

THE ST. LAWRENCE POWER COMPANY'S PLANT AT MASSENA, N. Y.

There is nearing completion at the little town of Massena, N. Y., near the St. Lawrence River, one of the latest and largest of the hydraulic electric power plants, the development of which is one of the most significant features in the world of engineering at the close of the nineteenth century. The earliest of these was the installation of the Niagara Falls Power Company, at Niagara, of which we have at various times given very complete illustrations. This plant has a capacity at present of 50,000 horse power, and a second wheel-pit is now being excavated which will exactly double the capacity. Another extensive plant for the utilization of the waters of the Great Lakes is that which is being constructed at the Sault Ste. Marie rapids, where works are in progress for the development of 60,000 horse power.

The ambitious undertaking which forms the subject of our front page engraving contemplates the development ultimately of 150,000 horse power, although the works at present in progress are designed for an output of 75,000 horse power, this being the capacity of the present canal. By a study of the accompanying plan of Massena and its surroundings, it will be seen that the natural conditions are remarkably favorable to the development of a scheme like the present one. For several miles in the vicinity of the Long Sault Rapids, in which the St. Lawrence River undergoes a fall of 50 feet, the Grasse River flows approximately parallel with the St. Lawrence at a distance of a few miles from the same, ultimately discharging into that river below the rapids. At the head of the rapids the level of the St. Lawrence is about 42 feet higher than that of the tributary stream, and advantage has been taken of this fact to cut a canal across the intervening country and utilize the head of water which is thus secured in a power plant located on the banks of the Grasse River, which is utilized as a tail-race for the discharged waters. The effective head above the Grasse River level at the power house is $35\frac{1}{2}$ feet. As at present constructed, the canal has a surface width of 192 feet, and a depth of 18 feet. The present capacity of the whole scheme is limited by the capacity of Grasse River, which has sufficient sectional area to carry away the tail-race waters for a development of 75,000 horse power. When this point has been passed in the development of the scheme, dredging operations will be necessary in the Grasse River; but it will be possible by dredging out the same and making full use of the capabilities of the canal, as ultimately enlarged, to produce a maximum of 150,000 horse power. The hydraulic-electric plant which is now being erected at the power house will have a capacity of 37,500 horse power; and the extension which is immediately to be made will bring up the equipment to a total horse power of 75,000.

By the courtesy of the St. Lawrence Power Company, a party made up of the representatives of technical journals of New York was recently taken down to Massena as guests of the Power Company, and driven over the work, every facility being extended by Mr. William F. Zimmermann, the general manager, and Mr. T. A. Gillespie, the contractor, of the St. Lawrence Power Company, for a thorough examination of the same. As a result of the very quiet manner in which this company has executed a work of this magnitude, surprise was expressed at the advanced stage to which it had been pushed. Of a total estimated excavation of 5,922,000 yards, 4,500,000 yards had been removed. The canal, which is about three miles in length, has been so far advanced indeed that it is likely it will be ready for use during the spring of next year. The concrete work of the power house is completed and roofed in, and the work of installing the turbines and generators is being actively prosecuted.

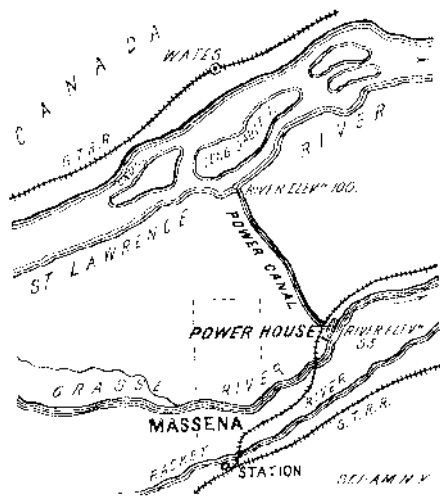
The power house, which is being built upon the bed rock of the Grasse River, will ultimately be nearly seven hundred feet long, with a width of about 150 feet. The fifteen 6,000 horse power turbines, or rather sets of turbines (each set consisting of six wheels), which will be here installed, are of the well known Victor type. These turbines will be placed upon horizontal shafts in three sets of two wheels each. This is in marked contrast to the turbines at Niagara, which, with their corresponding generators, are mounted upon vertical shafts. The Niagara shafts are 150 feet in length, while the horizontal shafts at Massena are but 80 feet long. The six turbines of each set will develop power sufficient to operate one 5,000-horse power generator. Such structural differences as there are between the two outfits are due to the difference in the character of the two water-ways, the fall at Massena being less, and the volume of water greater than at Niagara.

