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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal, 8200 copies are printed. Total circulation for 1907 to date, 171,750 copies, an average of 8178 copies per week.

Reinforced Concrete in the Sub-Station

Although the modern power plant has for some time past felt the influence of reinforced concrete construction to a degree that has resulted in the use of this material in many new installations, the sub-station has not so widely come to be regarded as a legitimate field for such methods of building. Brick and steel continue to be specified in a large amount of railway sub-station work; but, as a matter of fact, there is no good reason for the failure of designers to appreciate the value of reinforced concrete even in small structures for power service. The increased demand for cement in the past five years has, together with improved processes of production, brought the cost of this material to a point where even small buildings constructed of it can be erected to compare favorably in cost with other materials.

The scarcity and increased cost of skilled labor makes it expensive to erect sub-stations to-day out of brick and timber, or even brick and steel. Concrete, properly supervised, fills the requirements admirably in a well-designed installation, and as the cost of preparing forms is a large percentage—perhaps 25 or 30—of the cost of using concrete, there is great advantage in using the same forms repeatedly. There is a place for economy of first cost in railway sub-station building construction designed according to repetitive standards of wall and floor arrangement. Variety of architecture is not greatly needed in the average sub-station building located outside city limits. The absence of fire risk, great speed of erection, and freedom from the ill effects of machinery vibrations common to concrete block or concrete steel sub-stations warrant their more extended consideration in the field of electric railway practice.

The Development of the Organization

One clause in a recent report of the New York Railroad Commissioners directs attention to a subject which is often overlooked in the creation of modern industrial enterprises. The large corporation, both manufacturing and transportation, is a development of the last few years, and has been made possible and even necessary by the present status of financial, engineering and social conditions. But it is a question whether the science of organization in the operation and direction of the affairs of the vast energies thus created has kept pace with the rapid work of the constructor. This, then, is the problem of the manager; to avoid on the one hand the Scylla of the wasted energies and confusion due to having too many in authority, and to escape, on the other hand, the Charybdis not only of stagnation but, at critical times, of that breakdown which often comes from too greatly centralized authority. In other words, it is possible to have either an insufficient amount of system, or else to create one which is too cumbersome and has too much backlash to meet the physical requirements of the modern large enterprise. From the standpoint of the chief clerk of the red tape division the latter plan may be beautifully ordered and quite perfect, but as a practical matter of administration it is often most ineffective.

The question is of particular interest to readers of this paper as it vitally affects the efficiency of transportation companies in their work. Railroad enterprises are not only

the most important examples of the large business corporations of the modern age but are those in which breakdowns, when they occur, most closely touch the general public and so become most conspicuous. Experience has shown that in them the more common error is that last mentioned. An organization may perform satisfactory work under an original set of conditions, but when the traffic increases and fast trains are being hurried over the tracks as rapidly as is in any way practicable, a long chain of intermediaries in the execution of orders often becomes a fateful burden. No one can guarantee effective work at all times in every department of a large company, but the best method of securing it, after careful selection of the operative, is a system which will bring the responsibility for action quickly to some one who has the ability to act promptly and who cannot shirk the responsibility for inaction. Moreover, the position of each link in the chain must be so definitely known as to prevent its being shoved out of sight in case of disaster.

The fact is that modern transportation, especially in suburban service, has reached such a density that many of the methods in the past considered efficient in railway administration have become altogether unsuited to the case. Incipient weakness may go from bad to worse in a few hours to an extent which, under less arduous conditions of traffic, would require days or weeks. Hence there must be extraordinary alertness in following up the first symptom of trouble, and any lost motion in getting at it may be calamitous. It is consequently a grave question in railway administration whether centralization of action has not been carried, as it may be in governments, to an extent that defeats its purposes. If for example, it were necessary as a matter of business routine to notify a Minister of Public Ways in Washington, through half a dozen intermediaries, that there was a hole in the pavement of Wall Street, and to receive from him formal authorization for the foreman of District 916A to proceed with repairs at his convenience, how many honorable gentlemen might tumble into it during the interim? It may prove necessary even to change radically the working scheme of railways in suburban service so that every section shall have absolute responsibility as regards its own condition subject only to a very general supervision and control. The effect upon the conditions discussed of the introduction of electric traction on steam railroads has and will be of considerable import, but it will be so mainly on account of its being the accompaniment of a heavy increase in traffic which must inevitably grow greater year by year. One of the problems of the future, then, is to find for the large transportation systems now coming into being managers who are capable of administering the vast enterprises created by the genius of the modern engineer. Such persons would never have to worry about the question of remuneration because a large company could afford to pay almost any salary to secure real ability in this direction.

Business-Getting Methods on Interurban Lines

Up to about three years ago the electric light companies throughout the country were inclined to take only that business which came to them of its own accord and seemingly they made no effort to develop new business. But for some reason or other there has been a change in the methods of these companies and they are now found most active in their efforts to get additional business. Although the new practice has been followed for only a few years, the results, as shown by increased load on the stations, have in many instances exceeded the expectations of the most sanguine. Many electric railway managements pursue similar business getting policies and enjoy the resulting traffic. On the other hand, there are some who evidently seem to consider their duty to the stockholders and bondholders fulfilled when they take care of the passengers who get on the cars of their own accord and handle the freight that is brought to the stations.

A wide-awake management can usually develop many schemes for increasing both freight and passenger traffic. Of course, advertising is at the bottom of all of them. Some managements evidently underestimate the value of advertising, otherwise they would not carry card racks full of other people's advertisements in their cars to the utter exclusion of notice regarding the railway system. Probably the most important feature to which an interurban road should give publicity is its time table. Even if the cars leave terminals on the hour and every one in the city knows it, time cards should be issued, for there are many strangers, traveling men and people from the neighboring farming country who are not so familiar with the schedule and who may learn of the existence of the interurban line or may be induced to patronize it by seeing a stray time card in a newspaper or posted in a hotel lobby or other public place. The fare from a few extra passengers is practically all profit, consequently it takes but a few such fares to pay for considerable advertising. The desirability for this action is so self evident that it seems hardly necessary to refer to it except that personal observation shows it to be frequently neglected. Where one has a choice of starting for a steam train which he knows will leave at a designated time or of waiting perhaps 30 minutes or three-quarters of an hour for an electric car, he will usually adopt the former plan.

Many interurban companies have also created traffic by getting out booklets containing picturesque views along the right-of-way and within walking distance from stations. Often these circulars weave an atmosphere of romance about many of the most picturesque points along the line by connecting them with accounts of historic or prehistoric days. Such opportunity can nearly always be found, even in the most modern and prosaic neighborhood, by a little study, coupled if necessary with faith in legendary lore, and undoubtedly can be made a legitimate cause for the collection of many additional fares.

There are various ways in which the freight traffic may be increased. When an interurban system finds freight can be hauled at a profit, every effort ought to be made to capture every shipment which can be handled. Energies should then be directed to the development of additional business. While steam roads are congested with freight and are slow in delivering freight, managements of electric railways can frequently prove to shippers and dealers that the electric line is in condition to make quicker deliveries. Where the electric road crosses many steam roads, dealers in the small towns along the electric line may be induced to direct shippers to route all shipments via the electric line.

One interurban road we recall, induced shippers to send goods in car load lots to one of the electric line terminals instead of in smaller lots to the merchants along the electric line. The latter then distributed the goods to the consignees. This arrangement resulted in a reduced freight rate to the shipper and considerable income to the electric railway company.

In the past steam roads have often expended considerable energy in encouraging manufacturing and mining industries and the development of farms and stock raising in the territories served by them. In some instances an electric road could in a similar manner encourage industries along its route. One ten-mile steam dummy road which has since been changed to an electric line derived considerable revenue through encouraging the raising of potatoes by farmers along its right of way. The management impressed the farmers with the profits to be derived from this crop and then encouraged buyers to go into the district. The whole crop was shipped out over the railway line. Incidentally, the potatoes lifted the mortgages on the larger number of the farms and helped to put the whole region in a prosperous condition. This, of course, helped the future receipts of the road.

In determining methods to be followed in increasing business no set rule can be followed. Local conditions must be analyzed before anything can be done, but a close consideration of these conditions will usually make evident to a wide-awake manager numerous ways of increasing business.

Rotary Converter Starting

In the operation of rotary converter sub-stations the best method of starting the machines is a question of large importance in relation to the prevailing conditions of service. Considerable difference of opinion still exists as to the value of each of the principal ways of throwing a rotary into service now commonly practiced. The requirements of continuous service demand that when it becomes necessary to put a rotary under load after an interruption of the main sub-station output, no time shall be lost on account of the unreliability of the starting arrangements. The first cost of the proper starting equipment should never be weighed against the certainty of its action without disturbance of the other machinery in the sub-station or possibly the rest of the distribution system.

Rotaries are usually started from either the alternating current side or by means of an auxiliary direct-connected induction motor mounted on the same shaft. Power from the direct current bus bar is often employed in large installations, but in small sub-stations alternating current must, as a rule, be the main reliance. It is difficult to decide which is the most advantageous method in many installations. The type of rotary purchased may practically settle the question, as some manufacturers prefer to supply a starting motor with the converter, while others favor the use of low voltage transformer taps and reactance coils. Each of these three methods has its own advantages and drawbacks.

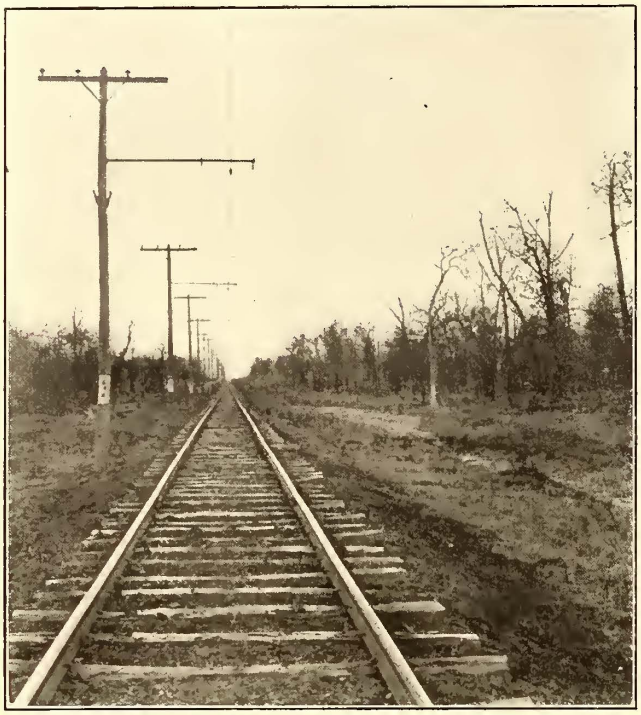
A converter started by a separate small motor has the advantage of being positively brought up to speed by an outside source of power which creates very little interference with the regulation of the rest of the system. Induction motors are practically always used for this service, and as there is no more reliable motor known in modern practice, the certainty of the method is almost unquestioned, provided that the proper voltage can be applied to the motor terminals. A drop of 20 or 30 per cent in the voltage available at the induction motor, however, may fail to start the machine, so that long delays may occur in getting a system into operation if the regulation of the generators at the power plant is demoralized by low steam pressure at the engines or turbines, or other causes. The speed of connecting a rotary to the system by the small motor drive is usually slower than in the case of starting from the direct current bus, or from a storage battery in case the sub-station is so equipped; but in the majority of instances the acceleration of the converter armature from standstill to synchronism is fast enough for commercial requirements.

In starting from the alternating current side the practice is to apply from one-third to two-thirds normal voltage to the collecting rings by switching a set of sub-voltage transformer taps to the converter through a set of reactance coils. The converter thus starts as an induction motor, since the shunt field windings are generally disconnected to prevent the induction of excessive potentials in them. Normal voltage is thrown upon the slip rings as the converter approaches synchronism. The speed of acceleration in this method is high, and with prompt work in synchronizing, the converter should be placed in service in considerably less than a minute if a small machine, and in possibly a minute and a half or two minutes if a large unit of 1,000 kw. or over. The method is exceedingly simple, but it has the objection of inducing the flow of heavy starting currents if the voltage taps are connected so as to permit more than 30 or 40 per cent of normal potential when first applied to the slip rings. The reactance coils hold back a considerable rush of current, take up little space and are thoroughly reliable pieces of apparatus. The heavy starting current is the price paid for the quick acceleration of the converter armature to synchronous speed, but on a large system the starting current of a single converter is a small percentage of the load or at least of the generating capacity.

Maintenance expenses of starting apparatus are too small in relation to the total operating cost of sub-stations to carry much influence in the choice of methods of bringing rotary converters into service. The direct current bus bar method offers the advantages of maximum simplicity, together with small starting current, low cost of upkeep and reasonable speed of operation, approximating the rapid acceleration found in the alternating current tap and reactance arrangement. On the adverse side, it is not as reliable as the other methods, and is liable to cause surging if provision is not made to open the direct current auxiliary supply circuit just before the alternating current bus bars are connected with the rotary slip rings. This may be done automatically, but the apparatus requires very close adjustment. Probably the wisest plan in laying out arrangements for starting rotaries in important stations is to equip the plant with two methods. It should never be possible for a combination of circumstances to occur which will prevent the starting of a rotary in normal condition when low-tension alternating current power is available at normal voltage.

