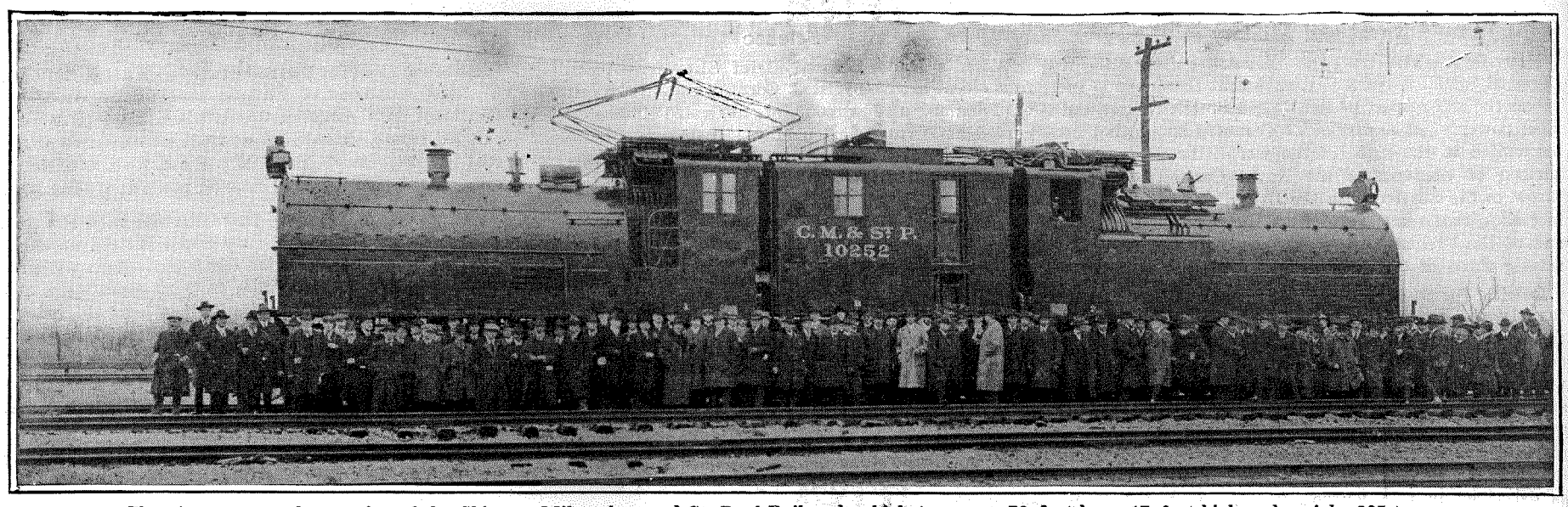


Electric passenger locomotive of the Chicago, Milwaukee and St. Paul Railroad, which measures 78 feet long, 17 feet high and weighs 265 tons

Electric vs. Steam—A Tug of War

An Interesting Test of the Giant Electric Locomotive Built for a Western Railroad

WHEN 150 prominent railway men and engineers from many parts of the United States and Canada, gathered at Erie, Pa., a few days ago to witness trial tests of a new type of gearless electric passenger locomotive, they believed, most of them at any rate, that the exhibition would be of a quite perfunctory nature. Instead, they saw what F. J. Sprague, noted consulting engineer and known as "the father of railway electrification," described as "the most magnificent exhibition of electricity applied to railroads, that the country has ever seen." "Indeed," added Mr. Sprague, during a dinner which followed, "I think the thing has never been duplicated in this, or any other country."

The feature of the exhibit, sprung at the last moment, was probably unique in the annals of electrification, for it was a test of brute strength between two powerful steam locomotives and the new electric—nothing less than a tug of war between three monsters of iron and steel to a stand-up finish.

Throughout the greater part of a dark, cold day, in the works of the General Electric Company in that city, these engineers and railway men had been busily engaged in comparing notes and figures and examining with interest the great electrical monsters. Nearly a dozen high-speed tests had been run off over the company's test tracks, in which one of the new locomotives without gears or transmission, hauled two passenger trains filled with guests over the four miles of track, at a speed of more than a mile a minute and carrying twenty passengers in the cab on each run, while a battery of camera men reeled off some highly interesting pictures.

The stellar event of the day's activities which had been crammed full of action from the beginning, took place just before dusk. Two modern steam engines—the kind the New York Central uses to haul its big limited trains—were switched to the spur of track and coupled securely to the electric locomotive. If the two contestants had hauled in opposite directions there might have been danger of pulling out the draw bars and a resultant accident. This possibility was avoided by having them push against each other in different directions.

At a given signal from the supervisor of tests, the steam engines got under way and began shoving the big electric ahead of them along a short piece of straight-way track; then the current was gradually turned on the electric while the engineers of both steam locomotives opened up their throttles to the last notch.

What was the surprise of the crowd to see the steam engines slowly but surely lose momentum and finally come to a complete stop still with their throttles wide, puffing and chugging as under an extraordinary strain. Then what appeared to be the impossible happened and a great cheer went up from the crowd as they saw the steam engines forced backward, first only by inches, but gradually as the full power of the electric was brought into play, the procession became almost a rout and when the test ended a few minutes later the steam locomotives were moving steadily backward and the electric locomotive was declared the victor.

