# World's Mightiest Electric Loco:

## Weight: 283 Tons Horse-power: 4,200 Speed: 65 miles per hour

**The use of Electricity is daily increasing in almost every walk of life, and railways are not behind in the movement. This article, specially written for the "*M.M.*," describes the latest developments in this direction in America. Huge electric locomotives are now used to haul the Olympian, famous trans-continental train, for 650 miles over four mountain ranges between Chicago, Spokane, Seattle, and Tacoma.**

ROBERT LOUIS STEVENSON, writing of a journey on the railway, said: "Herein, I think, lies the chief attraction of railway travel. The speed is so easy, and the train disturbs so little the scenes through which it takes us, that our heart becomes full of the placidity and stillness of the country; and while the body is borne forward in the flying chain of carriages, the thoughts alight as the humour moves them at unfrequented stages; they make haste up the poplar alley that leads towards the town; they are left behind with the signalman as, shading his eyes with his hands, he watches the long train sweep away into the golden distance."

Stevenson was, of course, writing of steam railways. Had he had the experience of travelling for hundreds of miles on an electrified railway he would certainly have been even more enthusiastic. We can imagine our readers asking:—"Yes, but where is there an electrified railway hundreds of miles in length?" Not in Great Britain, certainly, but such a railway exists in the United States, known as the Chicago, Milwaukee and St. Paul Railway.

### A Unique Railway

This railway crosses the American continent from Chicago to the Pacific coast, and 649 miles of its vast length are electrified, forming by far the longest stretch of electrified railway in the world. The first section of this project, moving from east to west, is that between Harlowton, Montana, and Avery, Idaho, a distance of 440 miles. In this section the railway crosses the Big Belt, the main range of the Rockies, and the Bitter Root Mountains, where the winter weather is so severe as to make steam operation very difficult. The whole of this region, regarded from a scenic point of view, is one vast expanse of rugged grandeur. The towering mountains, the impressive walls of the canyons, and the wonderful tangle of rocky streams provide an ever-changing panorama that alternately awes and delights. The electrification of one engine-division of this section was completed in December 1915, and the whole section by the end of 1916.

After two years of severe test the result of this electrification proved so satisfactory that a second zone of electrification was sanctioned. This includes the extreme western end of the line between Othello and Tacoma, Washington, a distance of 209 miles, in which occur heavy grades crossing the Cascade Mountains. This section was opened for traffic in November 1919.

### Electricity Beats Steam

The ease with which the trains on these electrified sections are handled shows that electricity gives smoother, more reliable and quicker running than steam. The great trans-continental trains of the company—"The Olympian" and "The Columbian"—are started, operated, and brought to a standstill, both up and down the severe mountain grades, with a precision that only electric power can supply. In addition, great economy has resulted from electrical operation. The 61 electric locomotives now in use on the two electrified zones have released for service elsewhere on the system no less than 162 steam locos, and they effect an annual saving of 265,000 tons of coal and 35,000,000 gallons of fuel oil.

As regards the comfort and pleasure of the passengers the improvement is most remarkable. Where previously an otherwise very pleasant journey was marred by smoke and cinders from the steam locomotives, struggling up mountain grades or steaming through mountain tunnels, it is now possible for passengers to revel in the delights of open observation cars, a most desirable feature for summer travel through a picturesque mountainous country. On this railway for the first time passengers enjoy a full-vision view of the wonderful scenery through which the train passes, and also have the experience of riding in the open air through mountain tunnels from one-and-a-half to three miles in length at elevations of as much as 6,000 ft. above the sea.

### Waterfalls Drive the Trains

As all our readers know, the steam locomotive is a complete power plant in itself, but the electric locomotive must receive energy from some outside source. In the case of the Chicago, Milwaukee and St. Paul Railway this source consists of a number of water-power stations in Montana and Washington, in which waterfalls are harnessed and made to produce electric current. Some of these power plants are more than 200 miles from the nearest point on the railway.

By means of transmission lines, electrical energy is delivered to the railway in the form of three-phase alternating current at 100,000 volts. This voltage is too high to be used direct, and therefore, at intervals of approximately 30 miles, sub-stations are provided to reduce the pressure and at the same time convert the alternating current into continuous current at 3,000 volts. At this pressure the current is passed to a heavy copper cable that runs parallel to the track throughout the electrified zone. At frequent intervals this cable is connected to the trolley wire, consisting of two copper wires about ½ in. in diameter, supported over the centre of the track at a height of about 25 ft. above the rails. From this trolley wire the locomotives pick up the current by specially-designed overhead collectors.