AN INDIAN TERRITORY INTERURBAN SYSTEM

With many people the idea prevails that Indian Territory is a wild, unpopulated country and little more than a rendezvous of outlaws and criminals. Such an idea, however, is far from true, for within the last fifteen years the outlaws have been driven out, a large portion of the farm lands has been put under cultivation, and mineral lands have been developed to such an extent that towns and cities have sprung up at relatively close distances all over the Territory.

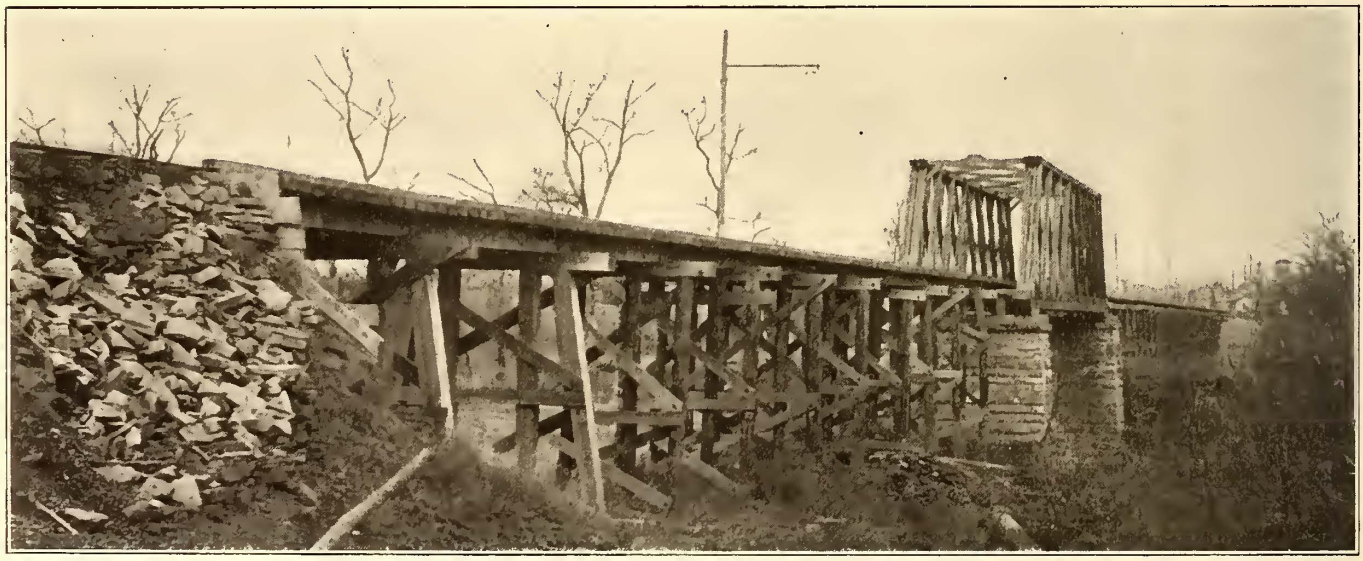


ALONG A TANGENT ON THE CHOCTAW RAILWAY

A ROCK CUT ON THE CHOCTAW RAILWAY

The fact that an electric interurban railway, doing both a freight and passenger business, connects several of these towns is very good evidence that the Territory has within comparatively few years undergone a wonderful development. This road is that belonging to the Choctaw Railway & Light Company, and extends southeast from South McAlester to Hartshorne, 17 miles distant.

South McAlester is one of the two larger cities in the Territory and has a population of about 15,000 people. That the city is not a cluster of temporary wood buildings, such as is frequently found in a new country, is evidenced by the fact that it has a hotel costing $200,000, a Masonic Temple built at a cost of $200,000, and that $175,000 is being spent in the erection of public school buildings. In addition, business blocks to cost $500,000 are at present under contract. The main business street of the city is paved with brick manufactured in McAlester, and the buildings fronting on it are constructed either of stone or vitrified brick made within a radius of 2 miles from the business center. It has sewerage, natural and artificial gas, water-works and electric light systems, and all the conveniences of cities of the same size in other regions. Its rapid growth from a town of 3500 inhabitants in 1900 is due in a great measure to the development of coal mines in the surrounding region. It is, in fact, located near the center of what is termed the "segregated lands," which comprise a coal and mineral belt about 70 miles long.



TRESTLE AND WOOD TRUSS BRIDGE AT DOW LAKE TO BE REPLACED BY A FILL

These lands, because of the value of the minerals, were not apportioned among the individual Indians of the Choctaw tribe, but have been retained for the common benefit of the members. The development of the mining industry and agriculture in this region has been, and is now, greatly hampered because the land cannot be purchased outright. Mining leases must be obtained from the government, which, however, is now considering the question of selling the lands outright. As the interurban railway is built entirely within the segregated lands, whenever the lands are sold and opened up to mining under better conditions and to agriculture traffic over it will be greatly increased.

The towns along the line at the present time are sustained almost entirely by the coal mines. There are, in fact, within 3 miles of the railway line twenty-one mines, some of them having a capacity of 10,000 to 15,000 tons per day. The interurban line is operated in connection with a city system connecting the two contiguous towns, McAlester and South McAlester, and also in connection with the electric lighting system of South McAlester.

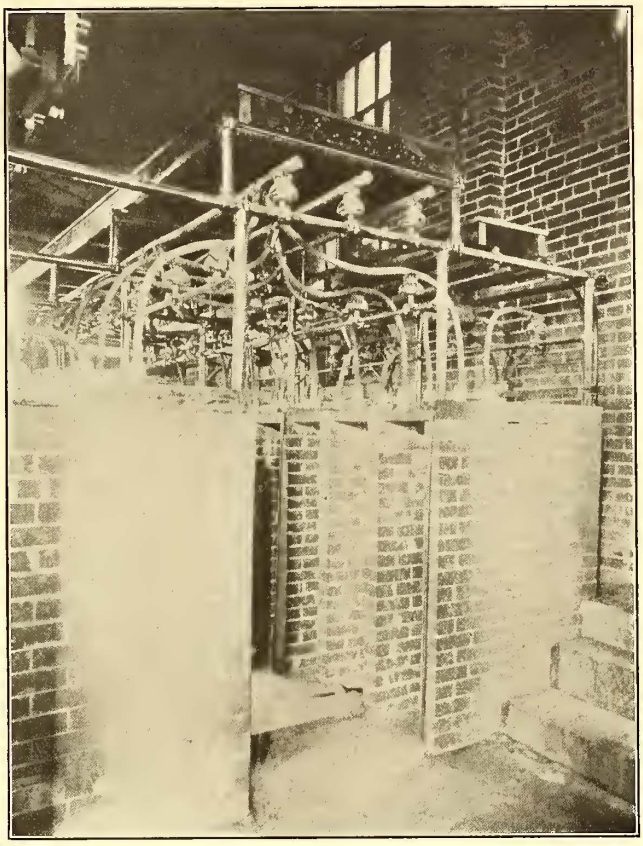
The line parallels the Choctaw, Oklahoma & Gulf Railway, the two roads being at no point farther than 1½ miles from each other. It is crossed by several mine switches from this road and by others from the Missouri, Kansas & Texas Railway system, but there is only one main line crossing with steam roads. At Bache and at Krebs switching connections are made with the steam roads.

TRACK AND ROADWAY

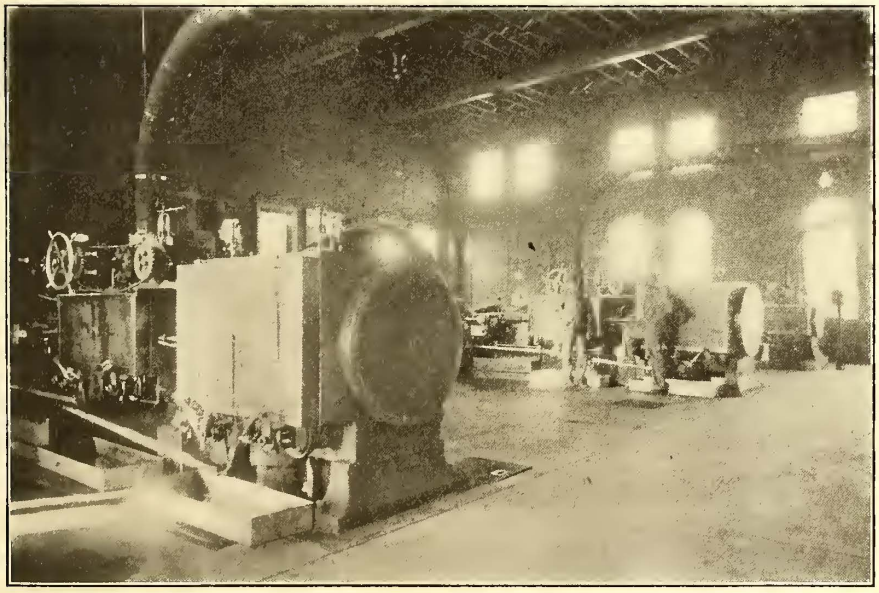
The private right of way on which the line is built was granted to the company by the government. Except in towns where it is limited to 60 ft. the width is 100 ft., and, as the land on either side is not cultivated or pastured, it is not fenced in. The line passes through comparatively hilly country, and to obtain a minimum grade of 2½ per cent. some heavy cuts and long trestles were required. The heaviest cut is in South McAlester. It is in solid rock, is 23 ft. deep, and about 800 ft. long. Near Dow, 13 miles from South McAlester, the track is carried over Brushy Creek, which lies in a ravine at this point, by a wood trestle 900 ft. long and 25 ft. high. At the middle point of the structure is a timber truss span supported on rock piers. The track is laid with 60-lb. rails, and practically all of it is ballasted with cinders.

POWER PLANT

The power plant for the system and for lighting North and South McAlester as well is located on the line about 1½ miles north and east of South McAlester. The station building measures 95 ft. x 69 ft., is of brick, and has concrete floors and timber roof trusses.



HIGH-TENSION WIRING IN THE CHOCTAW RAILWAY'S POWER HOUSE



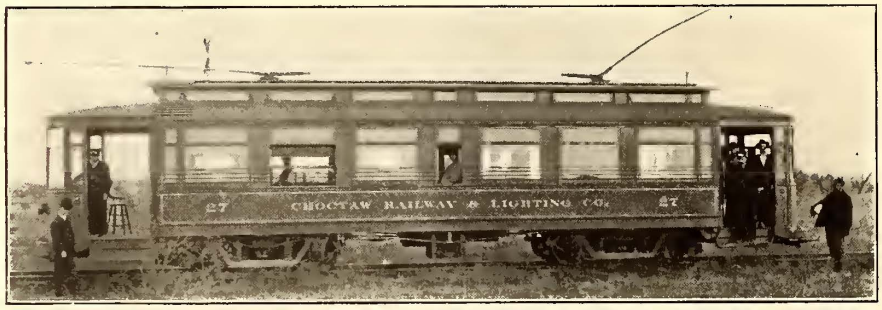
ENGINE ROOM OF THE CHOCTAW RAILWAY & LIGHTING COMPANY

The boiler room contains three 400-hp Stirling hand-fired boilers, high-pressure, and a low-duty Laidlaw-Dunn-Gordon duplex boiler, feed-pumps and a Cochrane feed-water heater. Coal cars are run from the main track onto a switch laid along the east wall of the boiler room, and the coal is unloaded through openings in the wall direct on to the boiler room floor. A lake south of the station, which has a capacity for about 6,000,000 gals., furnishes an ample supply of good water. The water from the lake flows by gravity into a settling well underneath the boiler room floor, from which it is pumped by the low-duty pump through a Cochrane feed-water heater. A stack, 6 ft. in diameter and 125 ft. high, serves all of the boilers.

The generating apparatus in the engine room consists of two 500-hp tandem compound Russell non-condensing engines direct connected to General Electric 13,000-volt, 25-cycle generators and a 150-kw Russell engine direct con-

nected to 2300-volt, 60-cycle generator, which, however, furnishes current for lighting only. It is the intention to install an additional 500-kw unit in the near future. A motor-generator set installed in the engine room consists of a 370-volt, 25-cycle, 350-hp motor direct connected to a 240-kw, 600-volt generator.

All of the high-tension apparatus is located in a small compartment between the engine room and the car house on the west. The railway apparatus in this compartment consists of two 13,200-volt, 120-kw, G. E. oil-cooled transformers, and instrument transformers located in brick cells and hand-operated, high-tension oil switches. The high-tension buses are carried on an iron pipe framework immediately over the aisle between the two rows of brick cells, while the lightning arresters are mounted on the east wall of the compartment. The one high-tension line leaving the station consists of three No. 4 copper wires arranged flat on one cross-arm. It continues to Dow, about 12 miles east, where a portable sub-station installed in a box car is located. The car is equipped with two transformers in one end, a 300-kw rotary converter in the other, and a switchboard in the open space in the center.



ONE OF THE CHOCTAW RAILWAY & LIGHTING COMPANY'S STANDARD INTERURBAN CARS

OVERHEAD CONSTRUCTION

Outside the city limits the single No. 000 trolley wire is supported on brackets. The poles carrying high-tension wires are 35 ft. long, while beyond Dow 30-ft. poles are used. Every pole is numbered. Two telephone wires are carried on brackets the full length of the line. Lightning arresters are placed five to the mile.

CAR EQUIPMENT

The car equipment consists of ten motor, two double-truck passenger trail cars, two standard steam road gondolas and one box car. Two additional interurban passenger cars are to be purchased. Four of the motor cars are small ones with single truck for city service, and the remainder, with the exception of a freight car, have double trucks and are for interurban service. Two of these are 43 ft. long and the remainder 47½ ft. long over all.

