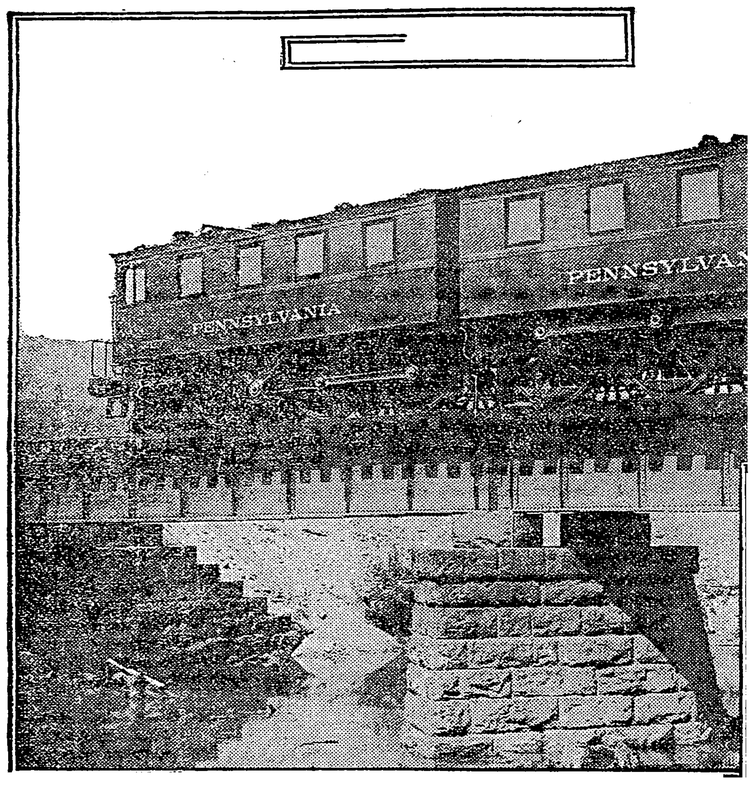
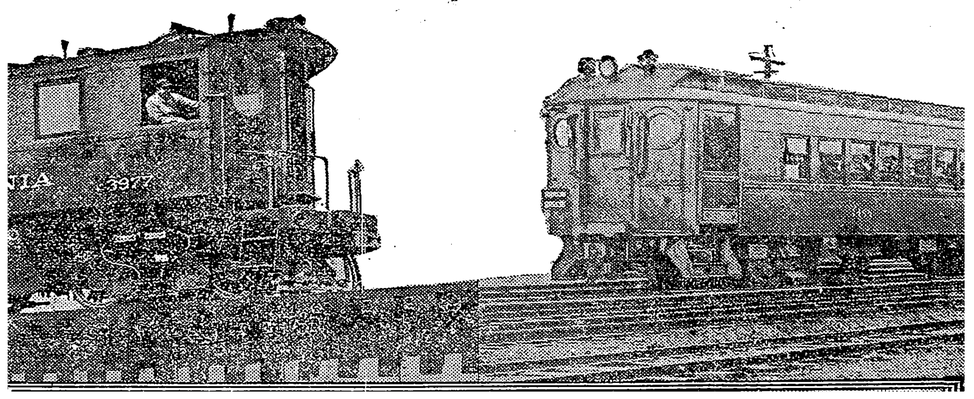
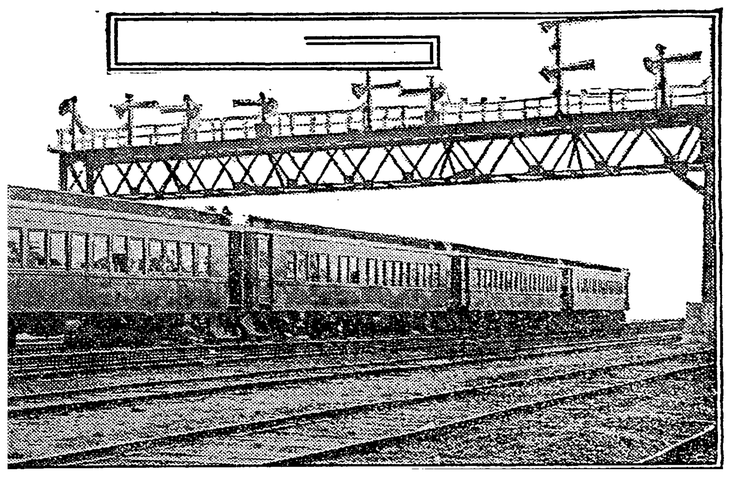
RAILROADS PLAN ELECTRIFICATION FOR BIG DISTANCES