The power house will have a height of about 60 feet, giving ample head room for an 85-ton overhead electric traveling crane, which will run throughout the entire length of the power house. In addition to the fifteen sets of turbines for driving the large generators, there will here be installed three smaller turbines, operating three direct-current generators, to be used as exciters for the main machines. Direct current is required for exciting alternating current machines, and this may be furnished by a small direct-current machine rotat-

ing on the same shaft with the large machine, or else separately driven. For the plant of the Power Company, as in practically all other large supply systems, separate exciters are provided, and in this case, as stated, they are operated on separate shafts, and by separate turbines.

Each of the enormous main generators, giving an output of 5,000 horse power, will weigh 175 tons. The generators will stand about 22 feet above the tops of the foundations, and each machine will measure on the ground 22 feet by 18. The generator shaft is a continuation of the shaft upon which one set of the turbines is mounted. This shaft carries the revolving field, which is in effect a huge steel wheel, 15 feet in diameter and 3 feet wide, cast with ten massive spokes. This field magnet is designed to rotate at a speed of 150 revolutions per minute, which gives a speed at the circumference of about one and three-quarter miles per minute. The wheel carries twenty externally projecting pole pieces, and rotates within a large stationary ring built up of thin soft steel disks held by a massive outside cast iron yoke. These thin steel disks constitute the stationary element of the magnetic circuit of the generator. Along the inner face of the ring which is thus built up are provided slots in which are laid the copper conductors of the armature. These copper bars are mica-insulated. The rotating wheel (which, with its projecting pole pieces and copper windings supplied with current from the separate exciting machines, forms the field magnet of the generator) induces an alternating current in the copper windings of the stationary outer ring or armature. It is this current which, at a pressure of 2,200 volts, will give an electrical output of 5,000 horse power. This current is carried to a main switchboard, the various machines being connected therewith by means of a set of massive copper bus-bars.

The method by which the output of 75,000 horse power will be controlled possesses unusual interest, on account of its simplicity. One man, by manipulating a series of electric buttons, arranged on a small stand, will be able to control instantaneously the whole out-



PLAN SHOWING LOCATION OF THE MASSENA POWER CANAL.

put of 75,000 horse power. Running the length of the power house will be a raised platform, in the middle of which will be built a central controlling stand, made desk-fashion and semi-circular in shape, so that an engineer stationed at its center will have within reach the controlling apparatus of the entire station. This controlling stand will carry a number of marble slabs or tablets (one for each generator), upon which will be mounted small controlling keys. These keys are arranged on the interlocking system, and they will operate, by means of local battery circuits, a series of compressed air valves and pistons. The latter will, in turn, control a series of fifteen switching stands, one for each generator, equipped with the necessary cut-outs and switches. The stand will be located under the raised platform and approximately opposite its corresponding generator. Each stand will carry three-pole carbon shunt circuit-breakers, in series with which will be three-pole double-throw switches. The circuit-breakers and switches are controlled by means of compressed air, as previously stated, from the central controlling stand operated by the engineer. Stands similar to the switching stands are provided for the different outgoing circuits. The operator thus has under his eye at every moment the huge generators themselves, their corresponding switches and indicating instruments, and in reach of his fingers are the electric buttons, by means of which the entire plant is regulated and controlled.

