

COMPARATIVE TESTS OF STEAM AND ELECTRIC LOCOMOTIVES.

In our issue of February 18 of this year will be found an illustrated article describing the six-mile stretch of experimental track upon which the New York Central Railroad Company is carrying on very exhaustive tests of its new electric equipment. This locomotive is the first of a large order, and it is the type to which will be intrusted the important work of handling the express-train service running into and out of New York city. The tests were carried on day by day, throughout the whole of the winter and spring under every condition of weather. On April 29 last, it was decided to carry through a series of comparative tests between the new electric locomotive and the newest and most powerful express locomotive that is now handling the New York Central trains. There were two sets of tests, one with an eight-car and one with a six-car train. The steam locomotive, which is a truly enormous engine, has 22 x 26-inch cylinders, 3,757 square feet of heating surface, and weighs with its tender, 342,000 pounds. In the first test it was placed on the express tracks, opposite the point at which the electrically-equipped local stretch of track begins, with eight or six passenger cars behind it. The electric locomotive, which weighs 200,500 pounds, was placed on the electric tracks with the same number of cars behind it, and these cars were loaded so as to bring up the total weight of engine and train to that of the steam train with its engine. Consequently, the electric locomotive was hauling, in the case of the eight-car train, a load greater than that hauled by the steam locomotive by 70.75 tons. This fact should be borne carefully in mind if we would appreciate the great superiority shown by the electric locomotive. In every test the two trains started from rest, and careful records were made of the speed, distance, time, and power consumption. The trials were witnessed by Mr. W. J. Wilgus, vice-president, and Mr. E. B. Kettie, electrical engineer of the New York Central Railroad Company, and by Mr. E. W. Rice and other officers of the General Electric Company, the builders of the engine.

TIME OF TEST AND WEATHER CONDITIONS.—The test started about 8 A. M. and continued until about 1 P. M. of April 29, 1905; temperature averaging about 50 deg. Fahr., cloudy. During the time of the test no rain fell, so that the rails were perfectly dry.

DESCRIPTION OF EXPERIMENTAL TRACK.—The experimental track, six miles in length, is the portion of old track No. 4 formerly used for east-bound freight movements between mile-posts 162 and 168 west of Schenectady. The working conductor consists of top-contact 70-pound steel rail reinforced with copper, and covered in part with a board protection. The alignment and grades on the six-mile stretch of track ("race track" for the time being) are easy. From the easterly end of the track at mile-post 162, going westerly, the rising gradients vary from 5 feet to 17 feet per mile to a summit between mile-posts 166 and 167, and thence the track descends on gradients varying from 6 to 19 feet per mile to the end of the track at mile-post 168. In the six miles there are seven curves varying from 0 deg. 48 min. to 20 deg. 17 min., the maximum length of tangent being 7,565 feet.

SOURCE OF POWER, TRANSMISSION LINE AND SUB-STATION.—The power for testing purposes is furnished by the General Electric Company, and for this purpose there has been installed at their Schenectady plant a 2,000-kilowatt three-phase 25-cycle Curtis turbo-generator, delivering 11,000 volts to the line. A special high-tension transmission line has been constructed for the intervening distance of about five miles to a sub-station that has been erected by the railroad company near mile-post 165. This sub-station contains a 1,500

kilowatt, 650-volt rotary converter, with static transformers for reducing the potential from 11,000 volts to 475 volts.