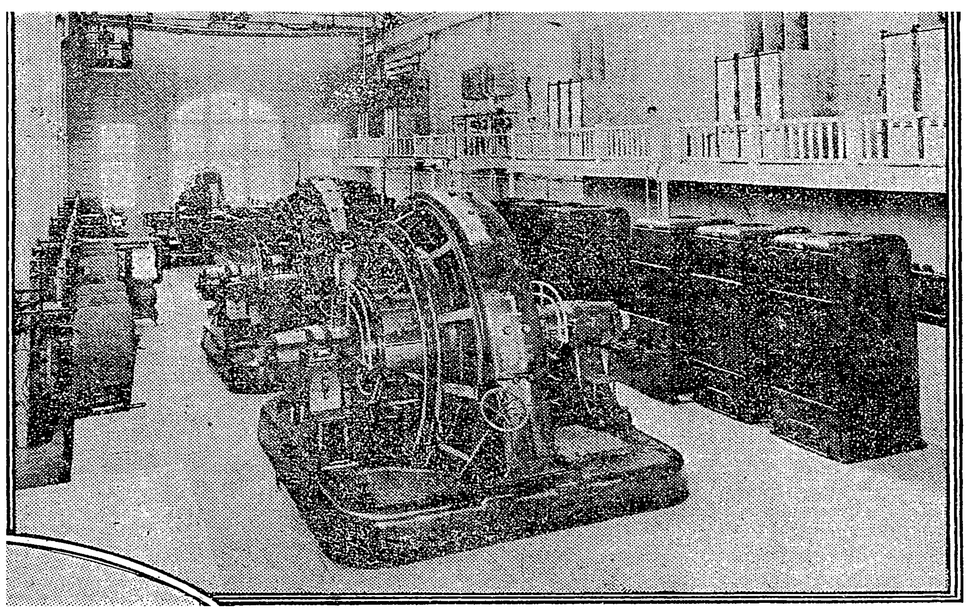


ONE OF THE PENNSYLVANIA ELECTRIC LOCOMOTIVES.

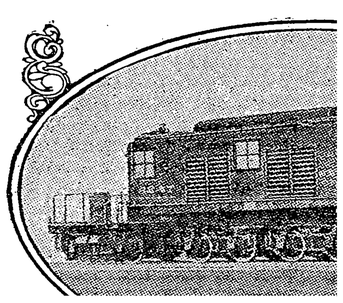




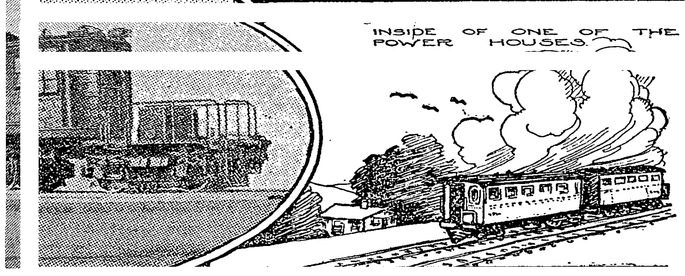
MULTIPLE UNIT CARS, LONG ISLAND R.R. (EACH OF THESE CARS HAS ITS OWN MOTIVE POWER, AND CAN TRAVEL ALONE OR AS ONE CAR OF A TRAIN.

