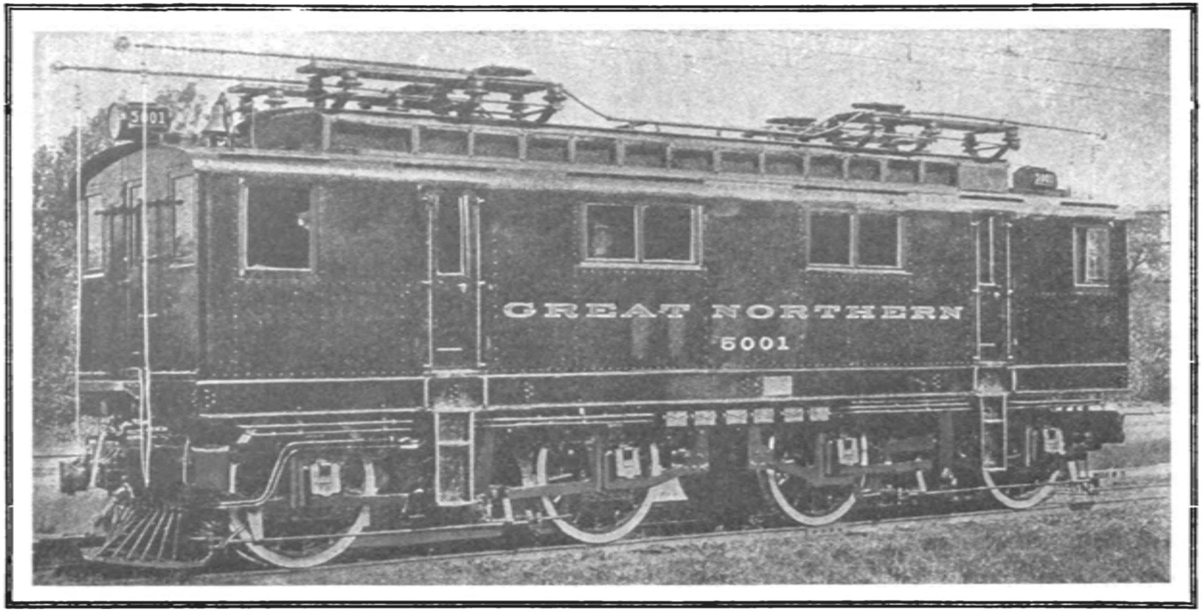
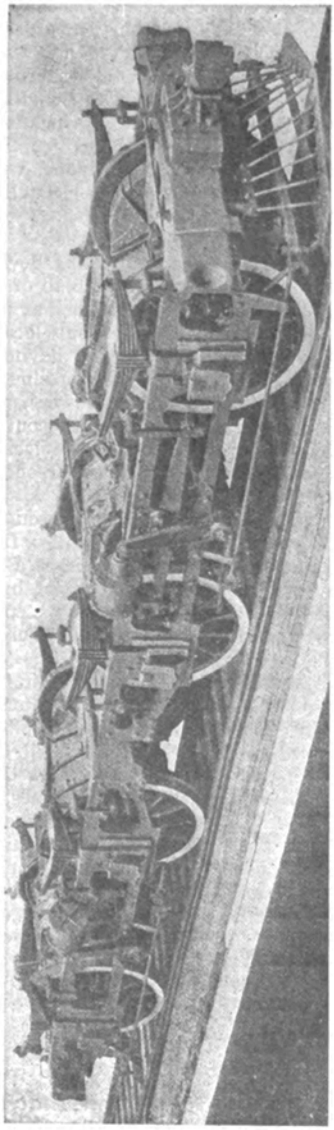


THREE-PHASE ELECTRIC LOCOMOTIVE FOR THE GREAT NORTHERN RAILWAY standard coaches hooked on and easily started the two trains up the steep grade at good acceleration and maintained it over a mile of such grade. Another motor hauled eighteen heavy Pullman cars which, the New York Central officials told the experts, would have required two steam locomotives.—Railway World.

Three-Phase Electric Locomotive for the Great Northern Railway.

The electric locomotive illustrated herewith is one of several which were recently completed by the American Locomotive and General Electric Companies and delivered to the Great Northern Railway. They will be used for hauling freight and passenger trains through the Cascade tunnel, which is a little less than three miles in length. Having a grade of 1.7 in one direction and being so located as to offer serious obstacles to the introduction of ventilating shafts, the Cascade tunnel makes it very undesirable to operate steam locomotives through it. The installation of electric locomotives it is believed will overcome the latter objection perfectly. At present it is the intention to use electric locomotives through the tunnel only, although plans are under way for the electrification of several other grades in the vicinity.

