A HIGH SPEED ELECTRIC LOCOMOTIVE.

The first electric locomotive of any considerable size in the United States, and what is said to be the first practically operative high speed electric locomotive in the world, adapted to the steam railroad, has recently been completed at the Lynn works of the General Electric Company, and will shortly be exhibited at the World's Fair. Its completion marks a distinct advance in electrical development.

It is a 30 ton locomotive, designed for a normal speed of 30 miles an hour, primarily intended for operation on elevated railways, and for passenger and light freight traffic on less important steam roads. It is of compact construction, solidly and substantially built, and runs on four 44 inch wheels. Its dimensions are: 16 feet 6 inches long, 11 feet 6 inches high, 8 feet 4 inches broad, having its drawbars 2 feet 6 inches from top of rail, the Manhattan Elevated Railroad standard height. The drawbar pull is calculated at 12,000 pounds.

The propelling power is furnished by two electric motors of especial design and construction, each axle being provided with one motor. The motors are gearless, and are supported on spiral springs resting on the side frames of the locomotive truck. This method of suspension leaves the wheels free to adjust themselves to the irregularities of the roadbed, and consequently the wear to both tracks and motors is diminished.

The motor fields consist of massive iron castings, to which the hollow field spools are bolted. The armatures are of the iron-clad type, having each separate winding embedded in a mica-lined slot cut into the curved surface of the laminated iron armature body. The axles of the locomotive pass through the hollow shafts on which the armatures are mounted. These shafts rest in bearings of the motor frame, and are connected to the axles by universal couplings, which allow of freedom of motion in all directions. The commutators are of massive construction, and there are four sets of brushes to each commutator.

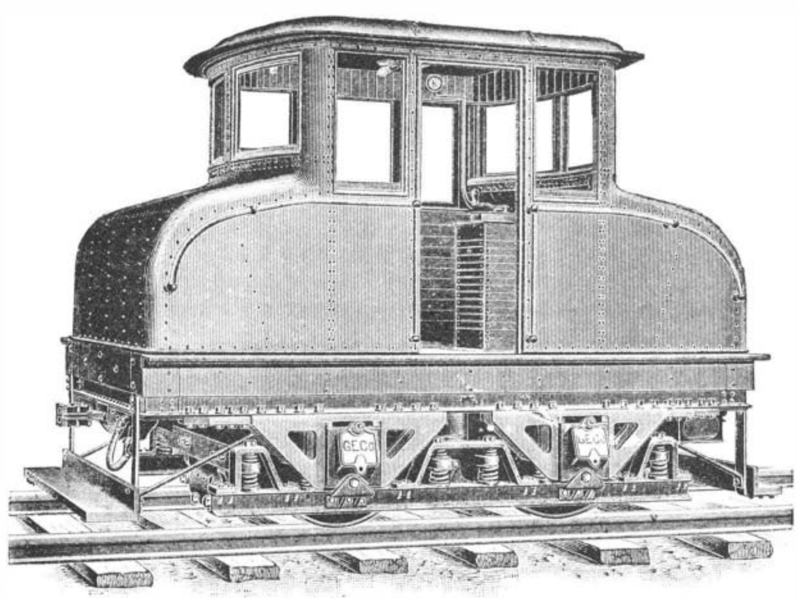
The motors are controlled by means of a series parallel controller, set up in the interior of the cab. This device embodies all the latest improvements made in this type of apparatus by the General Electric Company. Under test it is found that the series parallel controller allows of a more gradual and easier starting of the electric motor and the speed can be more delicately and instantaneously controlled than in the case of the steam locomotive.

The truck, suspended from the journal boxes, is constructed of heavy I beams, and forms the foundation for the locomotive cab, of sheet iron, of symmetrical design, and so curved off as to diminish the atmospheric resistance, as far as possible. The interior is finished in hard wood. Two sliding doors are placed at each side of the cab, and the windows are so arranged as to permit of an unobstructed view in all directions. There is ample space in the cab for the motor man's movements, and it affords him considerably better protection than that usually vouchsafed the steam locomotive engineer.