The freight motor is 49 ft. long over all, has an oval roof and is provided with longitudinal seats, which may be let down when it is desired to use it in passenger service.

REPAIR SHOPS

The repair shops are located in a brick building adjoining the power house. The greater portion of the building is taken up by three repair tracks without pits. One of these, however, is elevated on a trestle 5 ft. above the ground, to give the advantage of a pit. A brick addition west of the tracks contains machine tools, while the blacksmith shop is in a detached building in the rear. The equipment of machine tools consists of a 100-ton wheel press, 48-in. boring mill, an engine lathe with an 8-ft. bed, and a 14-in. swing, a drill press and an emery grinder.

FRONT VIEW OF THE CHOCTAW RAILWAY & LIGHTING COMPANY'S CAR HOUSE

WAY STATIONS

Stations of a substantial character are located at all of the towns. These buildings are usually constructed with the freight room floor elevated above that of the passenger waiting room and a freight loading platform built adjacent to the freight room. The terminal station at Hartshorne is

a brick structure, and has in the rear a yard for the storage of timber and other heavy materials.

The freight station at South McAlester is a pavilion provided with Kinnear rolling steel doors on all sides, which may be let down to enclose it entirely.

Station agents are kept at practically all of the stations from 6:30 a. m. to 8:15 p. m. On special occasions, however, they are kept later.

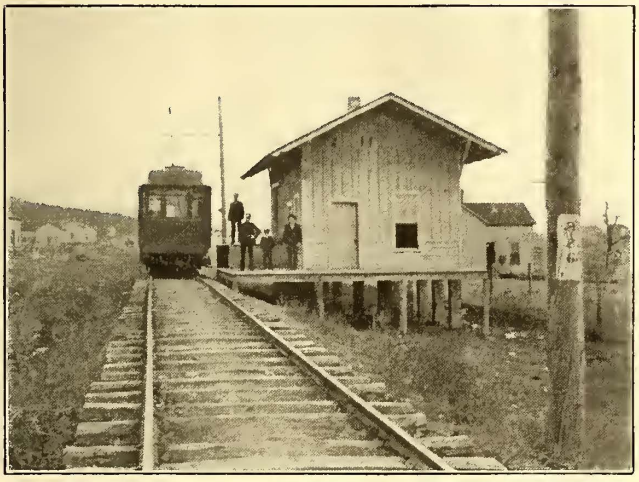
FARES

Regular fare on the interurban line is about 2½ cents per mile. A sixty-coupon ticket sold for $2.25, good for bearer, is the only form of special ticket. On the city lines the fare to school children and children under twelve years is 2 cents. The issuance of passes has been recently discontinued. This was effected by writing personal letters to the holders and no difficulties were experienced.

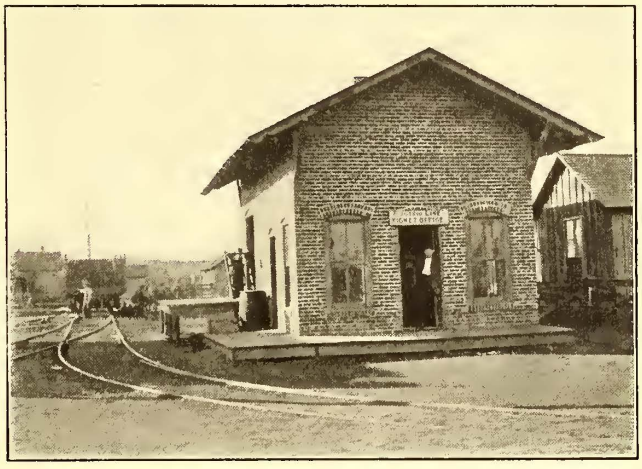
Interurban cars are operated at hourly intervals, one hour being required to make the trip between terminals. On special days a forty-five-minute service is given and all cars are double-headed. The cars are dispatched by means of a telephone dispatching system, the dispatchers being located at South McAlester.

A contract has been made with the government for handling mail, which is carried to and from all towns along the line in passenger cars. Express packages up to 200 lbs. weight are carried on all passsenger cars. To induce traffic, advertising matter of merchants in South McAlester is carried to the adjacent towns free when accompanied by one passenger.

FREIGHT MOTOR CAR ON THE CHOCTAW RAILWAY



COMBINED FREIGHT AND PASSENGER STATION

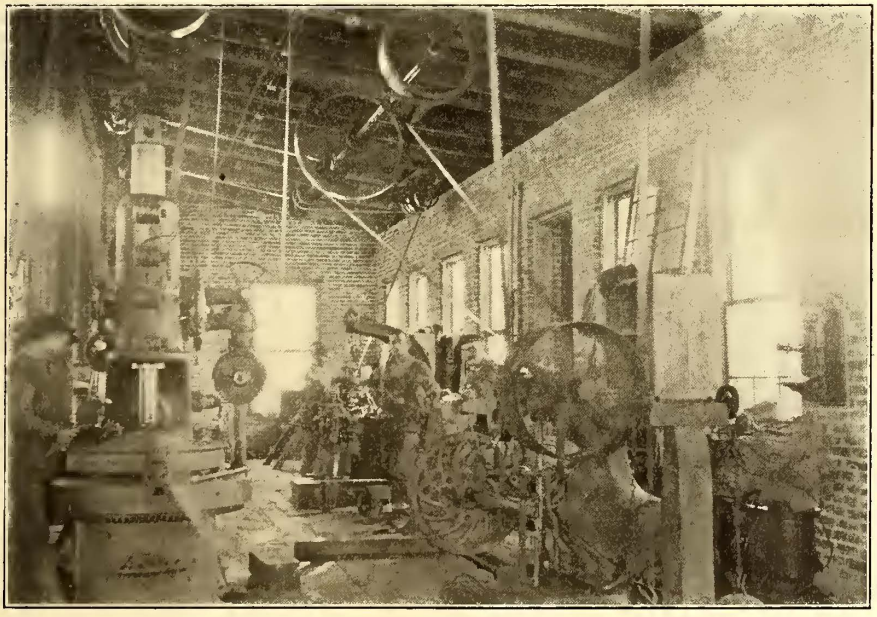


FREIGHT AND PASSENGER STATION AT HARTSHORNE TERMINUS

The freight car makes two round trips per day, usually hauling two or more trailers. All the coal for the power house and also that for the Rock Island pumping station at Dow Lake is hauled by this car. The two gondolas and the box owned by the company are in continual use carrying lumber from Hartshorne to South McAlester.

A large percentage of the freight receipts is obtained from hauling from the terminal cities of goods retailed by the merchants in the mining towns along the route. These goods were formerly shipped direct to the smaller towns in small quantities, and the business has been obtained by representatives of the railway company getting after the salesmen for the wholesale houses and showing them that cheaper rates could be obtained and less delays encountered by shipping in carload lots to South McAlester and distributing over the electric line from this point.

J. H. Merrill, formerly secretary of the Central Electric Railway Association, is general superintendent of the system, with office at South McAlester. Arthur W. Underwood, of Chicago, is president, and George W. Knox, also of Chicago, is managing engineer. The earnings for the six months the line has been under new management are 60 per cent greater than for the previous six months.



MACHINE EQUIPMENT OF THE CHOCTAW REPAIR SHOPS

EMPLOYING AND CARING FOR TRAINMEN AT LITTLE ROCK

The street railway system at Little Rock, while not large enough to demand all the "red tape methods" necessary on the larger systems to insure the employment of trainmen of the proper character, does nevertheless exercise a great deal of care in the employment of its motormen and conductors. Applicants are provided with a blank which they are required to fill out in their own handwriting. In making the application they promise to abstain from the use of intoxicating liquors if accepted. In addition to the customary questions, the blank requires the applicant to say whether or not he owns property and what its estimated value is, to what societies he belongs, whether or not he owns a watch or has ever been arrested.

After the references which he gives on his application blank have been investigated satisfactorily, he is ordered to report to the office, and upon the payment of a deposit of

APPLICATION

Badge No..... File No.....

LITTLE ROCK RAILWAY AND ELECTRIC COMPANY

Name .....
Position .....
Reference sent for { Personal ..... / Mail .....
Applicant sent for.....
Date Appointed .....
Position .....
Resigned .....
Discharged .....
Cause .....
.....

CAUSE OF REJECTION

.....

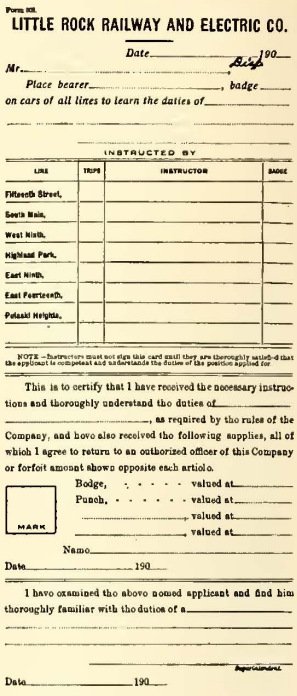
RECORD OF FORMER EMPLOYEES

$20 is given an appointment card which orders the dispatcher to place the applicant for a longer or shorter period of time on each of the lines of the system. After an instructor on each line has signed the card to the effect that the applicant is competent and understands the duties as is put on the extra list. The instruction period varies in length of time from ten days to three weeks.

Men are preferred who have not had previous experience on other systems, as it is considered easier to train men to the methods of the company who do not have to unlearn the practices of another company. Most of the men are obtained from the adjoining country and within a radius of 30 or 40 miles. Married men are preferred to single ones. The height requirement for motormen is 5 ft. 7 ins. and the weight 150 lbs. Conductors must weigh 130 lbs. or over.

DISCIPLINE

When trainmen by the exercise of good judgment avoid an accident, or when they show in any way that they have the interest of the company at heart, a letter of commendation is sent to them. Whenever a motorman or a conductor has committed an infraction of the rules not serious enough to warrant discharging him, he is made to report and work at his own expense as a student with one of the other motormen or conductors a length of time as designated by the superintendent. This system, which has been termed the "kindergarten" by the men, is much more effective in making them remember the rules than is the practice of laying them off for small offenses.



Form 101.

LITTLE ROCK RAILWAY AND ELECTRIC CO.

Date..... 190...

Mr.....

Place bearer....., badge.....
on cars of all lines to learn the duties of.....

INSTRUCTED BY

LINE	TRIPS	INSTRUCTOR	BADGE
Fifteenth Street,			
South Main,			
West Ninth,			
Highland Park,			
East Ninth,			
East Fourteenth,			
Pulaski Heights,			

NOTE.—Instructors must not sign this card until they are thoroughly satisfied that the applicant is competent and understands the duties of the position applied for.

This is to certify that I have received the necessary instructions and thoroughly understand the duties of.....
....., as required by the rules of the Company, and have also received the following supplies, all of which I agree to return to an authorized officer of this Company or forfeit amount shown opposite each article.

MARK

Badge, ... valued at.....
Punch, ... valued at.....
....., valued at.....
....., valued at.....

Name.....

Date..... 190...

I have examined the above named applicant and find him thoroughly familiar with the duties of a.....

.....
Superintendent.

Date..... 190...

FORM TURNED IN BY GRADUATE STUDENT

The company maintains a club room at the car depot which is equipped with shower baths, wash basins, large easy chairs, writing tables and reading matter. The employees have a baseball team which was equipped with uniforms and apparatus by the company, and which has won the city league championship. There is a benefit association composed of the employees and having employees as officers. Each member pays weekly dues to the association

LITTLE ROCK RAILWAY AND ELECTRIC COMPANY.

Little Rock, Ark....., 190....

Mr. .....
.....

Dear Sir:

Mr. ..... of .....
has applied to this company for a position as.....and refers to you for testimony as to his character. If appointed to this position, human life may depend upon his judgment, or be imperiled by his carelessness. He will, if appointed a conductor, have custody of the money of his employer, and will, besides, come in daily contact with the aged and feeble, and with women and children, who are entitled to the utmost courtesy and the highest degree of care. Is the applicant, in your judgment, fit to occupy the above position? This company feels seriously the responsibility of making such selections, there is too much at stake to accept applicants without the most careful inquiry, and therefore it adopts this means to assist it in securing the best men available.

Will you kindly give me, as early as possible, the information asked for in the following questions. Your answers will, I assure you, be considered entirely confidential and without prejudice to you.

Yours truly,.....
Superintendent of Transportation.

1. Was applicant ever in your service? If so, for how long? From..... to .....
2. How long have you known him?.....
3. Are you connected with him by relationship or otherwise? If so, in what way?.....
4. Are his habits sober and correct, and is his conduct such as to entitle him to our confidence?.....
5. Have you ever heard of his having been irregular or unsteady in his habits, or addicted to any bad habits?
.....
6. Is he quick tempered?..... 7. Is he polite?.....
8. Is he talkative or quiet?..... 9. Is he a careful man?.....
10. Do you believe him thoroughly honest?.....
11. Has he ever been dismissed from any situation to your knowledge? If so, under what circumstances?.....
.....
12. Has he ever, to your knowledge, been employed on any steam or street railroad in any position?.....
.....
13. Have you any reason to consider him incompetent to fill the position he seeks?.....
14. Has be any distinct traits of character not set out above?.....

Signature ..... Vocation.....
Address ..... Dated .....