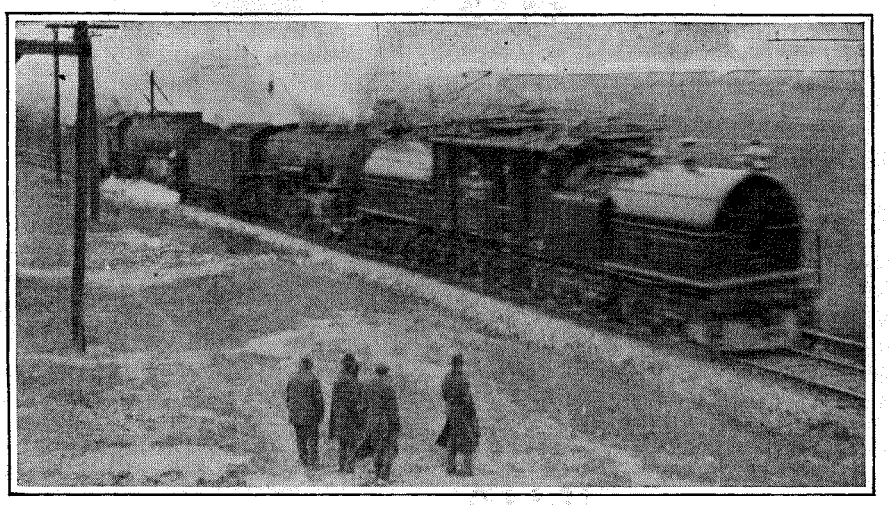
Interesting and spectacular as this test must have been to the laymen present, it was more significant to the engineers of the General Electric Company who had devoted years of their life to the perfection of this powerful electric locomotive. It was a conclusive test of power between steam and electricity.

Hardly second in interest to the tug of war, was an exhibition of the regenerative powers of the electric locomotive, which preceded it. The locomotive which is one of five being constructed for operation on a new electrified branch of the Chicago, Milwaukee & St. Paul R. R., hauls over a mountainous district and must frequently coast down steep grades. While doing so the engineers have so designed the engine that the locomotive will, by the turn of a switch, turn its power plant into a generating station and send back quantities of "juice" to the power station. In other words the electric motors are converted into electric generators. This process of regeneration acts as a brake to the progress of the engine down a hill, while at the same time it stores up new current which will later be called upon to propel the locomotive on the level or up the next grade.

The strength of the regeneration braking was given a spectacular exhibition. To reproduce the same conditions as those which exist when the engine is coasting with a full load of cars behind, two steam locomotives were coupled on behind the electric and pushed it along the track at a good speed. The regenerating system was then switched on and the steam locomotives soon found they were bucking a hard proposition. To overcome the regenerative braking power of the electric the steam engines were very quickly puffing like a stout man running for a train. Soon the speed was seen to noticeably decrease and before the trial was completed the two big steam locos had pretty much all they could do to make headway under full steam. All of this time the electric was turning back current to the power house, the dials of which indicated this to a group of expectant engineers who had gone inside to watch them with growing interest.

This new locomotive is one of the most powerful passenger locomotives in the world. It uses 3,000 volts direct current and its horsepower is 3,240. There are fourteen axles on which are mounted direct-connected motors. The locomotive is 78 feet long, 17 feet high and weighs 265 tons, of which weight 229 tons rest on the drivers. The locomotives have been designed for handling in normal service a 12-car train weighing 960 tons trailing against a grade of 2 per cent at 25 miles per hour. Tests have shown that the gearless electric locomotive operates at 10 per cent higher efficiency at 50 miles per hour than the geared type.

The center cab is occupied by an oil-fired steam boiler for heating the passenger trains, with accessories including tanks for oil and water circulating pumps and a motor-driven blower for furnishing forced air draft.



The contest between the great electric locomotive and two steam locomotives

Michael Sol Collection

Determining the Purity of Gases

AT a recent meeting of a scientific body in London, there were exhibited several instruments embodying the principle of Dr. G. A. Shakespear's katharoneter for determining the purity of gases. The principle upon which this is based is as follows: Two small platinum coils are placed in two cells, each about one centimeter in depth and half a centimeter in diameter. One of these contains the gas to be tested, *e. g.* the moist air in a workshop, while the other contains the standard air, *e. g.* dry air. These coils form two arms of a Wheatstone bridge, the resistances depending upon the degree of viscosity of the two gases respectively. The coils are heated in the humidity recorder by a battery of four volts; the humidity is automatically recorded; hygrometers have been found to be unreliable in the long run. In the hydrogen-purity meter the coil is heated to 800° C., and the cooling depends upon the density of the gas, since all possible impurities are denser than the hydrogen itself. The permeameter, the third instrument of this type, is used for testing air-craft fabrics. A disk of the fabric to be tested one foot in diameter (500 sq. cm. in area) is placed on the permeameter, which is a horizontal disk of gun metal having concentric grooves; the space above the fabric is filled with hydrogen, which can escape only through an opening in the center of the permeameter; this opening is closed by wire gauze, and through it the escaping gas passes into the cell block of the type mentioned above. The presence of local leaks is likewise disclosed by this apparatus.

These ingenious arrangements are described in a recent issue of *Engineering* of London, to which we are indebted for all of the foregoing details. These devices should have a wide application in aircraft works, especially balloon works.