The air for the brake is supplied by a special electrical air compressor, which also operates the whistles. This air pump has an oscillating cylinder of 6 inches diameter, with a 6 inch stroke, supplying 6,000 cubic inches of air per minute at 70 pounds pressure. The motor is similar to the N.W.P. 2½ in general appearance, but is wound for a higher speed. The normal speed of the armature shaft is 675 revolutions and of the crank shaft of the pump 110 revolutions. The dimensions of the air compressor are, length 41 inches, width 16¼ inches, height 25 inches. The pump motor is controlled by a special rheostat. This, by an intermediary device, is automatically regulated by the air pressure.

This locomotive has been designed for a normal speed exceeding 30 miles per hour. The use of these locomotives over very long distances is at present limited only by the cost of long lines of electric feeders, and until the problem offered by this condition is solved, restriction of its employment must necessarily exist. But for places comparatively near each other and where traffic is dense—the denser the better—the electric locomotive is peculiarly adapted, for here all the advantages of electric propulsion are available, unhampered by the extreme expense involved in long feeder lines.

The evolution of the use of the electric locomotive will probably follow along the lines dictated by expediency and favoring conditions. At first they will probably be used in elevated railroad service, and in New York, Brooklyn, and Chicago alone their advent will be hailed with a feeling of gratitude. They will then probably be adopted as feeders to the trunk lines, both for freight and passenger traffic, and to operate short suburban lines where a rapid, efficient service is requisite. Their peculiar fitness for switching purposes will advance their use another step, and then slowly, as the different problems presented are overcome, it is expected that they will invade the province of the trunk line steam locomotive, when it is hoped the millennium of railroad travel will be within the realities of life.



WORLD'S COLUMBIAN EXPOSITION—HIGH SPEED ELECTRIC LOCOMOTIVE.

THE INTRA-MURAL ROAD AT THE GREAT EXPOSITION.

The Intra-mural road at the Columbian Exposition is a particularly attractive study, because of its intimate relation to the subject of rapid transit.

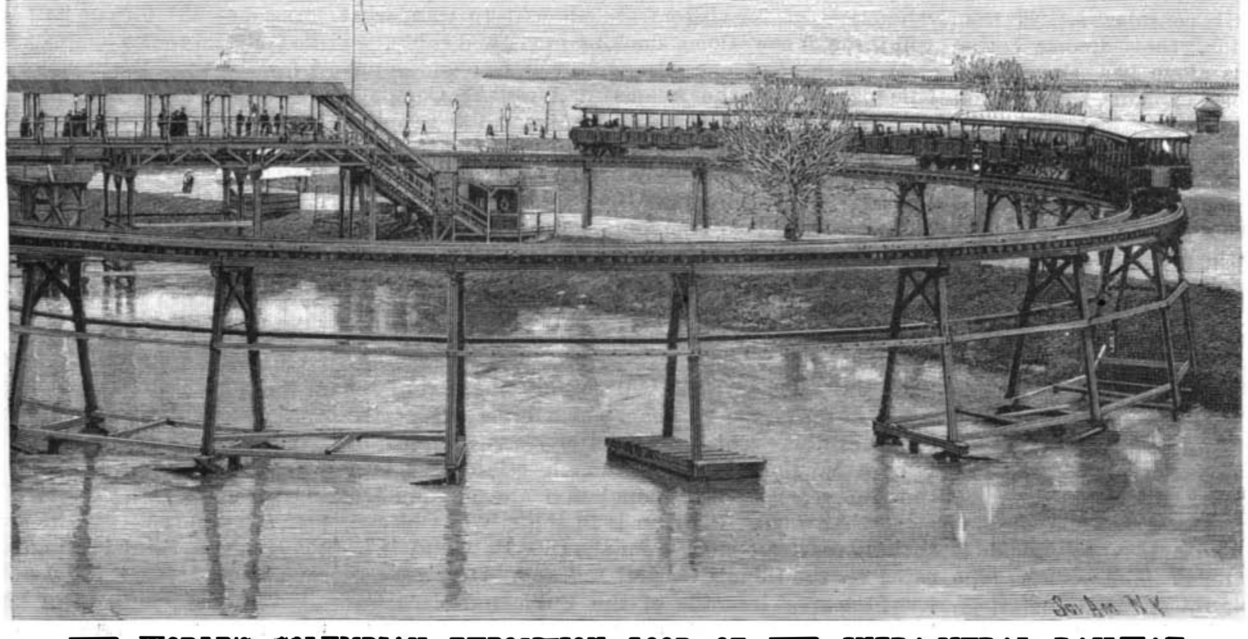
The railway is three and one-tenth miles long, it is double track its entire length and has a loop at each end. The entire superstructure is of wood. The foundations are of concrete placed four feet below the surface. On this concrete were placed cross sills into which were framed two posts of yellow pine, each post being securely pinned and braced. Each post is twelve inches square and posts are placed twelve feet from center to center. The spans of the structure are generally about twenty-five feet. Steel girders are strung along the superstructure and form a foundation on which the ties are laid. The height of the structure varies from twelve feet to twenty-seven feet. There is very little grade throughout the entire length of the line, one and a half per cent being the highest. The rails used are of the ordinary steam railway type, and weigh sixty-five pounds to the yard.