These locomotives are of the double truck type, each truck having two pairs of driving wheels, and weigh 230,000 pounds. The two trucks are joined by an articulated connection and the draft gear and couplers are incorporated within their frames, which relieves the cab underframe of all pulling stress. In order to conform to the relative positions of the two center pins when rounding curves, created by the use of the articulated connection referred to, it was necessary to arrange for a longitudinal movement of one of them, which, it is stated, was easily taken care of owing to the small amount of stress which comes on the pin.


Three-Phase Electric Locomotive for the Great Northern Railway—Running Gear

The locomotives are provided with four 400 horsepower three-phase induction motors, one for each pair of driving wheels, which act through a double set of spur gearing, the secondary circuit to each motor being mounted on a shaft carrying a pinion at each end, and the pinions meshing with gear bands which are shrunk onto an extension of the driving wheel centers, the gear ratio being 1 to 4.28. The motors, which are wound for eight poles, when operated at 25 cycles, have a synchronous speed of 375 revolutions per minute, resulting in a speed for the locomotive of about 15½ miles per hour. The voltage at the motors will be 500 volts, which is transformed from 6,600 volts at the trolley. Cast steel is used for the truck frames, which have been made very heavy and substantial.

Notwithstanding the heavy and substantial construction of the locomotives throughout, it was necessary in order to obtain sufficient adhesion to add extra ballast. The two truck frames are interchangeable but have different equalizing systems, the semielliptical springs over the journals on one truck being equalized together on one side of the truck, while in the other truck they are equalized across the truck, the two springs over each axle being equalized together.

The apparatus and controlling devices have been arranged within the cab of the locomotive in as simple a manner as possible. A fireproof compartment located in the center of the cab, and having a wide passageway on all sides, contains the transformers, contactors, blowers, air compressors, etc. The engineer's controller and indicating apparatus are located in the right-hand corner at either end of the cab.

A hydro-electric plant located on the Wenatschee river, about 30 miles from the mouth of the tunnel, furnishes a liberal supply of power, the current being transmitted at 30,000 volts and stepped down by transformers at the mouth of the tunnel to 6,600 volts.

The locomotive is equipped with four trolleys, two being used for operation in either direction, the rail being employed as a third conductor. It is stated that tests of the locomotives have shown them to be capable of exerting three times the guaranteed full load running torque at any speed from a standstill to within a few per cent. of synchronism. The principal dimensions are as follows: Total weight, 230,000 pounds; length over couplers, 44 feet 2 inches; length over cab, 40 feet 1¾ inches; height of cab, 14 feet; width over all, 10 feet; total wheel base, 31 feet 9 inches; rigid wheel base, 11 feet.

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*The Railroad Spike—An Anachronism of the Twentieth Century.**

In spite of the general excellence of the best modern American roadbed and track, with its deep broken-stone ballast, closely spaced ties, and heavy steel rails, it contains one important element, the railroad spike, which is so much out of date, so absurdly inadequate to the work it is expected to do, that it has no legitimate place today outside of a glass case in an American museum of railroad antiquities. The railroad spike was developed at a time in this country when the blacksmith's forge and anvil were more widely distributed and easier of access than the machine shop and the mechanic. The pioneer railroad builder in America built cheaply, not so much because he wished to as that perforce he had to; and when it came to the question of how to fasten the light thirty-pound rail of the early thirties and forties down to the wooden ties it was easily obvious that the quickest and the cheapest way was to *nail* it down; and so a nail or staple, with a hooked head, was forged on the anvil, and nailed down upon the tie with its hook clasping the base of the rail, in the hope that it would hold the two strips of iron in line and to gage, and prevent them from turning over under the lurching of the locomotive and cars.

Although nearly three-quarters of a century have passed, and each decade has seen a steady growth in the weight and speed of railroad trains and in the cost and quality of the tracks which carry them, we are still *nailing* the rails to the ties. Hence we do not hesitate to say that in the whole field of mechanical and civil engineering it would be impossible to find a device which is such an astounding anachronism as that miserable little piece of ⅝-inch-square iron known as the railroad spike, of which it may be truly said that it has absolutely no other qualifications to recommend it beyond that it can be cheaply made and quickly driven into place.

In proof of the above statement let us suppose it were possible that some first-class engineer, of wide experience and what we might call strong mechanical instincts, had never seen a modern railroad, and that for the first time the nature of a railroad were made known to him—the roadbed, track, steel rail and the 200-ton locomotive hauling 60-ton Pullman cars at a speed of sixty to seventy miles an hour, and after the functions of the steel rail, the wooden ties and the ballast had been explained to him, let us suppose that he were asked to design some suitable method of fastening said rails to said ties. After he had carefully studied the nature of the stresses to which the rails would be subjected, both in a vertical and a lateral direction, the pounding, bending, twisting, pulling and pushing stresses, is it conceivable that he would draft out a

*From Scientific American.