BLANK SENT TO REFERENCES GIVEN BY APPLICANT. NOTE THE ATTENTION CALLED TO THE RESPONSIBILITY OF THE POSITION

required by the position, he is sent to the master mechanic, who gives him a general idea of the car equipment and instructs him how to cut out motors, put in fuses, and what to do in case of other emergencies. He is then given special instructions as to what to do in case of accident and lectured in regard to his attitude toward the public. After having submitted to examinations on all the instructions given he

and receives sick and death benefits from it. The association dissolves at end of every twelve months and the money in the treasury is distributed pro rata among the members not participating in benefits during the year. It is then organized again for the succeeding year. The company contributes to the first payment and thus keeps the men from joining organizations which would be detrimental to their welfare.

Form 300 Little Rock, Ark., ..., 190....

LITTLE ROCK RAILWAY & ELECTRIC COMPANY

To Be Answered in Applicant's Own Handwriting

I hereby make application for a position as..... in the service of the Little Rock Railway & Electric Company, and if accepted I agree to comply faithfully with all rules, regulations and instructions governing the employees as the management may from time to time establish; to abstain wholly from the use of intoxicating liquors while on duty, conduct myself in a gentlemanly manner and work to the best interests of my employer.

It is further understood that in case my services are not satisfactory and I do not conform to your rules the company may terminate my employment at any time.

1. Name in full (no initials).....
2. Present address..... Street..... City or Town
3. How long have you resided at above address?.....
4. How long have you resided in Little Rock?.....
5. Birth place? ..... 6. Date of birth .....
7. Married or single?..... 8. Housekeeping or boarding?.....
9. State what family you have?.....
10. How many persons are dependent on you for support?.....
11. Where do they live?.....
12. Are you a citizen?.....
13. Are you subject to any sickness or infirmity?..... 14. Are you crippled or deformed?.....
15. Are you ruptured?..... 16. Have you ever had a fit?..... 17. Have you ever fainted?.....
18. Is your hearing perfect in both ears?..... 19. Are your eyes in perfect condition?.....
20. What property do you own?..... 21. Estimated value?.....
22. Where located?.....
23. To what societies or organizations do you belong?.....
24. Where did you last attend school?.....
25. Do you own a watch?.....
26. What trade have you learned?.....
27. Have you ever been arrested?..... 28. Have you ever been convicted of any crime?.....
29. Do you drink intoxicating liquors?.....
30. Have you ever been discharged or suspended from any position?.....
31. Where? ..... 32. What reason?.....
33. Have you ever been employed by this company?.....
34. In what position?..... 35. Why did you leave?.....
36. Have you any relations employed by this company?..... If so, give their names.....
37. By whom are you now employed?.....
38. How long have you been out of employment?.....
39. Reason for leaving last situation?.....
40. Were you ever employed on a street railway?..... 41. In what capacity?.....
42. Name of company.....
Employed from..... to ..... 43. Why did you leave?.....
44. Give names of all steam or street railways on which you have been employed. .....
Name of company.....
Name of company.....
Name of company.....
45. Fill in the following blanks showing how you have been employed during the past six years:

Name of Employer	Address	Your Position	Date You Entered Servitude	Date You Left Service	Reason For Leaving

Give the names, addresses and occupations of four persons for reference, who are not related to you, and who have known you at least two years:

46. Name .....
Business .....
Street number .....
City or town ..... State .....
47. Name .....
Business .....
Street number .....
City or town ..... State .....
48. Name .....
Business .....
Street number .....
City or town ..... State .....
49. Name .....
Business .....
Street number .....
City or town ..... State .....
50. I hereby certify that I understand the above and that the answers given are true and correct.

Signed.....

Witness .....

DO NOT FILL THIS OUT

Age .....
Height .....
Weight .....
Color Eyes .....
Color Hair .....
Mustache .....
Beard .....
Complexion .....
Characteristic Marks .....
.....
.....

Remarks .....
.....

STANDARD FORM OF EMPLOYMENT APPLICATION WITH PORTION TO BE FILLED OUT BY EXAMINER

THE SOUTHWESTERN ELECTRIC & GAS ASSOCIATION CONVENTION

The Southwestern Electric & Gas Association held its third annual convention at San Antonio, Tex., May 14, 15, and 16. The several sessions were well attended, and interesting and beneficial discussions were indulged in both upon the papers presented and upon questions originally submitted to the association question box. The papers read were all printed and copies distributed at the time of their presentation. The questions submitted to the question box during the year and the answers given to them by the several members of the association had also been printed, and each member was provided with a bound copy. The work of editing the question box and putting it in book form was well done by Samuel Kahn, of San Antonio.

TUESDAY MORNING SESSION

The first session of the convention was called to order Tuesday morning by President H. S. Cooper, of Galveston, who introduced Regan Houston, of San Antonio. In welcoming the convention to his city, Mr. Houston took occasion to refer to the recent legislation adverse to public corporations enacted by the last Texas Legislature.

President Cooper, in his address, said what was most vital to the association was the molding of public opinion to prevent the enactment of more stringent tax laws against Texas corporations. The corporations, he said, as a whole had gotten a bad name, and the public must be informed of the truth concerning them. He urged the establishment of a permanent secretary's office to carry out the association work better.

H. T. Edgar, of Fort Worth, at the request of President Cooper, told of the work of the legislative committee during the past session of the Legislature. Soon after the assembling of the Legislature the executive committee of the association held a meeting in Dallas and appointed three chairmen of a legislative committee, one for the electric railway, one for the electric light and one for the gas interests. These chairmen afterward selected associates from the managers of plants and systems. The chairmen, when not in Austin, were kept informed of conditions there by a representative kept in Austin for that purpose. The legislative committee, he said, had, by ardent work, prevented the passage of a law taxing the intangible assets of corporations, and had fought hard to prevent the passage of the law taxing the gross receipts. The best that could be done, however, was to get the tax reduced to a maximum of one-half of 1 per cent of the gross receipts of electric light corporations and three-fourths of 1 per cent of street and interurban railway properties. Had it not been for the efforts of the committee the taxes would, in most probabilities, have been 2 per cent and 3 per cent.

President Cooper called attention to the finances of the legislative committee, saying that there was a deficiency in cash that should be made up.

Legislative matters were further dealt with in a paper entitled "Education of Legislators with Reference to Public Service Corporations," presented by H. M. Moore.

TUESDAY AFTERNOON SESSION

At the opening of the session Tuesday afternoon, V. W. Berry, master mechanic of the Stone & Webster properties in Texas, read a paper on the use of labor-saving tools and devices in central stations and car houses. He urged the installation of pneumatic hoists and lifts in car houses, saying that the use of chain blocks and mechanically operated hoists were often overloaded, with disastrous results, and at times the men operating them were subject to injury.

President Cooper, in opening the discussion on Mr. Berry's paper, said he had installed pneumatic hoists and lifts in the shops at Galveston with good results. Two locomotive compressors were originally installed to furnish compressed air to pump fuel oil. Pipes had been extended from these pumps over the shops, and both car jacks and chain hoists had been substituted by air lifts. With present apparatus, with four men, wheels were set out in forty minutes and armatures were changed in a comparatively short time. The cost of the air apparatus had been only about $300, as most of it had been made in the shop. The hoists had enabled him to cut the shop force, so that about $2,500 was saved annually. Moreover, the work was done with more safety.

Mr. Cass, of the Westinghouse Air Brake Company, said that he found in many instances compressors of too small a size were installed in shops because of the rapidity of the extension of the use of air when the compressors were once installed.

A question box query concerning the keeping of pole line data resulted in a lively discussion. F. C. Randall, of Galveston, explained their method of keeping such data. Perspective views of sections of the pole lines were drawn on cards. The drawings were all made so that the observer faced the line in the outgoing direction. Pole locations were numbered consecutively, and where lines branched a separate set of cards was made for each branch.

E. T. Moore, of Dallas, had a small map of the city ruled off into twenty-five sections. For each section there was a map to a larger scale on which the locations of poles were shown. Each pole was given a number which referred to a card upon which all data concerning that pole were kept.

In reply to the statement of one member that he saw no necessity of keeping separate data for each pole where all carried the same wires, President Cooper took exception, saying that where definite data were kept, in the event of damage suits, statements could be sworn to, and this might enable the operating company to save thousands of dollars in damages.

In opening the discussion on the treatment of poles with preservatives, President Cooper said the question was a very important one, in view of the fact that in the last few years the price of lumber had gone up in Texas about 100 per cent. The question box query upon which the discussion was based was whether or not it would not be advisable to treat only the butts of poles, or possibly only a small section of the pole near the ground line, instead of treating the entire pole. President Cooper was of the opinion that poles could not be treated by the vacuum process for only a portion of their length, but that it was necessary to treat the entire pole. Mr. Edgar said a pole man had explained to him that it was possible to treat only the butts. The poles were set upright with only their butts in the creosoting cylinder, and an air-tight joint was made around the poles where they came out of the cylinder. A price of $4.50 had been quoted to him for a 35-ft. pole with a 7-in. top having only the butt creosoted. Mr. Edgar saw no necessity for treating the pole above the ground line, as the exposed portion would last as long untreated as the treated portion at the ground line.

George H. Cushman, of San Antonio, brought up the question of the conductivity of treated poles, and there fol-

lowed a discussion as to whether or not this conductivity varied with age.

President Cooper vouched for the fact that creosoted poles were good conductors. Because of this conductivity the linemen in Galveston were compelled to mount poles and dismount them with a jump, so as not to have a spur in the pole and a foot on the ground at the same time. He was compelled to use creosoted poles because in the wet, salty sand of Galveston an uncreosoted pole lasted only about three years. He did not believe the conductivity changed with age, as he had noticed no change in the conductivity of the creosoted poles put up soon after the Galveston storm in 1900. One member, in asking for information concerning creosoted cypress poles, stated that a price of $3.25 had been quoted him for a 25-ft. pole of this wood.

In the discussion regarding the effect of treatment on the wood fiber it was stated that the deteriorating effect was caused by high-temperature steaming. It was necessary to treat only green timber to the vacuum and steaming processes, as thorough penetration of seasoned timber could be obtained by treating it in vats with oil at a temperature of 200 degs. F.

E. E. Nelson, of Fort Worth, said his company was replacing the poles between Dallas and Fort Worth with creosoted pine poles.

The remainder of the afternoon session was devoted to discussions regarding the getting of new business by electric light and gas companies.

WEDNESDAY MORNING SESSION

At the opening of the Wednesday morning session President Cooper read a telegram from M. M. Phinney, expressing regrets at his inability to be present. Afterwards he appointed on the nominating committee H. S. Potter, of El Paso; J. P. Crerar, of Denison; Samuel Kahn, of San Antonio, and E. D. Kelley, of Hillsborough. A special committee to draw up resolutions regarding the establishment of a permanent secretary's office was also appointed. This committee consists of H. T. Edgar, of Fort Worth; W. B. Head, of Grand View; W. B. Tuttle, of San Antonio; A. E. Judge, of Tyler, and C. H. Dunbar, of Houston.

After the appointment of this committee Professor Arthur C. Scott, of the electrical engineering department of the University of Texas, read a paper on the value of scientific tests to public service corporations. He said the engineer of today occupied a position midway between the pure scientist and the strict utilitarian. He called attention to the work of the railway department of the University of Illinois and to the tests made on railway properties by the department with the aid of the electric test car and the dynamometer car with which the department was provided. He said that it was evident that the corporations saw the value of the tests or otherwise they would not have co-operated with the university in making them.

He suggested that it might be worth while for the corporation directors of Texas to inquire into the work of the technical schools of the State, with a view to increasing their own scope and productiveness and also to procure good men to fill vacancies. It would be to their interests also to co-operate with the schools with a view to making tests on power plants and other portions of the systems. Professor Scott, after the presentation of his paper, was, under a suspension of rules, elected an honorary member of the association.

Mr. Edgar wanted to know more in detail what facilities Professor Scott's department possessed for making scientific tests and what tests could be undertaken. In response, Professor Scott gave a general outline of the steam and electrical equipment of the laboratories in the university. The members were unanimous in the belief that the engineering department of the university should receive more encouragement from the State Legislature, and, with a view of calling the attention of the members of the Legislature to the school, a motion was passed to have 500 copies of Professor Scott's paper printed and a copy mailed to each member of the Legislature.

F. C. Randall, of Galveston, presented an interesting paper entitled "The Getting Up and Trying Out of Forms." Forms upon which data was kept, he said, should be gotten up in such a manner as to show at a glance the data required, and the data should be put down in proper sequence and along the trend of thought of the person who used the data. Employees should be thoroughly instructed regarding the forms they are required to use. A sample, properly filled in, often aided an employee to understand the character of answers or information desired. The size, shape and color of forms should be given careful consideration. The size should be such that in cutting it from stock paper no waste was entailed.

President Cooper, in opening the discussion on the subject of forms, termed a form a channel of communication of the office with the outside business. He emphasized the importance of trying out forms, adding that very frequently forms were unfitted for the purpose for which they had been gotten up. He cited a case where some forms which were intended to be filled in by outside men, who usually employed stub pencils, had blank spaces measuring 5/32 in. As to the proper size of forms, he had adopted an 8 in. x 11½ in. card as a basis. Other sizes used were either multiples or fractions of this size. These sizes could be cut from stock paper without waste. He had simplified the filling out of forms by so wording them that the answer "yes" or "no" was sufficient, and he had found that men not able to write well appreciated the privilege of using a circle for "yes" and a cross for "no."