This much of the structure is of ordinary construction. The cars, as will be seen from the illustration, are open and of a new and peculiar type. Each car is forty-seven feet long and has a seating capacity for ninety-six people. It is painted a dark color, with the word "Intra-mural" across the top. Seats run transversely across the car as in the ordinary open street car, but gates are provided on each side which are controlled by a lever convenient to the conductor. As a protection in case of storm or wind, curtains are provided. Each car is fitted with air brakes of sufficient power to stop a train running at a maximum speed in about four hundred feet. The cars are mounted on two double trucks, and are lighted by electricity for evening service. There are fifteen trains of four cars each and three extra motor cars to provide against mishaps to any of the other motor cars. The leading car on each train is the motor car. In construction and design the motor car does not differ from the others in any respect except in the matter of electrical equipment and that the trucks are somewhat heavier. There is an electric motor of 133 horse power capacity on each axle, thus giving the total horse power of each motor car 532, or considerably more than twice as much as the steam engines on the elevated roads in New York or Chicago have. Having so much horse power as this, one of these motor cars can pick up its train and readily attain a speed of ten miles an hour in twice its length—a very important consideration when stations are so near together as is the case with this road, and where the headway between trains is so short.

The electric current is supplied by an ordinary rail of sixty-five pounds weight, which is laid on the sleepers outside of the track upon which the cars run. This conductor is properly insulated and the rails are bound to each other by copper plates, thus giving an efficient electrical conductor. Over about two-fifths of the length of the road two rails side by side serve as conductors to prevent any drop in potential. Current is taken from this rail by means of a sliding shoe made of copper which is held in close contact with the rail by means of a spring. The return current is through the iron part of the structure, the tracks and the girders. The main purpose of the engineers in designing the road has been to secure the greatest amount of efficiency at a minimum cost, as the road is constructed to make money and not to demonstrate a principle.

The power house which supplies the current for operating the road is a commodious structure covered with staff. At the south end of the building on a level with the ground is the boiler room in which there are ten water tube boilers of three hundred horse power each. On the same level with the boilers under the main part of the building are the condensers, feed pumps, etc., used in connection with the engines. The engine room is in what might be called the second story. Between it and the boiler room is a gallery from which the work of the plant can be observed.

The engine foundations are on solid concrete and heavy timber and are amply strong. The engine equipment consists of one Allis two thousand horse power compound engine, which is coupled direct to a Thomson-Houston 1,500 kilowatt



THE WORLD'S COLUMBIAN EXPOSITION—LOOP OF THE INTRA-MURAL RAILWAY.