The current thus generated will be used for a variety of purposes. It is adapted for use in operating induction motors, which, because of their ideal simplicity of construction and operation, are coming widely into use in place of the more delicate and complicated direct current motor for general power service. It can be used for lighting and heating, and for electrolytic work, as well as in a great variety of electro-chemical processes, such as the manufacture of aluminium, cal-

cium carbide and other products which have been made commercially available only through the application of electric power at extremely low cost, as furnished by such means as the Niagara and the St. Lawrence plants. For some of these purposes the high tension alternating current has to be transformed into low pressure direct current, and this is readily done with very small loss, by means of the modern rotary converter.

Massena is an unusually good center for such a purpose, as its facilities for transportation are excellent. The New York Central and Grand Trunk lines intersect here, and the Vermont Central Railroad and the New York and Ottawa Railroad come within a short distance of the town. Large lake vessels may be admitted to the power company's canal, thus affording direct communication by water with the lake system. If necessary, in the future, a lock may be constructed which will pass vessels from the canal into the Grasse River, and thence back into the St. Lawrence River. Such a plant as this affords ideal facilities for the transmission of the electric current over great distances, as is done from the central power plant at Niagara, but it is not the intention of the St. Lawrence Company to so transmit it; but rather to furnish the power at such low rates that manufacturing establishments will find a strong incentive to locate in the vicinity.

Automobile News.

One thousand five hundred motor car licenses have been taken out in Belgium from January 1 to August 30.

The 50-mile championship cup offered by The Chicago Inter-Ocean has been awarded to Mr. Alexander Winton.

Self-propelled lunch wagons are to be built at Worcester, Mass., where is the headquarters of this distinctively American institution.

Fairmount Park has now been opened to automobiles, and the restrictions which were formerly imposed upon them have been removed.

An automobile freight line will shortly be established between Los Angeles, Pomona, Ontario, and Chino, Cal. A 40 horse power automobile truck capable of hauling eight or ten tons of freight at slow speed will be used.

The Transportation building at the Paris Exposition has a series of decorative symbolical figures. It would seem as though the bicycle and automobile would hardly adapt themselves to artistic treatment, but the result is fairly successful.

The Boston Park Board has extended the time within which horseless carriages can be driven in the park system. Automobiles can now be run from 8:30 until 11:30 in the evening. The vehicles must not travel at a higher speed than 10 miles an hour in the park.

King Leopold, of Belgium, has given an order for a 20 horse power carriage and an electric brougham, both of the Panhard-Levassor make. The king has also asked for plans of a van for servants' baggage and for an omnibus to run between the royal palace and the railway station.

A large iron works at Pueblo, Col., contemplate ordering a large motor vehicle for the purpose of conveying workmen to and from the plant. The proposal provides for a 25-seated car, which will start at six in the morning and following a certain route to the works pick up the men en route.

The Park Commissioners of San Francisco have at last decided to admit automobiles in Golden Gate Park after the drivers have obtained permits. They must appear before the Commissioners, and if they are considered competent, a permit will be given to them irrespective of the motive power of the machine.

Preparations are going forward in Washington, D. C., for an automobile show, which will be held during the week the National Capital centennial is celebrated—December 10. The purpose of the exhibition is to bring together in Washington representative exhibits of automobiles of every type and description, and to illustrate in this way the development and possibilities of this important branch of industry. No city in the country is better adapted to the use of automobiles than is Washington, and it is expected that the forthcoming show will exert an important influence in the development of the industry in that city.

Private automobiles will pay taxes in cities in Spain of \$11.58 for each vehicle, and for each seat including driver, \$1.36. In smaller cities the tax is decreased, and in places of less than 20,000 inhabitants the tax is further lessened to \$2.89 for each vehicle and 34 cents for each seat. Horseless vehicles for traveling along the public roads will pay for each 0.6 of a mile 58 cents, and for each seat for 0.6 of a mile 35 cents. It would seem that these excessive taxes would eventually prevent the use of any automobiles, especially those for traveling along the public roads. This is very short-sighted policy on the part of the authorities, because the automobile could easily work a revolution in transportation in Spain, where it is specially needed.