### Giant Locomotives

The locomotives that haul the magnificent passenger trains over the western electrified zone have been built specially for the work and they have many interesting mechanical and electrical features. They are of a gearless type, with the motor armatures mounted directly on the driving wheels. The great advantage of this system lies in its simplicity, for all gearing and transmitting devices are eliminated. The locomotives weigh 265 tons each and have 14 axles, 12 of which are driving axles and the remaining two guiding axles. Of the entire weight of the locomotive, 86 per cent.—229 tons—is distributed over the 12 driving axles. Each locomotive is designed to handle in normal service a 12-car passenger train weighing 960 tons against a two per cent. grade—a rise of 116 ft. per mile—at sustained high speed. Each has in reserve enough power to haul in emergencies trains with as many as 14 cars up a two per cent. grade at even greater speed in continuous operation.

"Quill" type locomotives, weighing 283 tons, are employed on the other electrified section of the road. They are equipped with six twin-armature continuous-current motors and six driving axles. They are rated at 4,200 h.p. for short periods and 3,400 h.p. in continuous service and are capable of hauling a 13-car passenger train, weighing 960 tons, up a two per cent. grade at sustained high speed. In all these locomotives "pantographs," a sort of overhead sliding bow, are used for current collecting.

All these locomotives are operated by the same men who formerly drove the steam locomotives. It would be dangerous to have the 3,000 volts from the trolley wire actually in the cab, and therefore

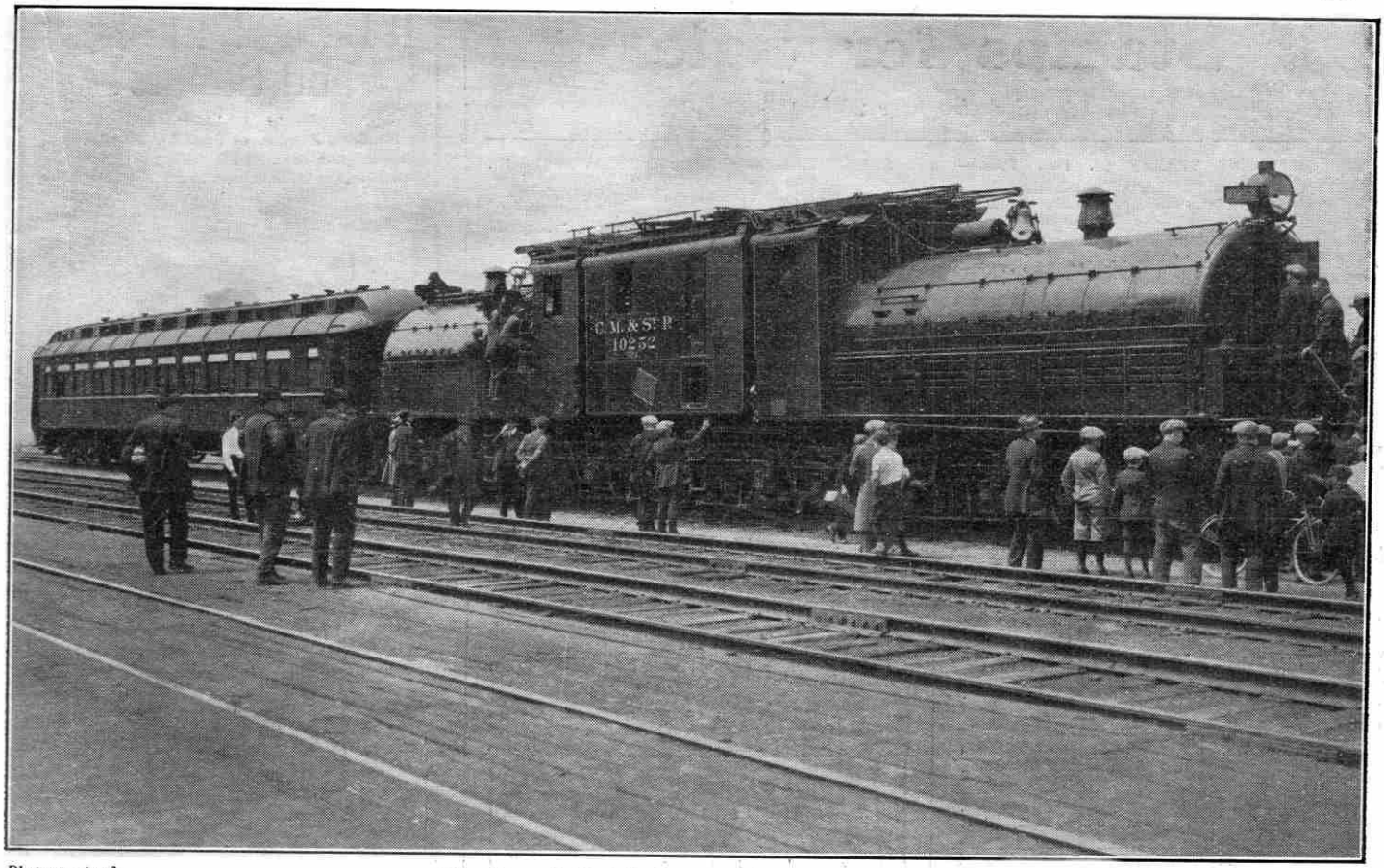


*Photo courtesy*] **The Largest Electric Locomotive in the World** [*General Electric Co. Inc.*

all switches that are in contact with this high voltage are operated by compressed air or low voltage electro-magnets. The high voltage circuits are all confined in a separate compartment, which nobody is allowed to enter while the current collector is in contact with the trolley wire.