Mr. Tuttle said that by cutting out unnecessary details and by avoiding the repetition of information on different forms he had simplified his system of forms considerably.

Mr. Edgar believed it possible for electric railways to use the same system of forms to a very great extent. He said the Stone & Webster Corporation had a department for the getting up of forms. All new forms designed by the different roads were submitted to the department, which compared them with other forms on file and was often able to make valuable suggestions.

WEDNESDAY AFTERNOON SESSION

The Wednesday afternoon session was opened with a discussion on the full convertible car and the best car for use in cities. Mr. Burdett, of Austin, said his company had had full convertible cars in use for several years. Some of them were going to pieces, and he did not regard them as a success.

E. T. Moore said that in Dallas they used the semi-convertible car successfully. He considered it a good car for summer use, as well as in winter, because of the protection afforded in sudden showers.

T. C. Brown, of San Antonio, had never had any experience with the full convertible car, but it was his opinion that an open car would not wear out until its cost had been paid in accident claims. He considered the semi-converti-

ble car the only one for all-round use. He had been operating twelve cars of this type for eighteen months and had had no trouble.

H. S. Potter, of El Paso, spoke of the California type of car. His cars had the closed compartment in the center. He did not consider them as good as the semi-convertible as regards accidents, and added that his company would not purchase any more.

President Cooper thought the open car had the advantage that it was preferred by the public, but added that the consensus of opinion was that increased liability to accidents precluded its use. He did not think he could get along without the open car. He had had very few accidents directly traceable to it.

Mr. Brown said he at first thought the public would object to the semi-convertible car, but had found they preferred it. He attributed this to the fact that an open car seat with five persons in it was uncomfortably crowded, and that the end-seat hog made it inconvenient for people to get in and out. Added to this, people usually went in pairs, and they could be seated together in the semi-convertible car. Further, in the open car with people standing between the seats the ventilation was not as good as in a semi-convertible car. One drawback to the semi-convertible car was the time required to load and unload it. There was hardly a day that there was not an accident report turned in regarding some one falling off the car.

Mr. Edgar said that people at Fort Worth preferred the semi-convertible car. Last year he got a petition from the people along one line not to run open bench cars on that line. He had sixteen open cars, but wished he had none. He questioned the statement that the open car could be loaded and unloaded the quicker. This, he thought, could be done only when the car was unloaded all at once.

President Cooper stated that he did a large excursion business and cars were loaded and unloaded all at once. Frequently he had to handle 5000 or 6000 people in twenty minutes, and that to do so the cars must be loaded and unloaded quickly. He also brought up the point that an open car was very much lighter per passenger carrying capacity. He always noticed an increase in the station load when the open cars were taken off. He thought also that the people naturally loaded the car evenly and this reduced the maintenance.

E. T. Moore said he could not make the same schedule with semi-convertible cars as with open cars, but Mr. Potter had found the semi-convertible car the quickest. He said the Mexicans of El Paso always hesitated as to where to get on an open car, and this took time.

At the conclusion of the discussion concerning types of cars the question of whether or not transfers should be registered on the same register as cash fares was open for discussion.

Mr. Brown thought everything should be rung up on one register. Too many traction men considered the register as a policeman. He regarded it only as a counter. The money the company lost was that which was never rung up. A complicated register system gave the conductor the idea that the register was a spotter and that the officials were depending on it to catch him and were not watching him. Mr. Brown was not afraid of those conductors who go into collusion with others. These, he said, were found out soon.

President Cooper also considered the register in the light of a tally—that too much importance was attached to it. He believed in using every possible check outside the register. The best way was to watch the receipt curve of the car, and when this curve became abnormal to look for the cause. He said we could not get a machine that would take account of human nature. The personal element must be pitted against the personal element.

Mr. Edgar said spotters wanted two registers, and that a checker was confused when everything was rung up on one register.

H. M. Moore believed in watching the men as is done in the United States mail service.

The question, "To what extent should transfers be checked by the accounting department," was next opened for discussion.

A. W. Q. Bertwell, of Houston, did not think it necessary to audit transfers every day. He thought it sufficient to see that all transfers were turned in on the line for which they were punched and that the time limit was O. K. About once a week a thorough checking should be made.

President Cooper said that his transfers were not dated. They were punched on the edge in an arbitrary place each day, and, as no one knew where the punch was going to be, there was no chance of fraud. It was easy for the conductor to tell whether or not a transfer was of the correct date, as the punched out portions of all transfers collected on one day must coincide.

Mr. Brown said that in San Antonio, although a conductor could not refuse to take a transfer dated incorrectly, a card had been gotten up for use in connection with transfers not dated right when the passenger insisted they be taken. The card simply showed that the conductor did not take the transfer unknowingly.

C. J. Thomas, of San Antonio, added that he did not believe constant checking of transfers with a big force did not pay. He counted the transfers and would check up one line at a time at intervals.

THURSDAY MORNING SESSION

The Thursday morning session was given over to the supply men or associate members. The object of the meeting was to bring about a closer understanding between the operating and the supply men.

Guy C. Gum, district sales manager of the Nernst Lamp Company, who had charge of the meeting, said the alert supply man usually noted the practice at different places and was often able to give to those he visited valuable information. A feeling of delicacy, however, often prevented him doing so until asked.

O. E. Turner, of the General Electric Company, urged the supply men to bring pressure upon non-members of the association they met in their travels to join the association. Among other speakers were Ernest Boehme, Electric Service Supplies Company; Sam Hobson, Wesco Supply Company, and T. B. Whitted, of the Westinghouse Machine Company.

The meeting resulted in the passage afterwards of a resolution providing that the associate members be provided with application blanks and by-laws with a view to getting new members. The resolution also provided that the associate members be supplied with a badge, somewhat different from that of the active members, and for the appointment of a committee to make arrangements for exhibits at future conventions.

THURSDAY AFTERNOON SESSION

The Thursday afternoon session was opened by a paper of interest to gas men only. The report of the secretary, given later, showed that the association had three honorary

members, sixty-seven active and sixty-six associate members.

A resolution was passed providing for the establishment of a permanent secretary's office in Dallas, and that this office collect data of interest to the members for the exclusive use of the members.

On a motion by Mr. Edgar, the thanks of the association was tendered to the officers of the San Antonio Gas & Electric Company and of the San Antonio Traction Company for the many courtesies received.

The nominating committee reported the following ticket, which was afterwards elected unanimously: President, H. T. Edgar, of Fort Worth; first vice-president, W. B. Tuttle, San Antonio; second vice-president, J. P. Crerar, Denison; third vice-president, J. D. Oliger, Cleburne; secretary, R. B. Stichter, Dallas; treasurer, A. E. Judge, Tyler. Executive committee—H. T. Edgar, H. S. Cooper, W. B. Tuttle, J. D. Oliger, H. M. Moore, J. P. Crerar, R. B. Stichter, M. M. Phinney and J. F. Strickland. Finance committee—W. B. Head, C. H. Dunbar and E. T. Moore. Advisory committee—J. E. Farnsworth, W. J. Jones, A. A. Hauser, W. H. Chapman, Arthur B. Foster, T. C. Brown, J. A. Myer, A. W. Guthrie, W. Broyles and Fred M. Lege.

At the invitation of H. S. Potter, it was decided to hold the next annual meeting at El Paso, Tex.

ENTERTAINMENT FEATURES AT THE TEXAS CONVENTION

The San Antonio Gas & Electric Company and the San Antonio Traction Company, as hosts, provided several features for the entertainment of the delegates and visitors to the Southwestern Gas & Electric Association Convention at San Antonio. Tuesday afternoon the convention party made a tour of the city in special cars. The trip terminated at Electric Park, where a Mexican supper was served. Thursday morning the ladies of the party were taken in automobiles to visit the famous Spanish missions, a few miles distant from San Antonio. At another time they visited interesting portions of the city in carriages. All members were supplied with free transportation while in the city.

EXHIBITS AT THE TEXAS CONVENTION

A very extensive exhibit of electrical apparatus was made at the convention by several electrical concerns. Among the concerns which made exhibits and which were represented were Westinghouse Electric & Manufacturing Company, Westinghouse Machine Company, Westinghouse Air Brake Company, Nernst Lamp Company, General Electric Company, Western Electric Company, Columbia Incandescent Lamp Company, Standard Underground Cable Company, Commercial Electrie Supply Company, Wesco Supply Company and the Electric Service Supplies Company.

The Brooklyn Rapid Transit Company has just placed in service on the Fulton Street line a new all-steel surface car. The car in its outer lines and interior arrangement closely resembles the well-known "Brooklyn type" of cross-seat eonvertible car which the B. R. T. has adopted as its standard.

IMPROVEMENTS ON STATEN ISLAND

During the summer of 1906 the Richmond Light & Railroad Company, of Staten Island, N. Y., suffered some severe traffie interruptions due to unlooked-for demands on the Livingston power station. This was caused by the extraordinary increase in pleasure traffic on the municipal ferry boats crossing New York Bay, as most of the passengers continued their journey either to the wooded parts of the island or to "Happyland," an amusement park reached by the company's lines. To make matters worse, part of the power station could not be used at all, owing to difficulties arising from the installation of new apparatus. The coming season, however, will find the company fully prepared to do justice to both its railway and lighting business.

No important change has been made in the power station building except to construct a Custodis perforated radial molded brick stack 200 ft. high and 15 ft. inside diameter. The two 500-kw Curtis turbines installed in June, 1904, are no longer operated with jet condensers, but with the C. H. Wheeler Manufacturing Company's "wet system" condensers. Each unit contains 2000 sq. ft. of surface. The air pump is of the Mullan horizontal, high-vacuum type, and the circulating pumps of the centrifugal type take their suction from a main which, in turn, draws its water from the river, and also furnishes condensing water to the other condensing plants in the station. The two turbines are spaced at about 25 ft. centers, and the exhaust connections between the turbines and condensers have side openings, permitting a cross-over connection of the exhaust main from one turbine to the other, and thus making it possible to use either turbine with either condenser

The new power generating equipment consists of two 500-hp Babcock & Wilcox boilers and one 1500-kw, 60-cycle, 2500-volt, six-phase Curtis turbine. Voltage taps are also provided so the machine can deliver current at 2300 volts. The turbine operates with a Blake jet condenser at a gage pressure of 150 lbs. The generator on the turbine has eight poles, runs at 900 r. p. m., and is provided with a rheostat suitable for mounting back of the switchboard. The auxiliary apparatus includes two steam-driven pumps furnishing 12 gals. of oil per minute at a pressure of 300 lbs. per sq. in., together with an oil tank and filter. A turbo-exciter is provided, consisting of a 35-kw, two-pole horizontal Curtis steam turbo-generator set running at 3600 r. p. m. and delivering current at a potential of 125 volts.

There is also one 500-kw General Electric quarter-phase, rotary converter running at 600 r. p. m. and compound wound to deliver current at 600 volts, together with two 275-kw, 60-cycle, oil-cooled transformers. The primaries of the latter are arranged for 2500 volts, two-phase, and the secondaries for 365 volts, six-phase; the primaries are provided with four 2½ per cent taps and the secondaries with one-third and two-third taps for starting. In addition to this apparatus the General Electric Company provided a complete switchboard.

Beside the turbo units mentioned, the Livingston station contains two 500-kw, 2500-volt Westinghouse alternators, one Walker d. c. generator and two 400-kw G. E. machines, all connected to Allis cross-compound engines.

The 1500-kw turbine will take care of the lighting load, the rest being more than sufficient to handle the railway business. The transmission voltage is 2300 to 2500 volts and the longest transmission is to Tottenville, 15 miles distant. Since the Richmond Company's station is on the

north side of Staten Island and that of the Staten Island Midland Railroad on the south shore at Grassmere, an agreement has been made between the companies to rearrange the circuits so the southern lines of one company will be fed from the southern station of the other, and vice-versa.

Vice-President and General Manager S. F. Hazelrigg, who has been directing the power house changes of the Richmond Light & Railroad Company, has also ordered twenty fifteen-bench open cars from the Stephenson Works of the J. G. Brill Company. These will be 42 ft. long over all and 7 ft. 3 ins. wide. They will be mounted on No. 22-E maximum traction trucks. There will be two G. E. 80 motors per car. The cars will be equipped with Sterling double-chain brakes and registers. This extra rolling stock will enable the company to give a three-minute service to "Happyland" from the New York ferry terminal at St. George.

THE AIR OF THE NEW YORK SUBWAY.

A paper discussing the quality of the air of the New York subway prior to 1906, hence prior to the introduction of louvres and other means of ventilation installed last year, was read by Dr. George A. Soper, of New York, before the Society of Arts in Boston, and has just become available through re-publication in the "Technology Quarterly." The paper itself is an elaborate one, but some of the main facts determined by Dr. Soper will be given.

His first test was to determine the extent to which the air was drawn through the stairways and was moved in the subway by the passage of trains. An average of 573,000 cu. ft. of air per hour moved in and out through one stairway was obtained. The circulation of air between stations was determined by the time required for an odor from a highly concentrated grade of cologne to pass from one station to another. It was found that the average rate was 3.08 miles per hour.