DIMENSIONS AND WEIGHTS OF THE TEST TRAINS.—The weights of the cars and locomotives were as follows:

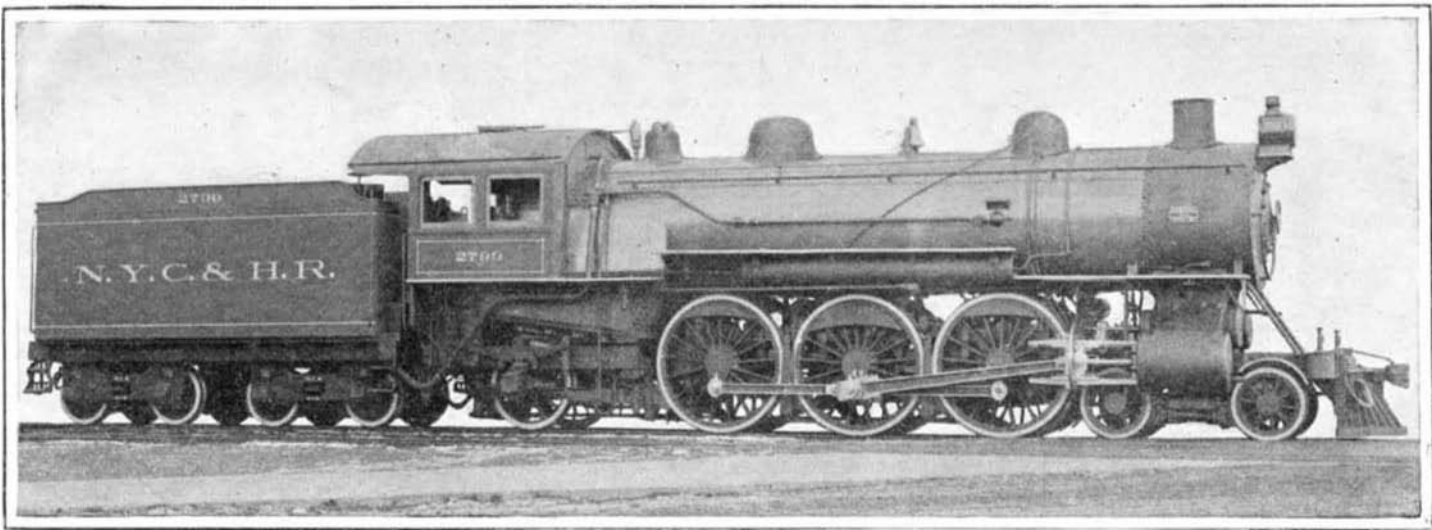
EIGHT-CAR TRAIN.					
Electric Train.			Steam Train.		
No.	Car No.	Weight Loaded.	No.	Car No.	Weight No Load.
1	1060	101,900	1	2527	79,900
2	1070	100,400	2	1547	86,100
3	1082	106,200	3	1534	87,800
4	1092	100,100	4	1521	84,500
5	1097	104,650	5	1069	86,300
6	1550	102,800	6	1099	87,400
7	1552	106,000	7	1563	86,400
8	1558	104,750	8	1513	86,700
	Locomo.	200,500		Locomo.	342,000
	Total.	513.6 tons		Total.	513 tons

It will be noted that, due to the restricted cross-section of conductors, the voltage dropped during acceleration considerably lower than will obtain in actual practice within the electric zone in the neighborhood of New York. Therefore the results obtained in this comparative test are much less favorable for the electric locomotive than will be secured in actual practice.



Electric Train Pulling Clear of Steam Train at 1500 Feet from the Start.

STEAM VERSUS ELECTRICITY.



Cylinders, 22 x 26 Inches. Heating Surface, 3757 Square Feet. Drawbar Pull, 28,500 Pounds.

THE POWERFUL 170-TON STEAM LOCOMOTIVE USED IN THE NEW YORK CENTRAL SPEED TESTS.