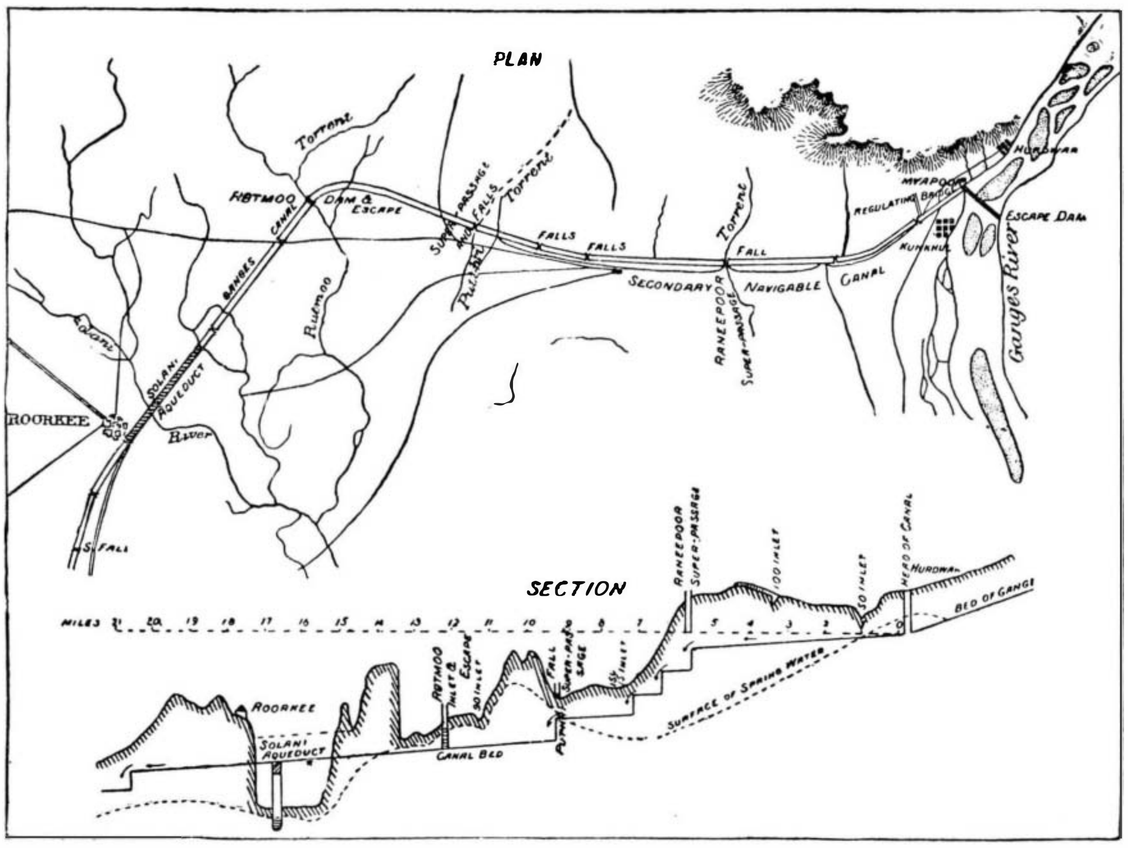
multipolar railway generator, three compound engines each of 750 horse power, one a horizontal, direct-connected to a Thomson-Houston multipolar railway generator of 500 horse power capacity, another a vertical engine direct-connected to a similar generator, and a third belted to one of these generators. There is also a four hundred horse power high speed compound engine direct-connected to a two hundred horse power Thomson-Houston railway generator. The switchboard is on the north side of the room, and from it the operator commands full view of all the machinery. The armature of the 1,500 kilowatt generator is probably the largest one in the Exposition service. It was built up on the engine shaft. The generator is fifteen feet in diameter, while the commutator is seven feet in diameter, and twelve clusters of carbon brushes with ten brushes in a cluster bear on it.