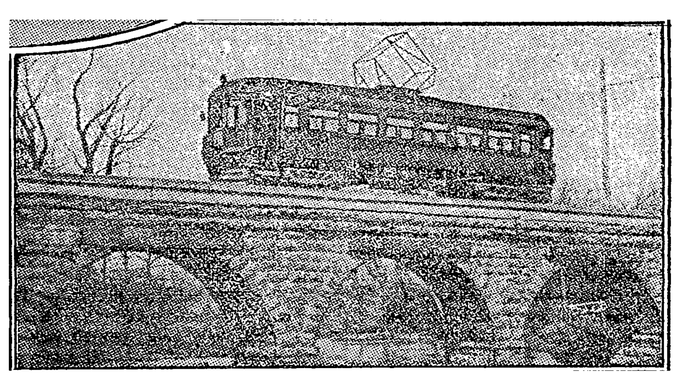


INSIDE OF ONE OF THE NEW YORK CENTRALS POWER HOUSES.



NEW TYPE OF ELECTRIC LOCOMOTIVE FOR GRAND CENTRAL TERMINAL





ERIE ELECTRIFICATION

Talk of Adopting This Method of Locomotion From Philadelphia to Pittsburgh on the Pennsylvania, and on Great Northern and Chicago, Milwaukee and Puget Sound.

ELECTRIFYING the Pennsylvania Railroad to Pittsburgh, over 400 miles from New York, is being talked of. Lately more and more is heard of it. Two or three years ago the scheme would have been called altogether too vast a piece of work from an engineering standpoint. To-day the question is solely as to the advisability of so great an investment; for, as the leading authorities say, it costs about the same, mile for mile, to electrify as to build a new railroad.

The day of big electrification of steam roads is, however, dawning. If the Pennsylvania New York-Pittsburgh line goes through it will be the biggest yet, 818 miles of single track, if only two tracks between the points are electrified, costing approximately $40,000 a single track mile, or $32,000,000. Huge as such an undertaking is, it is not impracticable now. Already two electrifications in this class have been decided upon. They will form in reality one line running across three States, North Dakota, Montana, and Idaho, 970 miles in all, 440 and 530, respectively. The railroads that have taken this almost revolutionary step forward are the Great Northern and the Chicago, Milwaukee & Puget Sound. One has already given out its roadbed and other construction contracts, and the other has contracted for hydro-electric power.

The Pittsburgh talk and these now certain electrifications in the Far West are very interesting, because they controvert the often expressed theory of the electric experts and practical railroad operating men and executives that, while electric railways are highly successful where there is density of population, as in the suburbs of cities and along thickly settled communities, such as on the Connecticut shore, there is great doubt as to whether changing to electricity would pay in a more sparsely peopled territory. One of the almost certainties of the next few years, for example, is the electrifying of the Pennsylvania from Philadelphia to New York, (90 miles—180 single-track miles.) Experts here have no hesitation in saying that there is a decided question whether the millions that would have to be invested for this can be made to earn fair interest.

Total of Electrified Roads.

To-day there are 1,645 miles of electrified steam railroads in the United States in actual operation or under construction, two-thirds of it leading out of New York. Plans definitely under way are to add 1,465 miles more, nearly all in the Far West, an increase of nearly 90 per cent. There can be little doubt from this, for the moment is not especially propitious for costly railroad construction, that electricity as a railroad motive power is making its way very fast and has a much greater and wider application than even its keenest enthusiasts dreamed.

It is electric railroad history that the first practical application of electricity to the steam railroad (though electric locomotives had been used on the tunnel line and terminal of the Baltimore & Ohio ten years before, and very satisfactorily) was in 1905, when the Long Island Railroad (just outside of New York) commenced the electrification of some of its suburban lines. The expert in charge of this was George Gibbs, electrical engineer of the Pennsylvania Railroad, who here and in Europe is regarded as one of the chief authorities on these subjects. He furnished a paper, "Electric Traction," at the International Railway Congress Association at Berne, Switzerland, in 1910 that even now is the standard on this phase of railroading.