### Wonderful Braking System

A particularly interesting feature on this line is the use made of what is called "regenerative" braking. By this system, energy is recovered on descending grades by reversing the usual function of the motors and using the momentum of the train to drive them as dynamos. In order to control a 2,500-ton train travelling at 17 miles per hour down a two per cent. grade, 4,700 h.p. must be dissipated, and using the ordinary air brake it is not surprising that the brake shoes sometimes become red hot. With the electric locomotives the air brakes are used only in emergencies, or for bringing the train to a dead stop. The energy that would otherwise be wasted in heating the brake shoes is thus converted into electric current and used for pulling other trains up the hill or returned to the power station. Regenerative braking strictly controls the speed of the train, and the jerking so often experienced with the air brake is eliminated, the train descending long slopes with remarkable smoothness. From 40 to 60 per cent. of the energy required to pull the train up the hill is recovered in the descent, and approximately 12 per cent. of the total energy drawn from the power plant is returned, or in fact merely borrowed.

### Edison's Prophecy

Our illustration shows one of the wonderful locomotives on this railroad, built by the General Electric Company. The huge size of this engine may be realised by comparison with the throng of interested spectators.

While this locomotive was on exhibition at Newark, New Jersey, a few weeks ago, it was visited by Thomas A. Edison, the famous inventor. Edison, who seemed in the best of health and spirits, was accompanied by his son Charles and representatives of the railroad and of the General Electric Company. He made a close inspection of the locomotive, examining every working part and keeping up a running fire of technical questions. He was clearly delighted with the engine. Afterwards, as he was just stepping into his car, he was asked for a statement, and waving his hand towards the locomotive he said: "This is an indication of what can and will be done with 'white coal' or electricity. Every railroad must come to it eventually. Every motor vehicle, truck and pleasure-car will some day be propelled by electricity. Its powers and uses are still but little known."

## How Far do You Cycle?

Nearly every cyclist sooner or later feels the desire to know exactly how far he has travelled, and in due course he fits a cyclometer to his machine. The foremost essential of a cyclometer is reliability, and the excellence of the Veeder Cyclometers in this respect has won for them such popularity that over four millions have been sold. For bicycles the Veeder is made in two forms, both of which register up to 9999.9 miles, when the next registration brings the dial back to zero ready to repeat. The more expensive model has a second dial that can be returned to zero at will, and therefore may be used to show the mileage covered on each ride. Veeder cyclometers are guaranteed for twelve months against imperfections in material or workmanship, and if accidentally broken they can be repaired provided the damage is not too extensive. (Lists from Messrs. Markt & Co. Ltd., 98, Clerkenwell Road, London, E.C.1).

## For Model-Builders

At one time it was almost impossible to obtain the various small parts necessary for the complete equipment of a model-builder, but to-day requirements are catered for in a remarkable manner. The well-illustrated catalogue, price 6d., of the Electro Supplies Co. (19a, Broadway, Wimbledon, London, S.W.19) contains an astonishing variety of small parts for the builder of model boats and engines of all kinds. For those whose tastes run in the direction of electrical apparatus there are dynamos, motors, transformers, voltmeters, and ammeters. A useful feature of the catalogue is a number of tables giving the maximum current permissible for various copper cables, the decimal equivalents of wire and letter gauge drills, and details of B.A. and Whitworth threads.

## Springs of All Kinds

Many of our readers no doubt find themselves requiring springs at some time or another, and it is useful to know of a firm like Messrs. Clarkes (Station Approach, Redditch) who supply springs for almost every conceivable purpose. This firm also make spring paper clips, spring washers, and in fact spring articles of every description.

## "The Quickness of the Hand . . . . !"

Most boys like to be able to perform one or two conjuring tricks to amuse and mystify their friends. Those in search of good tricks that can be performed without elaborate and expensive apparatus will do well to get the 6d. catalogue of "The Magical Mart" (Alston Buildings, 17, Spiceal Street, Bull Ring, Birmingham). This catalogue describes a large number of highly effective tricks varying in price from a few pence to shillings. For those who want greater variety there are cabinets of high-class tricks at very reasonable prices.