This is $12.08 per horse-power hour actually used, and is a very fair type of present practice, as gas engines are more commonly used for engines under 100 horse-power. This, of course, does not apply to producer gas plants.

Water Wheels I.

The importance of the development of water powers for electrical purposes is just becoming to be realized, and to-day we have the very largest plants operated entirely by this prime mover. The lessons of the last few years have been exceedingly valuable, and it is safe to say that the utilization of water power for electrical development will be kept up until every one which is capable of successful development commercially is worked to its utmost capacity. In spite of the length of time that water wheels of various sorts have been used, it is only quite lately, with the introduction of the turbines, that these prime movers have been brought to the development that renders them satisfactory for electrical purposes. We have the three distinct classes of turbines: pressure turbines, most efficiently used when low or uniform heads; impulse turbines, giving more efficient use of water at part load and a more convenient speed at moderately high heads, and tangentical impulse wheels do relatively the best work under very high heads and where water does not have to be rigidly economized. Each of these three classes has decided advantages over the other in particular situations, and the full load of efficiency is approximately equal.

(22) The success of a power development and transmission plant depends quite as much on careful hydraulic work as transmission proper. The two should go hand in hand, and any attempt, such as is often made to contract for the two parts independently of each other, or to engineer them independently, generally results in a construction of electrical and hydraulic machinery that is far from being the best possible under the conditions, and is quite likely to be anything but satisfactory. As before stated, the generator and water wheel must be considered together, for an arbitrary specification of one might well be beyond the electrical or mechanical possibility of the other. When generator requirements and water wheel limits cannot be brought into a reasonably close relationship, then gears and belts have to be resorted to, and this as a general rule is not desirable. Direct-connected work is the best, but an engineer should not ruin his station by unpractical arrangements just to obtain direct-connected prime movers.

On all hydraulic development the first point of interest in regard to the design of wheel used is the available head, and secondly, the flow of the stream. In low heads, and, therefore, moderate pressures, the wheels are sometimes placed in chambers in the forebay or headrace, the shaft running through the station wall and the generator being direct connected to it. This arrangement is a good one, because it does away with the necessity of having hydraulic valve-operated gates, as this arrangement of wheels will start with the opening of the turbine bucket gates and draft tube. In many high-head developments where a penstock is required this scheme is, of course, impracticable.

In high-head operation the wheels are usually inside the power station, and are incased in a large initial chamber, used as a water jacket. This arrangement calls for gate valves, and these are, perhaps, better operated hydraulically. A by-pass round the gate is essential in this type of wheel in order to fill the water jacket of the wheel before attempting to raise the gate, thus helping to equalize the pressure on each side of the gate and greatly relieving the gate-raising equipment. This by-pass arrangement may be very simple in construction and operation, and does not need to be controlled by a hand-valve, as with a plant running nearly continuously it need not be often used. If it is not desirable to have these wheel-gates operated hydraulically, an electrically-driven device from the exciters may be used, thus putting the operation in the hands of the general operator and centralizing control—a desirable thing in case of accident.

(22) F. Osgood, A.I.E.E., April, 1907.

One of the most common difficulties in laying out a hydro-electric plant is due to the variability of heads. The methods taken to get over this are various. A common one is to arrange the wheels to operate normally at a partial gate and to open at lower heads, while at higher heads the wheel is throttled still more. Such an arrangement works the dynamo in a fairly efficient manner. Another method of overcoming the difficulties due to variation in head is the installation of two wheels on the same shaft, one intended to give normal power and speed at ordinary head, the other at the emergency head. This practice is carried out in various forms. Sometimes two wheels may be mounted on the same horizontal shaft, and one of them is disconnected and runs idle unless needed. Another modification of the same general idea is the use of the duplex wheel with the runner and guides, arranged in one or two concentric sets of sockets, which can be used singly or together, according to the available head. This can be made a very effective way of maintaining uniform speed, and, although its first cost is high, it is decidedly economical of water at normal head.

MODERN GERMAN RAILWAY CAR TILTER.

Recently there has been erected in Germany a tower for tilting railway cars which contains several novel features. In Cosel-Oderhafen, an inland harbour, great quantities of coal arrive which are to be sent off from there by ships. The main object was to perform this large unloading business in a minimum of time and without many human hands. The ordinary types of car tilters could not be used on account of the considerably changing water-level and of the brittleness of the material to be shipped—coal.

Car Tilter.

A special apparatus therefore was designed, the principal feature of which is that it prevents crushing of the coal, as this falls always from the same height, irrespective of the water level, which varies between 165.25 and 169.7, that is 5, 4 meters. The platform is made vertically movable, by lowering that portion near the water, or raising the other part of shifting both accordingly, also it is turned to an angle of 45 degrees. The dead loads are counterbalanced