PLAN TO ELECTRIFY ALL AMERICAN RAILROADS

Engineers Hold Initial Cost the Only Deterrent to Secretary McAdoo's Suggestion—Greater Economies of the New System Are Pointed Out

By JOHN WALKER HARRINGTON.

THE electrification of the entire railway system of the United States, as proposed by William G. McAdoo, Director General of Railroads, is practical and feasible, according to the view of leading experts. They regard the problem as no longer a technical, but a financial one. If this mighty project is carried to completion who is to pay the cost of installation? What railroads would be able to meet the expenses of so vast an improvement?

Mr. McAdoo, on his return from his vacation in the West, spoke of carrying the plan into effect by the use of water power. Whether the electrical energy be obtained from the turbines at the base of cataracts, or from the burning of coal in regions where rivers are few and far between, the conditions and advantages of electrical operation would be much the same.

The best example of the utilization of water power getting current for driving the electric locomotives is furnished by that 440-mile stretch of the Chicago, Milwaukee & St. Paul Railway between Harlowtown, Mon., and Avery, Idaho. Another strip of 217 miles of electrified railroad is nearing completion between Othello and Tacoma. The current for this division comes from the big power house at Great Falls, Mon., through main cables carrying 100,000 volts. The electricity is stepped down to 3,000 volts at sub-stations thirty miles apart before it finds its way into the motors of the locomotives.

The power house was built by a copper company in which are some of the same interests as those concerned with the railroad, and economical distribution is therefore reduced to an exact science. As coal is costly in that part of the country, the Chicago, Milwaukee & St. Paul can well afford to use electricity. Tourists who have traveled on the Olympian and the Columbian of the Rocky Mountain division of that steel highway have given glowing stories of the dustless, cinderless air, of the noiseless operation, of the swift time, and of the easy, pulsing motion.

The discomforts of travel on the steam railroad have been reduced by putting in screens at the windows to shut out some of the soot, so that when the winds are favorable the passengers can live in comparative comfort.

The electric current may be made the unseen force of the coal which blackens the landscape when consumed in that traveling smokemaker, the steam locomotive. This plan is followed by the Norfolk & Western Railroad, which operates a thirty-five mile electric zone with current generated at its power house at Bluefield, W. Va., situated at the mouth of a large colliery owned by the company. Here the best combustion and the use of smoke consumers keep the air clear. The current is conveyed alongside the tracks and with it not only passenger trains, but also freight and coal cars are sent to their destinations.

There are Southern railroads which could obtain their electric current from burning saw mill wastes of all kinds. It has been suggested, also, that the dead wood gathered from Northern forests is readily convertible into power for the dynamo.

Many are the economic crimes which have been charged by efficiency experts against the steam locomotive. It is a rampant iron horse which goes snorting unconsumed carbon into the atmosphere. It looks wonderfully fit as it plunges over the steel rails, but what a wastrel, despite its polish and show of strength. Taken all in all, the average steam locomotive is next to the cook stove, which wastes all its fuel but 2 per cent., the most profligate fuel spender in the world. The boiler of the locomotive is only slightly jacketed, and the loss by radiation of heat in cold weather is enormous. The steam is driven squarely out of the cylinders with every stroke, for there is no conservation, as there is in stationary engines. The dense cloud of smoke which belches from the stack of even the highest type of steam locomotives consists of unburned particles of coal.

In the large plant efficiency and economy have full play—and in the burning of coal to derive electrical force every atom of fuel possible can be deliberately used.

"While the amount of coal in our country is enormous," said E. W. Rice, Jr., President of the American Institute of Electrical Engineers, in a recent address, "its supply is definitely limited. It is terrifying to realize that 25 per cent. of the total amount of coal which we are digging from the earth each year is burned to operate our railroads under such inefficient conditions that an average of at least six pounds of coal is required per horse power of work performed. The same amount of coal burned in a modern central power station would produce an equivalent of three times that amount of power in the motors of an electric locomotive, even including all the losses of generation and transmission from the source of power to the locomotive.

"But this is not all. It is estimated that something like 150,000,000 tons of coal were consumed by the railroads in 1917. Now, we know from the results obtained from such electrical operation of railroads as we already have in this country that it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam ones. On this basis there would be a saving of over 100,000,000 tons of coal a year. This is an amount as large as the total coal exported from the United States during 1917.