"For certain kinds of service," said Mr. Gibbs, speaking in his offices in the Pennsylvania Terminal in Eighth Avenue, "the electrification of steam railroads has proved a decided success. As yet it has only been applied in this country to passenger traffic, but that will not very long be the case. The New York, New Haven & Hartford is starting in to handle freight in a small way, and when the New York Connecting Railroad is completed—which will be in two or three years from now—we will bring freight from New England in electric trains across the new bridge of this railway and transfer it on Long Island to steam trains that will go around by way of Bay Ridge, then across New York Bay and thence to the West and South. So far as can be told this will be the first practical application of the electrification of steam railroads to the handling of freight.

On Suburban Lines.

"Where, in passenger traffic, the electrically operated railroad has realized all anticipations has been in the well-settled suburbs, a district just outside a city with a succession of small towns. It may be proved later on that it will be profitable to electrify long lines that run through sparsely settled districts. This we cannot tell just now. Electrification is very costly. It means an expense equal to that of building a new road. Where the population is relatively dense there is no question but that the electric road pays. It gives a quicker service and thus extends the suburban radius. Practically to-day a man cannot live more than thirty miles out of a city and come in daily; the clerk or the working man, that is. Where the trip is longer than an hour the limit of the suburban radius is about reached. Beyond that the people are mainly Summer residents and those who do not need to come in every day.

"The electrified railroad pays because by saving time it builds up a territory. We have found that with the Long Island Railroad. We are now constructing another suburban line just outside of Philadelphia. This runs through suburbs of about the same density as those of Long Island, a number of small towns, twenty-three miles out. There will be about seventy miles, single track, in all.

"Thus far this is the field of railroad electrification in this country. Now, take the Pennsylvania from New York to Philadelphia, proposed to be operated electrically. That is a distance of ninety miles. It will probably be built, yet it is likely it will not pay, though it passes through well-settled communities. But the conditions are quite different from those of the suburban lines.

"So just how much electrification will be expanded no one knows. It is a matter of investment simply. From the point of view of construction and operation there is no reason why any long distance line cannot be built. In the actual operation there are some small savings over steam, and crews can be utilized to better advantage.

"No, no special types of electric locomotives or cars seem to excel all others. Nor are locomotives necessarily better than 'multiple unit cars' or the reverse. There are many different systems. Sometimes one is adopted, sometimes another. The New York Central, and the New York, New Haven & Hartford, for example, have found locomotives very satisfactory. On Long Island, we have found our 'multiple unit cars' equally so. This is a factor that should be realized, though, and is exceedingly important. In scarcely another branch of practical science are there so great advances and so much development as in electric traction on steam railroads."

It does not require a long look into the past to remember the days when the steam train going out to the suburbs or coming in to the city did well if it averaged a speed of twenty-five miles an hour. The quick running giants, prides of the railroad yards, shot past drawing famous "through trains." Effort, money and skill were lavished on these, and the suburbanite had to take practically what was left. All this has been changed. With the coming in of electrification, the fast suburban train is now a feature of railroading and one of the great modern factors in suburban development. The twenty-five miles an hour of the old days has been increased fifty per cent. and there is constant study to get an even more rapid schedule.

Fast Locomotives.

Fifty to sixty miles an hour is not to be impossible; in fact, it has already come. The New York Central has just put into commission sixty-mile-an-hour electric locomotives, ten of these having been built for the local service of the road. Of course, just now, any such speed as this is not practicable on a suburban train making stops every two or three miles, but it shows the tendency to greater and greater speed. Suburban service is only a part of the benefit of electrification. Quite as important is the new idea of the past ten years to have the long distance train discard its steam locomotive when within reaching distance of the city and be carried into the station under electric power, going out in the same way. It is for this purpose, mainly, that the new, big and powerful electric locomotive has come into play.

So striking are the new possibilities that have arisen and so definitely have the new problems been solved, problems 'that a year or two ago seemed "blind alleys," that the technical press has taken them up. In a recent number of The Electric Railway Journal the situation has been reviewed editorially very completely as follows:

Widespread Electrification.

