

## THE ELECTRIFICATION OF STEAM RAILWAYS.\*

By N. W. Storer.

A discussion of the subject selected for this meeting is one which almost invariably arouses the greatest interest. It is not because it is an electrical subject nor because it is about railways. It is because it is a subject that concerns every one who travels, for all such men have been subjected to the discomfort of riding behind a steam locomotive and are interested in everything that offers an improvement. Mr. Dooley says that any one may experience all the delights of riding in a sleeping car without leaving home. His advice is: "Throw a \$2.00 bill out of the window, put a cinder in your eye and spend the night on the top shelf of your darkest closet." This is probably a slight exaggeration of the joys of present-day travelling, not due entirely to the steam locomotive, and although only the cinder and its attendant smoke and dirt can be eliminated from this picture by the use of the electric locomotive, most people are anxious to have the steam engine discarded even before they have seen an electric locomotive. When one has experienced the happiness of riding behind an electric on a hot day in the summer with all windows up and no smoke and cinders, he is ever after a convert to the electric.

The belief in the unbounded possibility of electricity has led to the idea that it is only a matter of a few years before all the steam locomotives will be relegated to the scrap heap. I used to share the belief, but the more I learn of the subject, the more respect I have for the steam locomotive and the work it is daily performing, and the greater the task of supplanting it with the electric appears to be; not that we are doubtful as to the ability of the electric locomotive to do the work, for we are certain that almost any railway can handle more traffic and do it better when operated by electricity than by steam. What, then, is the reason for doubting the speedy and general substitution of electricity for steam? Simply that the traffic on most railways at the present time would not pay for the large initial investment necessary for operating it by electricity.

A steam locomotive is an independent power unit requiring supplies only of fuel and water at intervals along the road. The electric locomotive is in itself powerless. It must have a power house back of it, with transmission lines to carry the power to it wherever it may be.

As the electric locomotive itself is much more expensive than the steam engine, and the power house and distribution system cost a great deal more, the investment for operating a heavy railroad by electricity must, therefore, be relatively very large, and unless the frequency of trains is high enough to maintain a good load factor on the line, substations and power house, it can scarcely pay. In other words, electric operation will pay if you can keep the apparatus working a reasonable percentage of the time, but will not pay if the percentage is small. A bank cannot pay interest on deposits when 90 per cent. of them are locked up in a safe. Similarly, a man who has a high-priced automobile that is run only 1,000 miles per annum, is paying a very high price per mile; much higher than the man whose machine covers 10,000 miles. Any apparatus must be used in order to make it pay for itself.

In comparing the cost of electric with steam locomotives, one railway official went so far as to say that the electric locomotives used to haul their trains cost not \$35,000 each,

which was the contract price for them, but \$100,000 each, which was the cost of the entire installation, divided by the number of locomotives. This might appear to be the case, but it is not strictly correct, unless the cost of all the round-houses, machine shops, coal handling and distributing apparatus, water tanks, etc., be included in the cost of the steam locomotives. Even that, however, would leave the cost of the latter motive power only a fraction of that of the electric. Under such a handicap, it cannot be expected that the railroads, which are laboring under great financial difficulties at the present time, will be able to electrify their lines except under conditions that absolutely require it or offer exceptional advantages.

Compulsory conditions are sometimes imposed by legislation to force a railroad to electrify to abate the danger and discomfort of operating steam locomotives through long tunnels. This was the immediate cause of the adoption of electricity as a motive power by the New York Central and the New Haven Railroads, for the entrance to New York City. This electrification cost a tremendous amount, but it has resulted in a most magnificent terminal, increased comfort and safety to the travelling public, and last but not least, in increased value of real estate owned by the railroads, which bid fair to make the electrification a paying investment. If this last proves to be really true, it will be

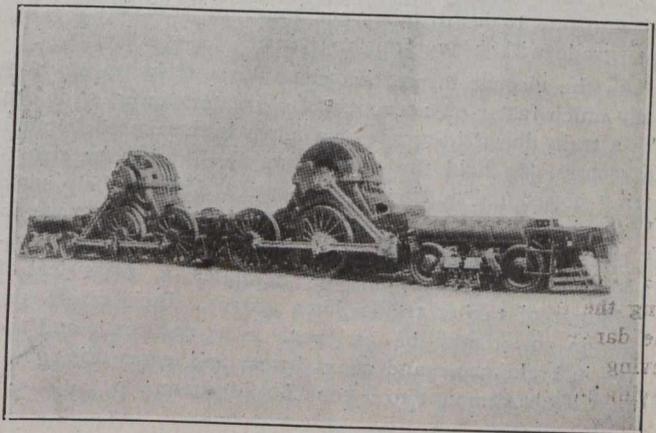


Fig. 1.—Running Gear and Motors, Pennsylvania Locomotive.

most important, as it will make electrification much more attractive to the far-seeing railway officials and will result eventually in the electrification of the terminals in all the large cities.

Beginning with the B. & O. R.R. at Baltimore, in 1895, a number of railroads have electrified tunnels which were a constant menace to the health and lives of the passengers and train crews. The St. Clair tunnel of the Grand Trunk Railway was electrified in 1906, and since then the Detroit River tunnel of the Michigan Central, the Cascade tunnel of the Great Northern, the Hoosac of the Boston & Maine, the Pennsylvania tunnel leading to the great terminal in New York City, have all been electrified in this country and are operating with great success, handling both passenger trains and the heaviest freight trains on both heavy grades and level track. These tunnels, in all of which, except the Pennsylvania, steam engines were originally operated, will be remembered by travellers as the places where every one was formerly nearly stifled. Now, either in the hottest summer day or the coldest of winter weather, the tunnel is welcomed as being the most comfortable part of the ride.

Another phase of the situation that is now receiving a great deal of attention is on the mountain grades where the heavy freight trains crawl up at from 5 to 10 miles per hour,

\* Abstract of paper read before the Cleveland Engineering Society