There are ten stations on the road. The first one is at the loop at the south end of the grounds, the others are in the following order: The Forestry building, the Colonnade, which is between the Palace of Mechanic Arts and the Agricultural building, the Railway Terminal Station, the Transportation building adjoining and connecting with the station of the elevated road from the heart of the city, the 62d Street entrance to the grounds, the 59th Street entrance to the grounds, the 57th Street entrance, the Iowa building, and at the loop at the north end of the line adjacent to the Fisheries building and the United States government building.

IRRIGATION IN INDIA.

The twelfth annual report of the U. S. Geological Survey, J. W. Powell director, contains, among other most valuable matters, a paper by Herbert M. Wilson, C.E., entitled Irrigation in India. It is an account of his personal observations in that country in 1890, during a visit and inspection of some of the principal irrigation works made under the auspices of the survey. The paper forms a volume of some two hundred pages, illustrated with maps and photographs, over eighty in number. We are indebted to the author for a copy. It is full of most interesting and valuable information. We regret that our limited space prevents us from presenting the paper *in extenso*. We can only give a few abstracts, sufficient, perhaps, to convey to the reader an idea of some of the extraordinary works that have been constructed and are being built in India, by the British government, for the benefit of the agriculturists of that great empire.

"India," says Mr. Wilson, "stands pre-eminent for her gigantic engineering undertakings. No other country has so vast and so fertile an expanse of territory, with such convenient slopes for the construction of canals, and at the same time such an abundant water supply. In general there is great similarity between the climate and topography of the great northern plains of India and portions of our arid West, especially the eastern slope of the Rocky Mountains and the great California valley. Central India and the Deccan have many features in common with the central arid Territories, particularly portions of northern Arizona and southern Utah. The climate is as similar to that of our central Territories as is the topography."



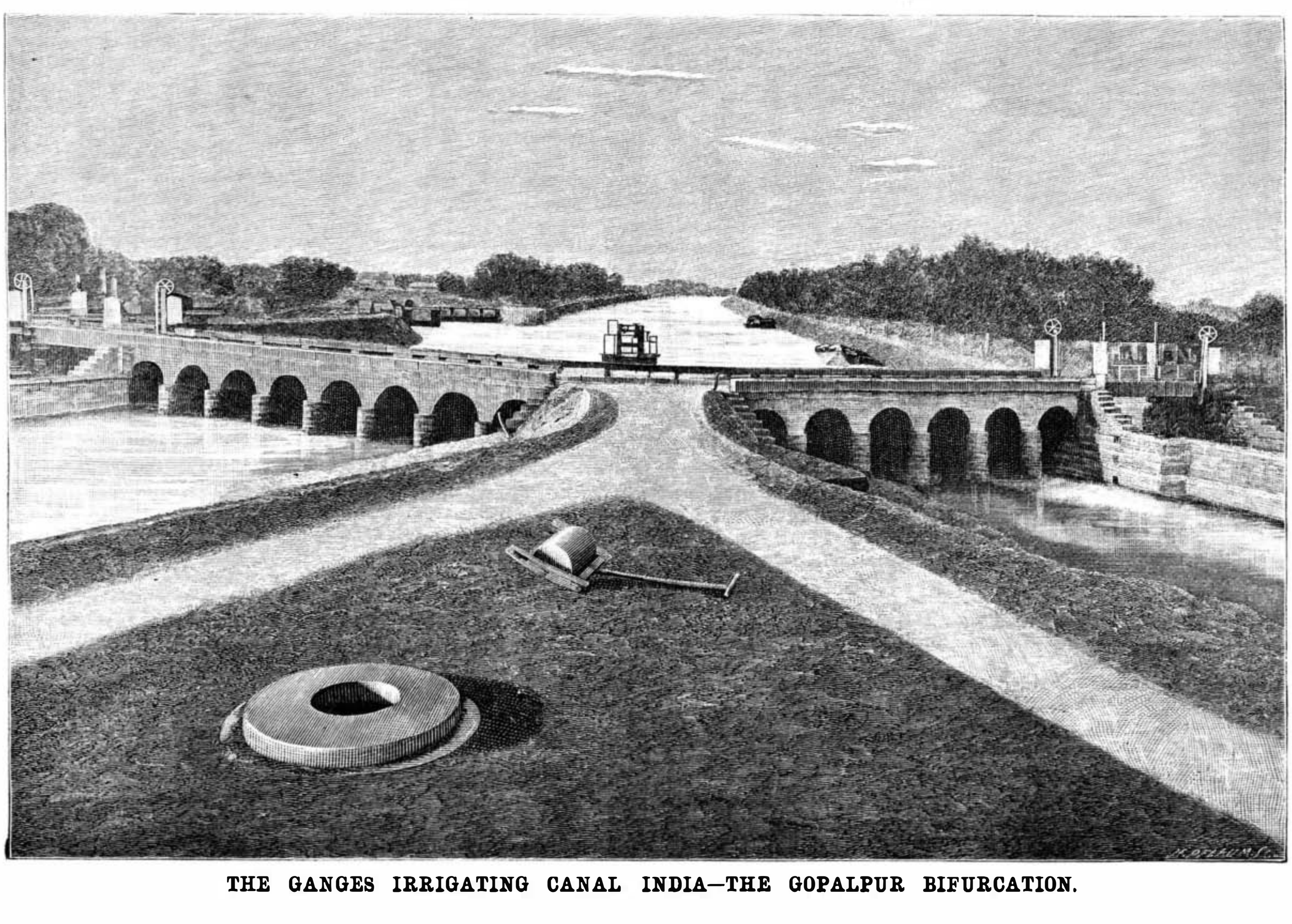
PLAN AND CROSS SECTION OF GANGES CANAL, HURDWAR TO ROORKEE.