"The résumé of progress in electrification in this country, published elsewhere in this issue, displays the rather striking fact that the electrified lines actually in operation or projected are not confined to any particular region. Quite as much is being done in the mountains of the West and on the Pacific Coast as in the level alluvial country of the Atlantic seaboard. The latter section naturally offers great advantages for the use of electricity owing to the very general density of traffic and, in fact, might easily be considered as the only place where the load factor could be maintained at a sufficiently high point to warrant the outlay for overhead construction and electrical equipment. Yet the projects of the Chicago, Milwaukee & Puget Sound and of the Denver & Rio Grande, together with the possible new line of the Great Northern, show that dense traffic, as the term is usually understood, is not a necessity. Nevertheless, one principal reason for electrification applies in all cases, and that is to reduce track congestion or the number of train hours per mile of track. Other reasons apply in each case. Thus, at New York City the underlying purpose was to provide adequate and suitable terminal facilities; on the New Haven the end sought was economies with extremely dense, mixed traffic; on the Norfolk & Western it is a matter of handling enormous coal trains; in the Rocky Mountains cheap power is available; in one Great Northern electrification a long tunnel was the cause, while on the projected line for Dakota and Montana the almost prohibitive difficulties of poor coal and bad water can be eliminated completely. Summed up, it would almost seem as if any operating difficulty could be overcome by electrification."

"The waste of fuel in the steam locomotive is what is bringing the electrification of steam railroads in America to pass," says a prominent electrical engineer. "More than 90 per cent. of the heating value of coal is lost in a locomotive. There is no more wasteful method of using fuel. The most perfect combustion of coal is obtained in large plants, where the fuel is spread thinly over great areas by automatic stokers. Even under these highly favorable conditions nearly 85 per cent. of the steam-producing value of coal is lost. This is a comparatively small saving, but when it is considered that the railroads of America consume many millions of tons of coal a year it amounts to a stupendous sum.

Waste of Coal.

"The way in which coal is burned in a locomotive is the most wasteful that could possibly be devised. The dimensions of the fire box of the locomotive cannot be increased. A certain amount of power must be produced in order to haul the train. The coal must be spread on frequently and much more thickly, so as to keep up the steam pressure. It must burn rapidly, therefore a forced draught is necessary. All but 10 per cent. of the steam producing value of the coal blows out through the smokestack.

"This is the theory that has become one of the basic principles of the electrification of steam railroads where the country is thickly settled. It costs less to convert coal into power and distribute it from a central plant than it does to have hundreds of units like locomotives to produce the same power.

"Of course, the cheapest way in which electrical energy can be produced is by means of water power. Once a water-power plant is established and transmission lines are put up the cost of maintenance is very small, indeed. To-day practically all the efficiency of a body of falling water can be obtained. There is no waste, if the plant is properly constructed. The power can be transmitted for hundreds of miles. Of course, the greater the distance that the power lines are carried the greater the loss of electrical energy, but this is being decreased every year. The power lines of to-day do not lose half as much of their efficiency as they did fifteen years ago. I heard a man lecture in Denver in 1898, one of the greatest experts in power transmission at that time. He said that on a line 100 miles in length the loss of energy would be about 60 per cent. To-day this loss is about 25 per cent. on a line 250 miles in length."

Electrification has thus come to be on the firmest of bases. Officially the parts of steam railroads in the United States that have been electrified and are now in operation are:

ELECTRIFICATIONS MADE.

	Miles of Single Track.
Baltimore & Ohio	7.4
The original electrification of the steam railroad. The pioneer user of heavy electric locomotives.	
New York, New Haven & Hartford.	594.8
Including 22 miles on the Hoosac tunnel route of the Boston & Maine, the lines from New York to Stamford and Providence to Warren, (38.5 miles and 109.3 miles,) the Harlem River Branch 141.4 miles, the line from Stamford to New Haven now nearing completion, 210 miles, besides more than 50 miles of short lines including a very complete system about Hartford.	
New York Central	371.6
Two hundred and thirty-four miles out of New York City, 19 miles on the Michigan Central. (Detroit River tunnel,) and 118 miles on the West Shore Railroad between Utica and Syracuse.	
Pennsylvania	435.5
Comprising 186.8 miles on the Long Island Railroad, 98.4 miles of the Pennsylvania's approach into New York, and 150.3 miles between Camden and Philadelphia.	
Butte, Anaconda & Pacific	90.0
An ore carrying mountain line.	
Southern Pacific	96.0
Suburban lines at Berkeley, Oakland, and Alameda, Cal., close to San Francisco Bay.	
Grand Trunk	4.0
Four miles of tunnel track (St. Clair tunnel) at Port Huron, Mich.	
Erie	40.0
In Central New York to the south of Rochester.	
Great Northern	6.0
The electrification of the Great Northern Railway's cascade tunnel, between Leavenworth and Skykomish, about 100 miles east of Seattle.	