The subjects of temperature and humidity were then considered. Before the trains commenced running the air in the subway was cooler in summer and warmer in winter than that outside. After the opening of the subway conditions began to change, and by the summer of 1905 the subway was generally warmer than the streets. In the early part of July, 1905, the average difference was less than 5 degs. By the end of August it became 7.5 degs.; in October it was 11 degs., and by November 10-16 it was 18 degs. The highest average temperature for any week in 1905 was 88.2 in the subway and also in the streets.

The relative humidity in the subway was generally less than out of doors, and varied from less than 1 per cent in August to 16 per cent in November. There were no fogs or mists in the subway, but a faint haze was not uncommon.

Another test was to determine the amount of carbon dioxide. The average of all results was, for the subway, 4.81 volumes per 10,000 volumes of air, and for the street, 3.67. This difference was regarded as very slight, since at no time or place was the carbon dioxide large. The greatest amount discovered was 8.89 volumes per 10,000. This occurred in the tunnel between the Grand Central station and the Thirty-Third Street station on Dec. 27, 1905, at 6:02 p. m., where there was a blockade. The carbon dioxide in the subway varied according to season, place where the sample was collected and other circumstances. More carbon dioxide was found in the autumn than in the summer or winter. It seemed likely that this was explainable largely on the ground that many more passengers were carried in autumn than in summer, and that in winter there was more wind in the streets, increasing the amount of ventilation.

Bacterial tests showed that there were on the average more than twice as many bacteria in the air of the streets as in the air of the subway, except after rains, when fewer were found outside than inside. The same applied to the molds. The number of bacteria in the air of the subway varied with the amount of travel. It was not found that any harmful germs were capable of multiplying in the oil which dripped from the machinery of the cars upon the broken stone ballast and wooden ties of the roadbed.

The examination of the dust in the subway showed that over 60 per cent of it was iron. The rest was silica, oil and organic matter. The speaker explained the large proportion of iron by the wear of the brake-shoes, which he calculates at one ton every month for each mile of subway, to which should be added the wear from the rails, wheels and contact shoes.

In his conclusions Dr. Soper said: "According to usual sanitary standards, based on chemical and bacteriological analyses, the general air of the subway was always and everywhere satisfactory. The air in the cars in winter is not included in this statement. The general air, although disagreeable, is not actually harmful, except possibly for the presence of iron dust." This matter is now being investigated by the author. The high temperature of the subway, according to Dr. Soper, was its most noticeable objectionable feature, and is worse in the mornings and evenings of summer, during the hours of greatest travel and when the air outside was cooler than during the rest of the day. This heat did not indicate that the air was vitiated or stagnant, as is popularly supposed, but because a great deal of heat was produced in it and stored by the material of which the subway was built. The small excess of carbon dioxide in the subway over that in the streets showed that the air was renewed with remarkable frequency. The air was best where the subway was most open to the streets, and conversely it was least satisfactory where the subway was most enclosed. The comparatively small number of bacteria found in the air of the subway indicates that the bacteriological condition of the air was satisfactory, but no attempt was made to identify the different kinds of bacteria. The odors of the subway were objectionable chiefly because they were disagreeable, and they can probably be reduced.

A new through service to Granite City was started by the East St. Louis & Suburban Company May 15. Cars leave Third Street and Washington Avenue, St. Louis, on the hour, twenty and forty minutes after the hour for Granite City, without change. In Granite City the cars leave Nineteenth and B Streets at ten, thirty and fifty minutes past the hour. The running time is forty-five minutes. Six handsome new high-speed and up-to-date cars are used in this service, and the fare for a single trip is 20 cents. Commutation tickets are sold, making the fare 12½ cents to St. Louis and 10 cents to East St. Louis. On the same date the service to Edwardsville was improved by starting the Alton cars on the half hour. The Illinois Traction System's cars run on the hour, and the change gives an additional car each hour to Edwardsville. The regular Edwardsville car leaves on the half hour, but the trip by way of the Alton line, with a change at Mitchell, can be made in much less time than by way of Collinsville.

SOME FACTS AND PROBLEMS BEARING ON ELECTRIC TRUNK-LINE OPERATION*

BY FRANK J. SPRAGUE

It is not my intention in the present paper to investigate railroad economies, or to formulate any final conclusions in the matter of steam railway electrification, but rather briefly to analyze and make running comment upon various phases of the problem often discussed by engineers; to give some comparative facts as they have thus far developed; to describe sundry developments in electric locomotive construction; and to illustrate in some detail features specifically characteristic of the three typical initial equipments now commanding attention.

MOTOR EQUIPMENTS

In discussing the selection of any system, the first thing to investigate is the motor. In railway operation that which is to be replaced in a steam locomotive; in other words, a motor supplied by a local boiler, furnace, and coal bin: that which is proposed in its place is another motor, or group of motors, supplied through a wire by bigger boilers, furnaces and coal bins, or by energy from a water-power. The working conductor, with everything connected to it in transmission or generation, although essential, is tributary to the motor and its requirements.

It is not sufficient that the source of power can be made of any desired size, although it is an essential feature; in any case, such concentrated generating equipment must supply a number of motors. What is essential, and in the last analysis vital, is that the new motor shall have not only certain mechanical advantges, to the extent of eliminating the evils of reciprocating parts and reducing the cost of up-keep, but above all it must have capacity, measured not alone by drawbar pull or speed, but by both, and it must be of sustained character; and this capacity, to accomplish more than the steam locomotive, must be greater than that of the latter. Such capacity should naturally be attained first, by increase of the capacity of the individual motor or locomotive, and then, when this increase has reached its limit, by combining motors or locomotives under a common control by the multiple-unit system.

LIMITATION OF DESIGN

The designing of electric railway apparatus is handicapped by certain physical limitations which it is not in the power of the designer to change; for example, gage of track, size and number of drivers, length of rigid wheel-base, dead and total weights per wheel and axle, clearance of motors above the track, permissible speeds of parts, provision for accessibility and repairs, and capacity for heat radiation. Every steam locomotive, when properly designed, has capacity to slip its drivers on sanded tracks; it can maintain nearly its maximum average drawbar pull for a considerable range of speed as long as its boilers can make sufficient steam. Although at the disadvantage of having reciprocating parts, its drivers, being coupled together, cannot slip individually. In short, it is designed of a weight necessary to get the tractive effort required to pull a definite load, and then for all the capacity in the matter of speed which its fire-box and boilers can provide for. Essential defects are that its drawbar pull varies widely, depending on the position of the connecting-rod; that it does not materially increase below a certain speed, and the steaming power is limited. Hence comes the limitation of the "ruling grade." On the other hand, the electric locomotive, when likewise properly designed, provides a drawbar pull of constant character throughout the revolution of the driver; it increases to an extraordinary degree when necessary; and the capacity of the boiler supplied at the central station is ample. On all service, however, high continuous capacity of the motor is essential.

Capacity being, therefore, the keynote of the equipment, I shall discuss at some length the characteristics of conductors and motors used with direct current and with alternating current. In so far as these comments relate to single-phase, alternating-current operation, they will in some measure be based upon the only existing commercial development of this character now in the United States; that is, upon the series-wound, commutating, single-phase motor with compensated fields, operated at 25 cycles. Lowering the number of cycles to increase the capacity of the single-phase motor, as has been suggested although not yet developed in commercial practice, of course merits serious consideration, and I shall add some comments upon this proposed change.

BEHAVIOR OF CONDUCTORS

Both motors and conductors when used for direct current or for single-phase alternating current, present certain differences of such inherent character that there seems no present likelihood of material change, and this conclusion is as sound in regard to the motor differences as it is in regard to conductors. When used for single-phase alternating currents, conductors offer, by reason of self-induction, an impedance or resistance to current materially greater than they present to direct currents. This impedance, and the consequent loss of energy at any particular potential delivery, depends upon the shape and material of the conductor, upon the frequency of alternation, the density of current and the power factor. Under ordinary conditions, a round copper conductor of, say, No. 0000 size, has at 25 cycles an impedance of about 1.6. But with iron or steel conductors this impedance is increased many times, because the magnetization of the iron and the self-induction drive the current toward the skin of the conductor, so that the body of it is useless, and it might as well be a shell of very much less weight.

This effect in steel rails increases with the quality and with the cross-section of the rail. For example, according to the report of the test commission of the recent International Electrical Congress, on 50-lb. traffic rails the ratio of impedance to direct-current resistance at 25 cycles and 300 amperes is about 5.4, while on 80-lb. rail this ratio with the same current is 9.0, with the curious result that increasing the cross-section of the rail does not apparently increase its actual capacity for carrying single-phase currents. Quite the contrary, of course, is the fact in regard to direct currents, the conductivity increasing with the cross-section and quality.

These statements are made, not because of special novelty, but in emphasizing certain inherent differences in conductors in their behavior toward the two kinds of current; additional weight is lent to the statement that the differences inherent in direct-current and single-phase alternating-current motors are likewise radical, and are probably permanent in character.

TYPES OF MOTOR

Among the many types of motors proposed for railway service four are now being exploited: Polyphase alternat-

*Abstract of a paper presented at the meeting of the American Institute of Electrical Engineers, New York, May 21, 1907.

ing-current motor without commutator; single-phase alternating-current motor without commutator; single-phase alternating-current motor with commutator; and direct-current motor with commutator.

Of these, two, the direct-current and the three-phase motors, each have a continuous rate of energy input, while the single-phase motor has an intermittent and variable rate. Moreover, there is combined in the single-phase motor two distinct functions, those of a motor and a transformer, and the latter cannot be entirely eliminated. The result is a reduction in both continuous and overload capacities.

It is in this particular that the single-phase motor, despite a great amount of experimental development, has remained defective; and while not prohibitive to the extent of making it an unworkable machine, its defects are so inherent as to place it at a serious disadvantage in individual comparison with other types of motors. To attain the pre-eminence hoped for, the external advantages in current supply must be very marked. In fact, rated in the same manner and under like physical conditions, it is only about half as good as the direct-current motor. Or to put it another way, the weight of the complete single-phase electrical equipment on a car or locomotive, including transformers, motors and controlling apparatus, for continuous hard service, and with like physical limitations and ventilation, is about twice that required for direct-current apparatus. In addition to this there is, of course, a material increase in the mechanical equipment necessary to carry the electrical apparatus. The reason is simple—it is because of the heat generated on account of lower electrical efficiency, and the working the fields of the motors at a reduced magnetic flux.

When considering locomotives, the net result is that the total weight of a single-phase alternating-current locomotive, with a service capacity equal to that of a direct-current locomotive of like armature speeds and permissible temperature-rise (this temperature-rise being the ultimate limitation of a motor for continuous service) will easily be from 30 to 50 tons more.

An increase in the total weight of a train amounting to from 3 per cent to 10 per cent is perhaps not of itself of so much importance, because such a difference in net power demand can easily appear for various reasons; but a ratio of 2 to 1 in capacity for the limit of equipment possible to install within given allowable dimensions and number of units is a matter of vital importance.

If an increased weight is permissible for any given capacity, there must be some ample compensation for it. Of course, this is claimed to be the fact in the single-phase system, but another possible advantage which might prove important is the abolition of gearing and bearings, and simplification in motor and locomotive construction.

COMPARATIVE WEIGHTS OF DIRECT-CURRENT AND 25-CYCLE SINGLE-PHASE ALTERNATING-CURRENT MOTORS

While testimony is practically universal that not only is any single-phase motor, whatever the number of alternations, more or less inefficient than a direct-current motor of like weight or capacity, the differences of efficiency, excluding the losses in the gearing, are variously estimated.

Valatin and others have indicated one measure of comparison between motors of different makes, types and capacity.

Fig 1 shows a comparison between a 125-hp d. c. motor and an a. c. motor of the same weight. The comparison also includes the "weight-coefficient," which for convenience may be expressed by the following equation:

$$\text{Weight-coefficient} = \frac{\text{Nominal rated horse-power}}{\text{Revolutions} \times \text{weight in tons}}$$

This is a factor of the greatest importance, and it should be considered not only for the one-hour 75 deg.-rise load, but throughout the whole thermal curve.

Generally speaking, it will be noted from these curves that: starting at 500 revolutions for a thirty-nine-minute run, the capacity of the direct-current motor averages approximately nearly double that of the alternating-current throughout the thermal range; the speed of the alternating-current motor rises at a much more rapid rate, until on a five-hour run it is double that of the direct-current motor, despite the fact that it is only developing one-half the

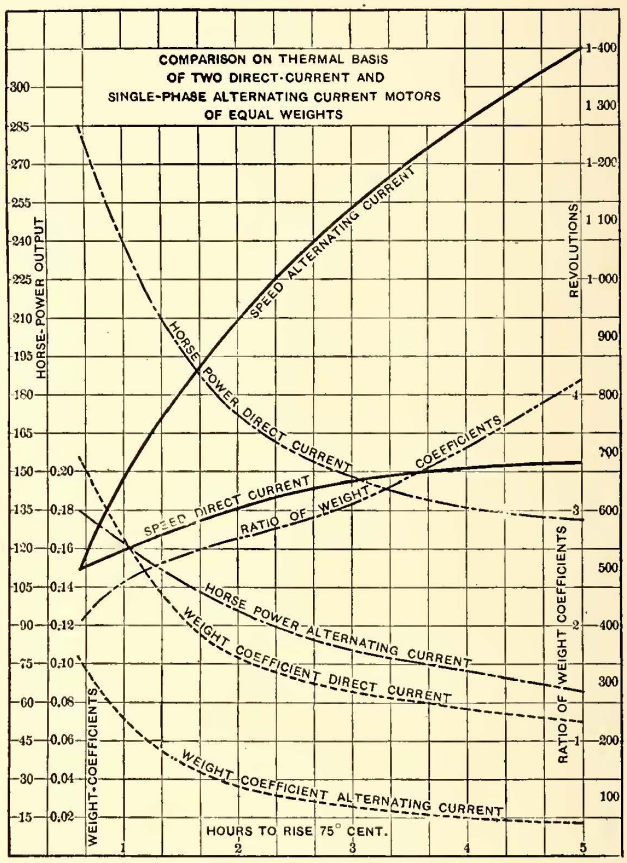


FIG. 1.—COMPARISON ON THERMAL BASIS OF TWO DIRECT-CURRENT AND SINGLE-PHASE ALTERNATING-CURRENT MOTORS OF EQUAL WEIGHTS

power; the direct-current motor has a five-hour capacity in excess of the one-hour capacity of the alternating-current motor; and the ratio of the weight-coefficients, beginning at a trifle of over 2 to 1, rises to more than 4 to 1 in favor of the direct-current motor on the longer runs. This comparison of weight-coefficients does not include the collectors, control switches, rheostats, transformers, or wiring, which in the aggregate are enough heavier for the alternating-current motor to maintain these disparities.