RUN "A".—The "Pacific" type steam locomotive had an eight-car train, with a total weight, including the locomotive, of 513 tons, as compared with the eight-car train behind the electric locomotive weighing 513.6 tons. Both trains started together, with the steam locomotive accelerating faster than the electric locomotive, due to the abnormal drop in voltage from the pressure

SIX-CAR TRAIN.					
Electric Train.			Steam Train.		
No.	Car No.	Weight Loaded.	No.	Car No.	Weight No Load.
1	1060	101,900	1	2527	79,900
2	1070	100,400	2	1547	86,100
3	1092	100,100	3	1534	87,800
4	1097	104,650	4	1521	84,500
5	1550	102,800	5	1069	86,300
6	1558	104,750	6	1099	87,400
	Locomo.	200,500		Locomo.	342,000
	Total.	407.5 tons		Total.	427 tons

AVERAGE VOLTAGE DURING ACCELERATION.			
Runs.	Series.	Series-Multiple.	Multiple.
A	520	540	325
B	620	520	275
C	600	640	330
D	680	680	515
E	650	600	420
F	600	620	455

at the station of 700 volts to a track voltage as low as 325 volts. At 3,000 feet from the starting point the electric locomotive gained the same speed as the steam locomotive, and from that point accelerated more rapidly, so that at a distance of two miles from the starting point the electric locomotive passed the steam locomotive, and at the shutting-off point was two train lengths ahead. The maximum speed of the steam locomotive was 50 miles per hour. The maximum speed of the electric locomotive was 57 miles per hour.

RUN "B".—This run was made under the same conditions as run "A," with results practically the same, except that the speeds were higher, as follows: Maximum speed of steam locomotive, 53.6 miles per hour; maximum speed of electric locomotive, 60 miles per hour.

RUN "C".—This run was made with six-car train for both locomotives, with total train weights as follows: Electric locomotive, 407.5 tons; steam locomotive, 427 tons. Owing to extreme low voltage under the conditions above stated, which during acceleration fell as low as 330 volts, at first the steam locomotive accelerated more rapidly, but at the end of about a mile the electric locomotive overtook the steam train, and continued to forge ahead until the power was shut off. Maximum speed of electric locomotive, 61.6 miles per hour; maximum speed of steam locomotive, 56 miles per hour.

RUN "D".—In order to secure as nearly as possible results comparable with the conditions of voltage that will obtain in the actual operating zone, this run with six-car trains, similar to those used in run "C," was started at a point nearer the sub-station, near mile-post 164. For this run the electric locomotive from the first turn of the wheels accelerated faster than the steam locomotive, as plainly illustrated in the attached photograph, where at a distance of 1,500 feet from the starting point the electric locomotive led by a train length.

RUN "E".—This run was made with the electric locomotive and one coach, a maximum speed of 79 miles per hour having been attained.

RUN "F".—This run was made with the electric locomotive running light and with the power shut off on curves, a maximum speed having been attained of 80.2 miles per hour.

Had it not been necessary to shut off the current on curves, it is believed that the locomotive would have attained a speed of over 90 miles per hour in this comparatively short run.*

SUMMARY OF RESULTS.—The most important test is run "D," as the voltage during that test more nearly approached the conditions that will be obtained in the electric zone. Therefore, the following comparison of the steam and electric locomotives based upon the results of run "D" are very interesting as illustrating the marked superiority in acceleration of the electric locomotive over the steam locomotive, considering the fact that the "Pacific" type of steam locomotive has practically the same weight upon the drivers.

CONDITION IN RUN "D."			
	Steam.	Electric.	Difference in favor of Electric.
Length over all.....	67 ft. 7¾ in.	36 ft. 11¼ in.	30 ft. 8¾ in.
Total weight (inc. tender for steam locomotive)....	342,000 lb.	200,500 lb.	141,500 lb.
Concentrated weight on each driving axle.....	47,000 lb.	35,500 lb.	11,500 lb.
Revenue-bearing load back of locomotive.....	256 tons.	307.25 tons.	51.25 tons.
Acceleration miles per hour per second average up to 50 M. P. H.....	0.246	0.394	0.148
Time required to reach speed of 50 M. P. H.....	203 sec.	127 sec.	76 sec.

* A speed test on May 1 reached 85 miles per hour with a limitation on the 2 deg. 17 min. curve of 78 miles per hour.