Brilliant as this record of accomplishment is, it is to be almost duplicated within the next year or so by the remarkable installations already decided upon.

New Haven's Plans.

The first and most important of these is the project of the New York, New Haven and Hartford, easily the leader thus far in extent of lines, if in no other way, for electrification of its four-track line between Boston and Providence. The distance between these great New England cities is just about fifty miles. There are to be 196 miles of main line track and twenty miles of yards and sidings, 216 miles in all. This is not colossal, compared with several other projects approved and now commencing to be under way, but in important particulars it is the most interesting of all, since there is such heavy traffic between these two points and the territory is one of the oldest, best built up, and most thickly settled of all the country.

ELECTRIFICATIONS PLANNED.

	Miles of Single Track.
New York, New Haven & Hartford.	216
As described above.	
Pennsylvania	70
The new suburban electrified section of the Pennsylvania, extending out from Philadelphia to Paoli.	
Norfolk & Western	73
A mountain electrification over thirty miles of territory for heavy coal carrying. A very interesting application of electricity in railroading. Northern part of West Virginia.	
Denver, Rio Grande & Western	114
One mountain division of this road that is to be electrified. Line will run from Helper to Soldier Summit and from Helper to Salt Lake City, all in Utah.	
Chicago, Milwaukee & Puget Sound.	440
Contracts have been let for hydroelectric power for the line from Harlowton, Montana, to Avery, Idaho. Here water power is far cheaper than coal.	
Great Northern	530
Electrification has been decided upon here because of poor coal and water conditions for locomotives. The two projects, this and that of the Chicago, Milwaukee & Puget Sound, are the biggest in the West and will make practically one single long line, though on two systems, there being a "break" between Harlowton and Lewiston in Montana. The Great Northern line is to extend from Lewiston over to New Rockford, North Dakota.	

The Denver and Rio Grande people have informally and unofficially announced that sooner or later they will electrify their entire main line. The Santa Fé, according to recent news from the West, has been asked to electrify its system from Dodge City west, the main object being to provide cheap power for the establishment of pumping irrigation plants on every farm in the Kansas-Colorado-Arkansas Valley.

The idea here is for the railroad to sell power. It is claimed that this can readily be done and that the opportunities are limitless. As one authority says: "After nearly a quarter of a century of effort, irrigation boosters in these States are agreed that the surface flow of the river will not furnish enough water to meet the valley's demands. It is known positively that there is a vast underground lake throughout the semi-arid regions of these States extending from ten to fifteen miles on either side of the river bed. Most of the pumps now in operation are run by gasoline engines, but the cost of installation and operation is greater than many farmers can afford, and a cheaper power is needed. Should the Santa Fé Railroad electrify its system and furnish power at a reasonable rate, thousands of acres in both States would be put under water at once. Irrigation by electricity costs about one-third as much as by gravity or canal."

At Gallitzen near Altoona, Penn., the Pennsylvania system is preparing to build a power house. At first this is to be used for operating cross switches and a lighting system, so high authorities say, but later will move trains between Altoona and Pittsburgh.

The Chicago railway terminals are almost certain to be electrified. A committee of the Association of Commerce of that city, appointed in 1911 and due to report in 1915, has collected a vast amount of data and made a very thorough series of investigations. Thirty to fifty per cent. of all the polluting smoke of Chicago comes, this committee says, from locomotives. The committee's preliminary report in July, 1910, announced that electrification was practicable from an engineering standpoint, and that the most serious and difficult feature of the problem was the financial one.