"The carrying capacity of our steam railroads is seriously restricted by the movement of coal required for the haulage of the trains themselves. It is estimated that fully 16 per cent. of the total ton mileage movement behind the engine drawbar is made up of company coal and coal cars, including in this connection the steam engine and its contents. In other words, the useful, or revenue, carrying capacity of our steam roads could be increased 10 per cent. with existing track facilities by eliminating the entire movement of company coal."

The carrying of coal over the country to be burned in some fixed place is the modern application of Charles Lamb's dissertation on roast pig. The burning down of houses is no longer necessary to cook the porker to a turn, and likewise electrical development has made it unnecessary to burn quantities of coal in order to move coal. We can transmit the energy over long distances. The sending of fuel by wire has become an assured fact.

Such companies as the Norfolk & Western, which use current obtained from the consuming of coal in furnaces at the mouth of the pit, are able to use culm and the inferior grades to good advantage. Large quantities of coal could also be transported by canal to power houses well beyond the limits of our cities and there converted into the current. The annual coal drama in the neighborhood of New York requires an endless procession of tugs and lighters and wheezing trucks and carts to get fuel across the bay and river to be burned. The great power house of the New York, New Haven & Hartford near Cos Cob, from which the current for its electrified zone is produced, is dependent upon supplies of coal brought from long distances and in Winter under the greatest difficulties.

There is, to be sure, some loss of current in the cables by transmission over long distances. The average ton of coal costs just half as much at the mine as in our cities; that is to say the loss by transportation is in the neighborhood of 100 per cent. The enormous losses by burning in the locomotives have already been demonstrated.

E. B. Katte, the engineer in charge of electrical traction of the New York Central, says that the loss of power through cable leakage in the operations at the terminal of the New York Central is 2 per cent., and that he would consider 10 per cent. a fair average of loss for transmission over long distances. Whether the current is generated by the burning of coal or obtained from water-driven turbines the factor of loss by transmission is the same. As the art of electric traction develops the losses from leaks will grow less and less, for hitherto the conservation of the current has not come in for intensive study.

Theodore Dwight, technical adviser of the Society for Electrical Development, says that as the installations are improved the losses from leakage, which now vary from 10 to a maximum of 20 per cent. over long distances, will be reduced to terms so low that they will not be any drawback to the use of electricity for transportation purposes.

The railroads of the United States have been held back in their plans for electrification largely by the costs. There are some enterprises in which the expenses of this kind of installation are easily borne. The New York, New Haven & Hartford finds that the operations in its electrical zone justify the expense on account of the great volume of traffic.

The New York Central has obtained enormous indirect returns from its system of electrification, a fact largely due to the foresight of the late William H. Newman, its former President. The railroad, by putting in electric transportation into what was once "The Backyard of New York," eliminated dust and ashes and sulphurous odors and chugging and rumbling, and, as a result, the old stables and breweries which once lined much of upper Park Avenue have been displaced by fine hotels, apartment houses, and clubs. As the railroad owned much of the property on which some of these splendid improvements have been made, the vision of Mr. Newman was justified. Even he, however, used to hail the electrification engineer as the most expensive luxury the corporation had.

The installation of electric power was well justified at the Pennsylvania terminal and tunnels in this city, and especially at the twelve-mile Chestnut extension in Philadelphia.

Electrically driven locomotives are costly. At present a steam locomotive, which before the war cost $26,000, can be built for $45,000 to $50,000. An electric locomotive costs $100,000, and there are monster ones now being built which will cost more.

"Adding to the original price of the electric locomotive," said Mr. Katte, "the cost of installation of all kinds, power houses and substations and cables, the locomotives really represent an outlay of $250,000 each. As more of them are being built, however, they will become much cheaper. When the war is over, the whole problem of electrification will have another aspect than that which it wears in view of the present high costs of all materials. It is the initial outlay which counts—the electrification of the railroad is feasible and desirable, as far as the operation is concerned.

"Once the power houses are ready and the installations are made, the cost of the current is much less than the cost of steam. The losses from leakage are being reduced constantly, and as cables have been made which will carry a voltage of 160,000, and even 260,000, with no greater loss than those of much lower capacity, that item is constantly decreasing. The power of the electric locomotive can be turned off when not in use, while the steam locomotive must be ready, when the train is still, to take up the load anew.