It is evident, therefore, that a pair of these alternating-current motors can handle only about one-half of the total load of the direct-current motors, with all the disadvantages of higher armature speed and smaller air-gaps; and considering the excess weight of the control apparatus, the net load over and above the electric equipment would be considerably less than one-half.

The general comparison is not, so far as the relative characteristics are concerned, individual to this particular

size of motor, but seems to be equally applicable through a wide range, and indifferently as to the make, or whether the alternating-current motor is of the series-compensated or the repulsion type. Furthermore, these differences are seemingly so inherent that there is little chance for improvement at 15 cycles.

DIFFERENCE BETWEEN DIRECT-CURRENT AND SINGLE-PHASE ALTERNATING-CURRENT MOTORS

The inherent differences between single-phase and direct-current motors may be briefly summed up as follows:

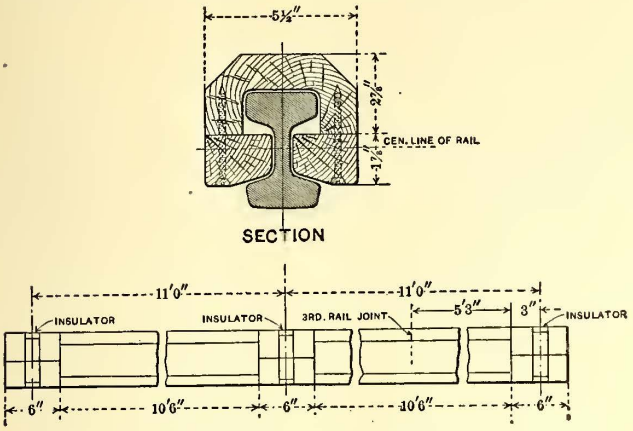


FIG. 2.—NEW YORK CENTRAL THIRD RAIL, WITH WOOD COVERING

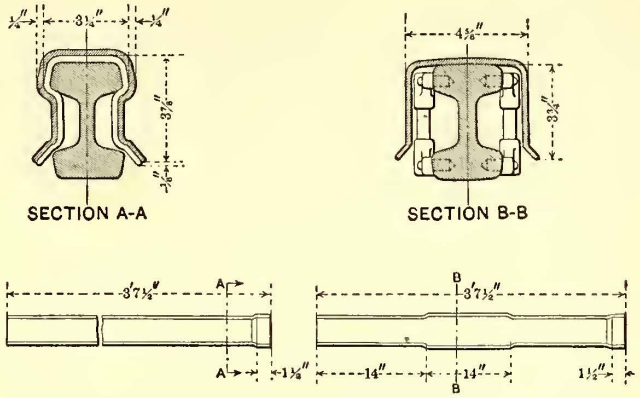


FIG. 3.—NEW YORK CENTRAL THIRD RAIL, WITH FIBER COVERING

1. The input of current in one is continuous; in the other intermittent.

2. One has a single frame, the electrical and mechanical parts being integral; the other has a laminated frame contained within an independent casing. Hence there is not equal rigidity or equal use of metal.

3. One has exposed and hence freely ventilated field-coils; the other has field-coils imbedded in the field magnets.

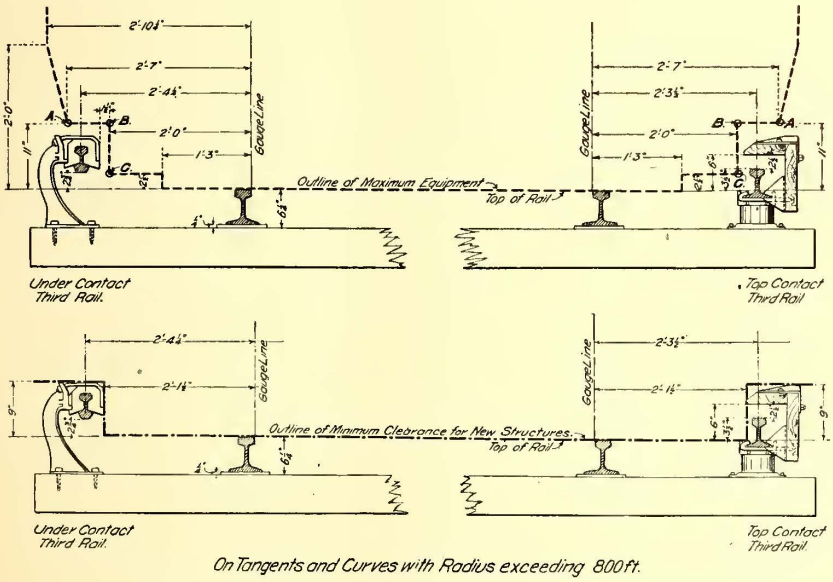
4. One has a large polar clearance, and consequently ample bearing wear; the other has an armature clearance of about only one-third as much, and hence limited bearing wear.

5. One is operated with a high magnetic flux, and consequently high torque for given armature-conductor current; the other has a weak field, and consequent lower armature torque.

6. One has a moderate sized armature and commutator, and runs at a moderate speed; the other, with equal capacity, has a much larger diameter of armature and commutator, and runs at a much higher speed.

7. One permits of a low gear-reduction, and consequently a large gear-pitch; the other requires a higher gear-reduction, and a weaker gear-pitch.

8. The windings of one are subject to electrical strains of one character; in those of the other the strains are of rapidly variable and alternating character.



FIGS. 4 AND 5.—CLEARANCE LINES FOR UNDER AND OVERRUNNING THIRD RAIL

9. The mean torque of one is the corresponding maximum; the mean torque of the other is only about two-thirds of the maximum.

10. The torque of one is of continuous character; that of the other is variable and pulsating, and changes from nothing to the maximum fifty times a second.

11. One has two or four main poles only, two paths only in the armature, and two fixed sets of brushes; the other has eight to fourteen poles, as many paths in the armature, leading to unbalancing, and as many movable sets of commutator brushes.

12. One can maintain a high torque for a considerable time while standing still; the other is apt to burn out the coils which are short-circuited under the brushes.

13. In one, all armature-coil connections are made directly to the commutator; in the other, on the larger sizes resistances are introduced btween the coils and every bar of the commutator, some of which are always present.

14. In one the sustained capacity for a given weight is within the reasonable requirements of construction; in the other it is only about half as much.

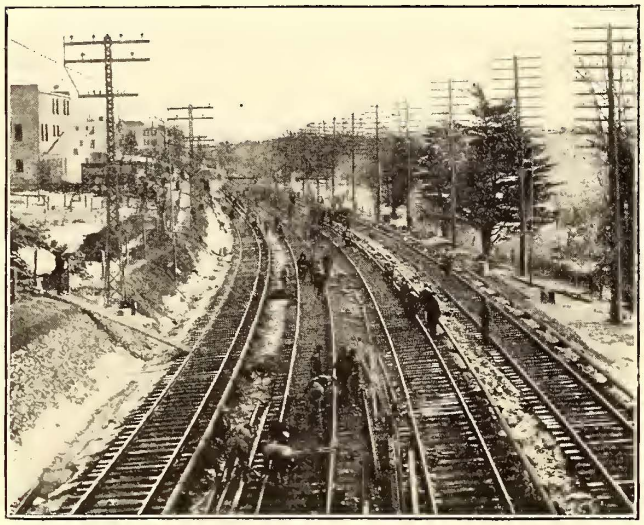
15. Finally, the gearless type, with armature and field varying relatively to each other, is available for one, but this construction is denied to the other.

Consideration, then, of the characteristics peculiar to each class of motor indicate, not that the single-phase motor cannot be used, but that if adopted the weight or number and the cost of locomotives or motors required to do the work must be much greater; that the depreciation of that which is in motion will be much higher; and that there will always be an excess weight of fixed amount per unit

which must be carried irrespective of the trailing or effective loads. We must, therefore, in many cases be led to the selection of the direct-current motor, that motor which has the higher weight-capacity, the greater endurance, and the lower cost per unit of power.

COMPARISON OF DIRECT CURRENT AND ALTERNATING-CURRENT BRAKING

On the general subject of braking it should be pointed out that with direct or continuous-current motors there is always a residual magnetism in the fields because of their construction, and the fact that the exciting current never changes direction. Such machines, therefore, can always promptly build up automatically when properly closed upon themselves and the reverser is set in the proper direction.



FIGS. 6 AND 7.—TRACK AT WOODLAWN AFTER ACCIDENT, SHOWING EFFECT ON THIRD RAIL

A similarly effective method of braking has been claimed for motors operated by single-phase alternating currents, but it would seem that in this case there is not the same degree of reliability. In such motors the field is laminated to the last degree to cut down heat-losses and to increase the capacity; it will hold but little residual magnetism under any circumstances, and furthermore the field is excited by a rapidly varying alternating current. It is, therefore, possible that at times the field will be nearly inert, and comparatively slow, with its low-turn winding, in building up, or possibly the field may be entirely inert, and may refuse to build up at all. There seems, therefore, no certainty whatever that a single-phase alternating-current motor, disconnected from the line, and without any other exciting source, will, when closed upon itself, always build up into a braking dynamo.

Aside from the ordinary objection of having such a possible failure, the consequence might be serious should it be necessary suddenly to call upon the machines to brake; as, for example, when getting under way, or when slowly ascending a grade there should be a failure of current and the train begin to back down before the air brakes were applied, or in case for any reason they should not be promptly available.

GENERAL COMPARISON OF WORKING CONDUCTORS

All working conductors are in many ways objectionable, but since they are a necessary connecting link between the source of supply and the motors, some comparisons may be made of the two types, the under-contact, protected type of third-rail and the overhead trolley, as affected by construction and operation.

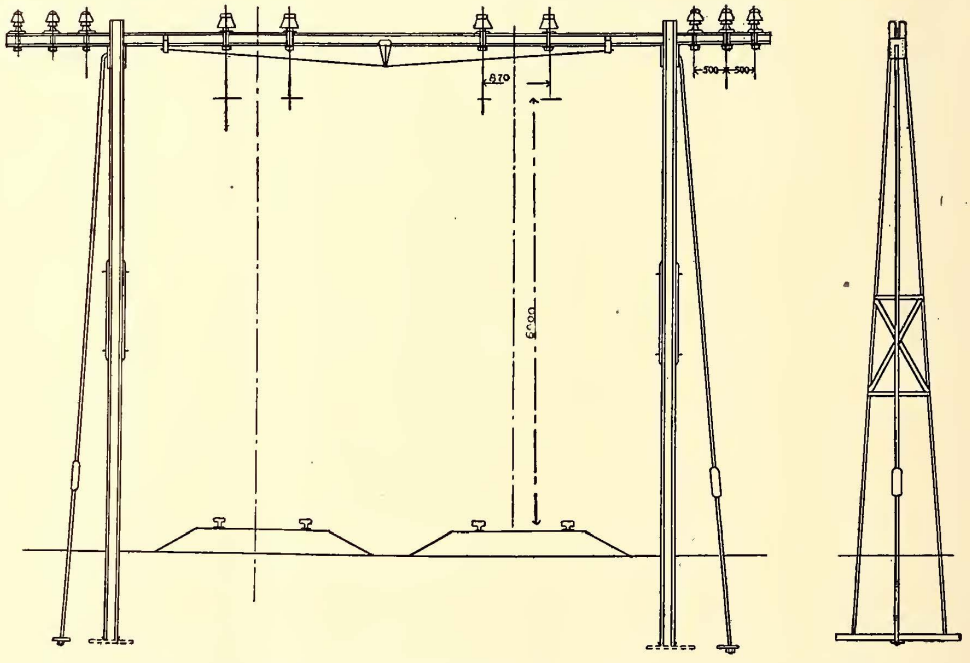


FIG. 8.—THREE-PHASE LINE CONSTRUCTION ON THE PONTEDECIMO-BUSALLA LINE, ITALY

The third rail is an inert structure, it can be aligned

accurately with the track, is not under strain, and its expansion can be readily taken care of. The overhead trolley is necessarily a system under strain, and where permanency is desired and high potentials are used it must be carried by one or more catenary cables, which on roads of high curvature makes the construction more difficult. Its alignment in the latter case does not correspond with the line of track, and as ordinarily constructed it is subject to extreme variations of tension on account of weather changes.