"The conditions under which Americans must undertake irrigation enterprises are not so different from those exising in India and southern Europe as would at first appear. Any works we may construct must depend for their utilization and revenue on immigration, as they will be largely undertaken in a sparsely inhabited country. A few of the great canals of the Northwest Provinces and the Punjab were undertaken in districts that were sparsely inhabited. These canals are among those of India that have paid the largest interest on the original outlay. Within ten years from their construction the country was fully populated, although the immigration was often from remote portions of India." In 1888 the area of British territory in India was 1,064,720 square miles and the population 269,477,728. The area cultivated was 144,000,000 acres, of which 25,000,000 acres were irrigated lands.

"The irrigation works of India are divided by the engineer into two great classes, (1) gravity irrigation and (2) lift irrigation. The former includes four great heads, namely, perennial canals, intermittent canals, periodical canals and inundation canals. The water supply for these may be supplemented by storage works. This will be treated as a third class. Perennial canals are taken from the rivers the discharge of which at all times suffices for the irrigation of the lands without the aid of storage. Intermittent canals are taken from intermittent streams, the water of which must be stored in order to furnish a constant supply. Periodical canals are taken from streams having an available supply during the rainy season only, and are used altogether in the cultivation of the summer crop. Inundation canals are taken from rivers having a constant discharge of some magnitude, but are fed by those rivers only when in flood. Lift irrigation is chiefly illustrated by wells. Of these there is little to say, although the area irrigated by them is considerable. They are used in a country where labor is cheap, and are valuable adjuncts of irrigation, catching the seepage water from the canals and irrigated fields which otherwise would be wasted. Owing to the cost of labor, it is doubtful if they will ever be used to any extent in America."

"Men, women, and children are engaged alike in the construction of all works. As common laborers women and children receive about 4 cents per day, and men from 8 to 10 cents. Skilled masons and machinists receive from 18 to 22 cents per day, and carpenters and blacksmiths nearly the same."

"There are 34 major works designed to irrigate, when fully completed and irrigation has been fully developed, something more than 10,000,000 acres. Of 5,520 miles of main and branch canals, no less than



THE GANGES IRRIGATING CANAL INDIA—THE GOPALPUR BIFURCATION.