"I should say that even where coal is used for the generation of power, at least a saving of one-half could be made by using it in central power houses, instead of in the steam locomotive."

The new type electric locomotives are not content with merely not using power; when they run down grade they reverse the motors and actually regenerate themselves by making current from friction and feeding it into their own dynamos.

Where the average steam locomotive will wheeze and freeze in cold weather through loss of heat, no matter how busy the fireman may be, the big Moguls of the electric speed up with every drop of a degree in the mercury. They are often at their best when the weather is below zero. Although there has been some trouble with overhead wires, and often there are escapes of current from third rails, the electric railroad on the whole is a success. The interurban trolley lines of the Middle West, although they have not the name, are in reality railroads, for they carry not only passengers, but their baggage, and they do an express and freight business as well.

We of New York have in the subway lines a perfect electrified railroad, which carries millions of passengers a year, and owing to its protection from storms and other difficulties of traffic in the open, it maintains a vast service.

To such enterprises as these it could hardly be said that electrical operation was a luxury. They are run without cinders, ashes, and dust, and, compared with the old steam engines of the elevated, they are models of comfort giving.

Some of the railroads of the country are using oil for fuel, and the same extravagance has been charged against the management of this fuel as in the burning of coal under railroad locomotive boilers.

In view of the great demand for coal and oil, and the fact that their transportation over long distances involves so much delay and expense, railroad experts and the scientists regard the proposal of Mr. McAdoo as of the highest value. It is estimated that there are 25,000,000 horse power of water power available in the United States. It is not distributed in the regions where the railroads are thickest, but there is so much of it at hand that its capabilities are almost unlimited. In Los Angeles a large system of street railroads is run by permitting a column from the city water to fall from the top of a high tower on turbines. Water power from mountain torrents is used in creating enormous stores of electrical energy.

The powers of Niagara Falls are not yet thoroughly realized, although power from them is led by cable as far east as Utica, and might indeed be brought further with no great leakage.

Charles S. Bradley, a pioneer in the use of water power in this country, who spent years studying the mechanical possibilities of Niagara, says that there are still 4,000,000 horse power going to waste which might be obtained from it. This would be equivalent to the work of 32,000,000 men.

"The possibilities of the water powers of the United States are so great," said Mr. Bradley, "that the plan of Mr. McAdoo, evidently based on a first-hand study of Western railroads, should be carefully studied. Two months ago the Secretary of the Interior, Franklin K. Lane, was so good as to hear me on the subject of water power in this country. I suggested to him that a survey of the water powers of the United States be made in connection with the Census of 1920.

"In order to do this efficiently it would be necessary to appoint two or three men to draw up a general scheme, and if this were done at once, they would have plenty to do before the actual taking of the census. One of the men whom I mentioned to Mr. Lane as peculiarly fitted for such a task was an expert in the electrification of railroads.

"It would be possible to get one million horse power from the rapids in the St. Lawrence near Messina, for the New York Central, or to get a considerable power from streams in the Adirondacks. The dropping of columns of water from any large reservoir, such as that at Ashokan, would furnish electric power. Every river bed might be made the means of conserving energy. The smallest creek is a source of power. The water powers of the country are so great that it would be impossible at this time to give any figures which would convey an idea of the forces represented.

"Electrical energy from water and from any other source should be conserved. When this war is over we shall have many thousands of capable young engineers returning to the country. There will be a period of reconstruction and they must find their places again in the industrial system. Many of them could be put to work in the development of the untold riches of our water power, guided by the details gathered in an official census.

"Our water powers belong to the nation and I would see them supervised by the Federal authorities. Every shoemaker at his bench should have his half horse power of electricity at his elbow, if he wants it. Every farmer should be able to draw from some central source.

"If the Government took control of the water powers it would be possible for it to sell current at a cost of $10 the kilowatt year in excess of the expenses of production. This would produce a good revenue and greatly aid in the reduction of the national debt and at the same time be of great benefit to all persons engaged in industry and to the nation at large."

The consensus of technical men is that Mr. McAdoo has opened up the way to an important new field in traffic management. The old battles among engineers as to the various applications of electricity in railroad management are at an end and the profession is regarded as well prepared to co-operate in the development of the project.

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