Abroad the work of steam railroad electrification has gone on even more rapidly than here, but not so extensively. Italy, Germany, Finland, Switzerland, France, England, Norway, Sweden, and Prussia are keenly alive to the great possibilities opening up. In many of these countries abundance of water power cheapens the cost materially. England is just now doing a vast amount of work in connection with finally developing electrically suburban railroads leading out of London. Electrical operation on the portions of steam lines thus far modernized has been highly successful from the financial point of view. One single railroad is immediately to add 170 miles of extra electrical trackage.

Of operating methods and equipment of these electric roads converted from steam Mr. Gibbs, the electrical engineer, has written:

The character of the service determines whether motor cars or locomotives are employed; in this respect electric traction differs from steam, in which all service is conducted by locomotives. In general, electric traction methods tend in America to the use of multiple-unit trains for all short runs and local services. Electric locomotives are employed only where necessary; that is, for long express runs where the cars must go beyond the electric zone; for special freight service, such as heavy grade pusher and tunnel work, and for terminal shunting.

Such a division is logical, since it utilizes one peculiar possibility of electric traction, i. e., the possible concentration of great power on the train by equipping any desired number of axles with motors, and thus utilizing any desired portion of its weight for driving adhesion at the rails. The result is rapid acceleration of the train from rest, and a consequent quickening of time where stops and starts are frequent.

The importance of this characteristic of multiple-unit trains is illustrated when it is said that local runs are largely supported by a class of passengers known as commuters who travel daily to and from business. As a rule, a longer journey than 60 minutes each way daily is inadmissible, or, say, a distance of 24 miles by the fastest steam local trains making stops one to two miles apart. A multiple-unit electric train will cover, under these conditions, a 25 per cent. greater distance in the same time, or, say, 30 miles; or it will make a 24-mile run in 45 minutes instead of 60 minutes. In other words, increased electric speed means to an important class of railway patrons either 25 per cent. less time on the road daily, or the ability to live further from the city without increasing the time spent on the journey. This increase of local run radius is obviously a consideration of importance to a railway in holding a large class of traffic and in fostering its growth.

Further and important facts which are leading to the general adoption of multiple-unit trains is their characteristic of great flexibility in train makeup without the necessity of complicated and time-consuming switching in terminals, and the ease of turning and dispatching trains at close headway while occupying the minimum of space at expensive terminals. The fullest utilization of these advantages requires that each car in the train shall be a motor car, but where the service is fairly light it is frequently advantageous to make a certain number of the cars in a train "trailers" to economize in first-cost and weight of train for a given seating capacity.

When electric locomotives are employed the operating methods do not greatly differ from steam locomotive practice, except that electric locomotives permit of more convenient double-heading, as they may be controlled by a single unit.

Future Possibilities.

Central steam-power plants are in nearly all cases employed, as hydro-electric plants are not generally available in the Eastern portion of the country. Extension in radius of transmission by the use of very high voltages will doubtless in the future enable water power to be used to some extent, although the number of possible sources of such power is limited in the thickly settled portions of the country and the economy resulting from its development is not always as great as supposed; this because of the fluctuating character of a railway load and from the fact that it is generally not possible to locate a hydro-electric station centrally with reference to the traction loading, or even to place it on the line of the railway itself. In such cases the problem of transmission over foreign or purchased right of way becomes an important one in the electrification plan, and the costs and operating inconveniences of a badly located plant may become an offset to any figured saving.

In a number of early installations a duplication of power houses was thought desirable, to provide a safeguard in case of a breakdown in one power house, and frequently the low transmission voltage dictated more than one plant for reasons of economy in transmission copper. Of late, however, the tendency is too concentrate power development in a single plant, as it has been found that a total breakdown of a modern power plant is of rare occurrence.

To-day the situation stands that, when the new plans for construction have been carried out, between one and two per cent. of the steam railroad mileage of the United States will have been electrified, an extending wedge that opens up almost an unlimited new field.

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