pitch diameter (approximately). Reduction ration, 7.45.

This pinion ran for six weeks, and then failed much as the others at the lower station did, but from another cause. The shrinkage was much less, the raw hide undoubtedly being a superior article, but something happened inside the pinion which prevented it being taken up. It is the writer's opinion that the raw hide contracted radially and got between the ends of the cast-iron centres carried by the shrouds. However, in spite of plenty of clearance at the ends of the pinion, it was found impossible to compress the hide in the middle so that it was sufficiently tight. The consequence was the load all came on the ends and the teeth got out of shape, causing extreme heating in the pinion. The co-efficient of expansion of this substance being high, the ten $1\frac{1}{8}$ -inch steel bolts holding the raw hide laterally were broken as quickly as they could be renewed. The raw hide itself stood the test, and did not break as with the other. The raw hide was not keyed to the cast-iron centre or otherwise secured, except by the bolts passing

through from end to end. While this pinion ran it was extremely noiseless at times, but atmospheric changes, particularly the amount of moisture in the air, seemed to have considerable effect upon it. An appreciable variation in the running of gearing was observable, apparently from no other cause than atmospheric changes. A cast-iron pinion was cut as soon as possible and installed in place of the raw hide one, pending the arrival of the pinion now running. The first raw hide pinion was, of course, the largest ever attempted in face and mass of raw hide. But in the writer's opinion the very quality to which raw hide owes its noiselessness—viz., the spring—renders an all raw hide tooth of such a length impossible for heavy work. The teeth, as mentioned, spring away from the work in the middle, or point of maximum bending moment, and, the cast-iron teeth of the gear being relatively rigid, too much work comes on the ends, which in consequence show excessive wear in a few days. Unfortunately, the writer was unable to hold a post-mortem on this pinion, without which the above is offered as an explanation of its failure.

The pinion now running is one-third brass; that is, it is cut from a blank having a section of brass in the middle 8 inches wide, with 8 inches of raw hide on each side. The whole is keyed as well as bolted to the cast-iron centres, which makes a rigid point in the middle of the face of the teeth. This pinion has run since April 9th last, and shows only a slight amount of wear. It is not, however, in point of noise much ahead of the cast-iron pinion. In fact, with

its present slight wear it is doubtful whether it runs as smoothly as the iron pinion. The raw hide people are anxious to try again, using an all raw hide face having the raw hide keyed to the centres. I understand they now have one of that type under way. This pump runs only 20 hours a day, and there is therefore ample opportunity to take up the slack in the raw hide, etc.

LUNKENHEIMER METAL FURNACE.

The Lunkenheimer Metal Melting Furnace for melting brasses, bronzes, etc., has been evolved after considerable experimenting with nearly every type of furnace on the market. As will be seen from the cut, the furnace consists of a cylindrical sheet-steel drum A, having cast-iron heads. The interior of the drum is lined with fire-proof tile, and there are two openings on opposite sides of the drum. Only one of these openings is in use, the other being closed by a fire clay filling. The object of having two openings is to increase the life of the linings of the furnace. It has been found that the furnace wears out quicker around the filling hole (which also serves as outlet for the flame) than elsewhere. The advantage claimed for the Lunkenheimer furnace is that when one filling hole is worn out, it can be closed by a fire-clay filling and plate, the furnace reversed, and the other hole cut out and put in service. The oil burner is of a special type, designed to give the greatest amount of heat with a minimum consumption of oil. In the Lunkenheimer foundry there are ten of these furnaces in use, and they are able to secure from six to seven heats per working day of ten hours from each furnace. The weight of each heat will average