The third rail offers some hindrance to the ordinary maintenance of track; but overhead construction is inelastic, and the laying of additional tracks, or changes in grades or alignment require radical and expensive alterations or additions in permanent overhead structures.

Derailments will crush one form of conductor to the ground, forming a short-circuit which will cut off the section; but they may also knock down the supporting structures of the other, and, where there is a plurality of tracks, put them all out of service.

In wrecking, the third rail offers some obstruction to the throwing of the equipment to one side; but, on the other hand, overhead conductors may interfere with the operation of the crane booms of the wrecking car.

Where there are two or more tracks, snow cannot be piled up between them if the third rails are located there; but on the other hand overhead conductors are a source of danger to trainmen, to snow-shed and tunnel repairers, and in the open are subject to troubles of sleet formation.

The third rail will oftentimes be covered with snow, but is unaffected by sleet. Very thorough tests made in connection with the New York Central work show satisfactory operation, not only in sleet storms, but with the rail buried in snow. Additional depth should not add much difficulty. With regard to frogs and switches, there are no problems which cannot be solved with this type of third rail, with an occasional overhead section, and any required amount of power can be collected at operative speeds.

On Western roads, where a rotary snow-plow is used, overhead conductors and the supporting insulators, especially in yards, will be subject to a heavy bombardment of snow, ice and refuse, with possible resultant breakage, and the under sides of the umbrellas of the insulators will be often filled up with wet snow.

As to danger to passengers or employees, this is largely overcome where the under-contact third rail is properly protected, and is designed with due regard to equipment clearances. With an overhead high-tension trolley, there is, on trunk railways, where there are overhead street or highway bridges, tunnels and snow-sheds, great possibilities of danger because of rearing equipment in case of derailments or collision, and the physical necesssity of often bringing the trolley within a short distance of the cars.

Then there are corrosion and soot deposits when steam and electric operation are maintained over the same track. Where the steel supporting bridges also carry signals, as is proposed in some cases, there is increased danger to men engaged in cleaning, painting, or repairing overhead structures, and taking care of signals; and when spanning two or more tracks there is a possible interception of the train operators view of signals because of dips in the railroad grades bringing overhead bridges in front of the semaphores, which likewise may be made less distinctive if they have truss members for a background.

In the matter of inspection, that of the third rail can probably be carried on by the regular section hands, and ordinary repairs made without interfering with traffic. Repairs of an overhead system on a main trunk line presents some special difficulties. It will often require judgment and experience to determine just where trouble may exist, and in any case that particular section of the line must be absolutely cut out and made dead. If the repairs be other than at a rigid cross-suspension, it would seem that they would have to be made from the top of a structure, running on, and for the time being occupying the rails and propelled by its own power. The old practice common to street overhead trolleys is, of course, unavailable; there a construction wagon can drive on to the track and off again at will, and the line even while alive can be readily repaired, but a practice possible with 600 volts would probably be fatal when attempted with the very high potentials now obtaining in single-phase operation.

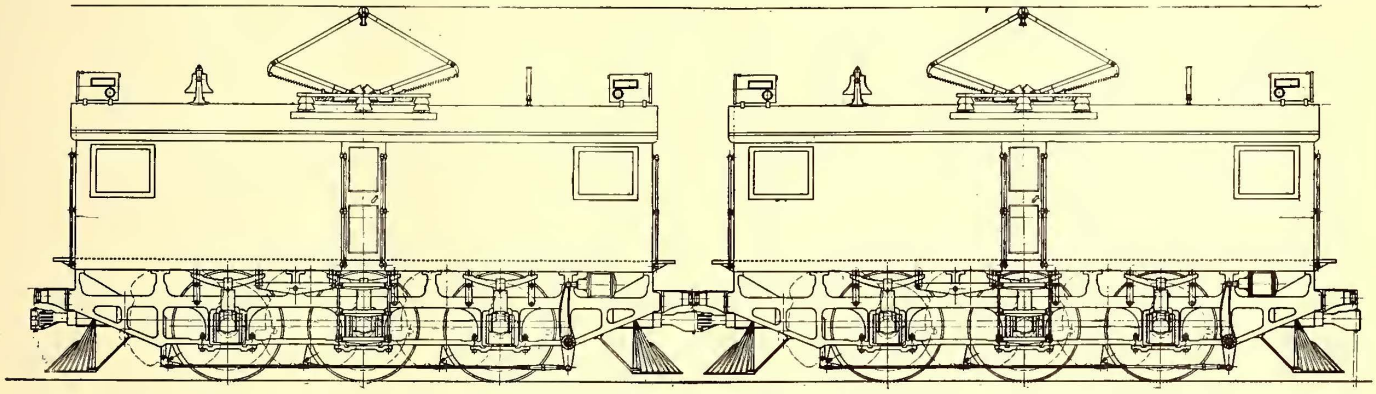


FIG. 9.—140-TON DOUBLE UNIT A. C. LOCOMOTIVE

In this latter system it seems vital in the interests of general safety that every crossing bridge, and every supporting structure should be mechanically and permanently connected with the return circuit of the rails, to avoid the possibility of such structures being in partial or complete contact with the overhead conductors and not absolutely grounded, and at all crossings and highways both the catenaries and the trolley wire should be thoroughly shielded from either accidental or wilful interference.

The time-honored tickler in universal use on steam railways to warn freight brakemen of the proximity of highway crossings, bridges and tunnels seems unavailable with an overhead system, because if it did not catch in the pantograph collector it would be an ever present menace not only in wet but also in dry weather, because of the possibility of it coming in contact with the overhead line.

Where single-phase alternating-currents are used, the magnetic and static inductive effects on telephone and tele-

graph circuits cannot be ignored, nor the danger of interference with signal systems disregarded.

The attitude of city authorities may in time raise effective obstacles to the use of overhead wires except where all crossings pass beneath the line of the road, and will, I think, ultimately require new third rail construction to be fully protected—even although on a private right of way.

The degree of success of the alternating-current development will depend primarily on the development of capacity and all-round operative features in single-phase locomotive and car equipments. The 25-cycle motor (hitherto the only frequency actually installed) whether judged by individual comparison or specific equipments, or the general testimony of electrical engineers of manufacturing companies, has proved inadequate when compared with its rival. To correct this defect it has been proposed to adopt 15 cycles as a standard of operation. It is difficult to establish exact comparison of equipment weights unless one personally conducts tests, or has complete technical reports which have been made on identical bases; but the following table is one comparison of the approximate weights of complete equipments of two recent typical types of like nominal capacity.

Weight of Four-Motor Alternating-Current Equipments.	A	B
Motor		
Cycles	15	25
Nominal capacity per motor	75 hp	75 hp
Individual weights:	Lbs.	Lbs.
Armature	1333	1146
Field	2414	2646
Gear, case, and pinion	398	407
Total motor	4145	4199
Car equipment:	Lbs.	Lbs.
Four motors	16,580	16,796
Transformer and rheostat	6750	4325
Controller and adjuncts	1000	1000
Trolley	500	500
Wiring, switches, etc. (?)	1950	1239
	26,780	24,060
Excess A over B	2720	

These totals are not final in either case, for the individual motor weights of each type will very likely be increased from 300 to 450 lbs. in regular manufacture. But allowing for such changes and corrections as seem reasonable, not only is no actual saving in A over B probable, but the excess of nearly a ton and a half against the 15-cycle equipment will remain in some makes. On the other hand, the manufacturers of B hope to show about 10 per cent total saving in the weight of a 15-cycle equipment, but this hope is based upon theoretical estimates, not actual performance.

On other sizes it is probable that these relative differences will vary somewhat, but a comparison of the weight coefficients of large 15-cycle motors and direct-current motors of like weight show a ratio of two to one in favor of the direct-current machine.

MOTOR AND LOCOMOTIVE CONSTRUCTIONS

Motors are of the geared and gearless types, may be entirely separate units or partly integral with the truck frame, and may be wholly or partly spring-supported. Locomotive designs, influenced in part by the type of motor adopted, show a great variety of constructions, and may be very generally classed as rigid frame with all weight on the driving axles and without leading trucks; rigid frame with either single axle or bogie leading trucks at each end; and bogie-

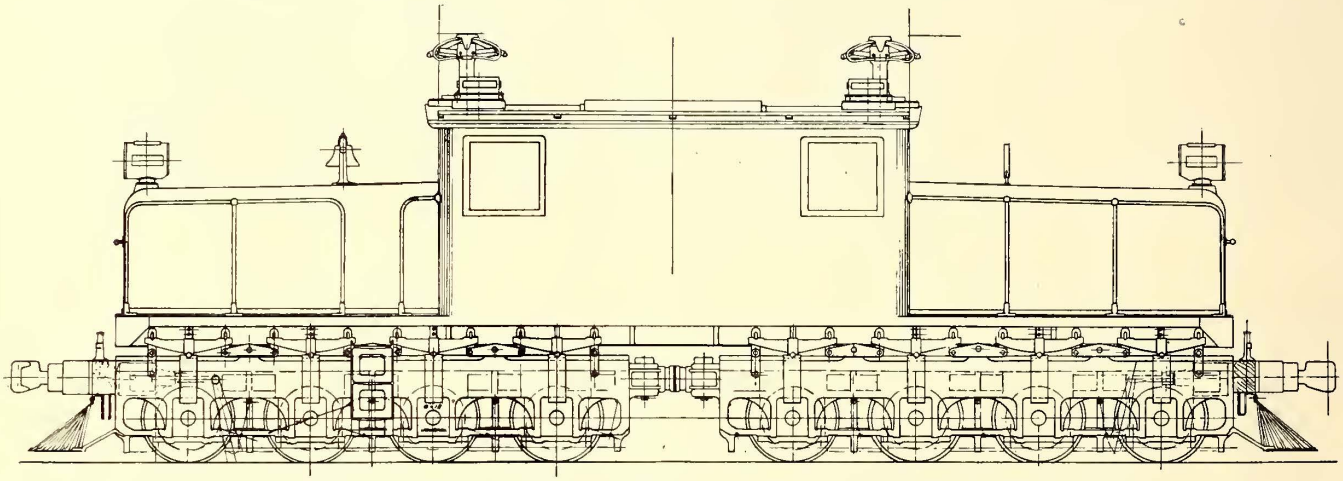


FIG. 10.—A 125-TON ELECTRIC LOCOMOTIVE EQUIPPED WITH EIGHT GEZ 28 MOTORS

truck locomotives, the bogies being pivoted under the cab and sometimes linked together.

Each half of the double-unit locomotive shown in Fig. 9, which is a study by one of the large companies, has three axles, to each of which is geared an alternating-current motor, after the usual fashion. Each section has a rigid wheel-base of about 12.5 ft., and weighs from 65 to 70 tons, making a total weight of from 130 to 140 tons for a unit having a rated capacity of about 1500 hp with natural ventilation.

An analysis of the action of a locomotive demonstrates beyond question that this general type of machine, that is, one having a rigid frame and no guiding trucks, is limited to moderate speeds, and would be unsafe if operated at high speed on a road with much curvature and special work. Notwithstanding the fact that it has been strenuously advocated, even recently, I think this particular type will not find favor among the railroad men, and it is already practically abandoned in the proposals of the manufacturers in favor of a bogie-truck type, or an articulated type composed of two rigid frames with single axle leading trucks at each end of the complete unit. It is also proposed to carry the geared motors, centered on a spring-connected quill, directly over the main driving axles, and to support the entire motor by springs from the locomotive frame.

Particular interest naturally centers upon the distinctive types of locomotives installed on four important railway sys-

tems, the Valtellina and the Simplon Tunnel in Switzerland, the New York Central, and the New York & New Haven, which well illustrate three of the principal methods of construction developed to meet the demands of different electrical systems.

As illustrating a high order of electrical and mechanical engineering, the work of the Ganz Company merits special mention, for it is undoubtedly true that the present status of the polyphase system, which stands on a favored plane with many Italian engineers, is owing almost entirely to the efforts of this company.

The general characteristics of the New York Central type of locomotive, the Batchelor machine as developed by the General Electric Company, are pretty generally understood.

It is gratifying to note that although the electric service was inaugurated only as recently as the 22d of last December, has been developed under extraordinarily difficult circumstances, and has had to face much adverse criticism because of a serious accident due to extraneous causes, already 305 train movements, representing 86 per cent of the present total of the New York Central and Harlem trains, both locomotive-drawn and multiple-unit, are operated electrically. The aggregate delay has been less than with the old steam service, a fact particularly noticeable in times of snow storms. The main station output for twenty-four hours is but about 65,000 kw-hours, and when the batteries are in service but one steam unit is required at time of maximum load.

The New Haven alternating current-direct current locomotive, built by the Westinghouse Electric & Manufacturing Company, is of the two-axle free bogie type. The rigid wheel-base is 8 ft., the total wheel-base 22 ft., the length over all 37 ft. The weight of the locomotive is 93 tons, having been raised considerably over early expectations. It has an hour rating, on the usual standard, of 1000 hp when operated at 25 cycles, but is fitted with blowers to raise the average capacity. It is intended to handle a 200-ton trailing load at schedule, with some margin of performance.

Although built primarily for operating directly from 11,000-volt, single-phase alternating current, these locomotives must operate also from the 650-volt direct current while on the Harlem tracks. They, therefore, have additional control provision, and besides the double-pantograph collectors, have contact shoes, those on the side being arranged for lifting by air pressure on account of limited clearances on a part of the run.

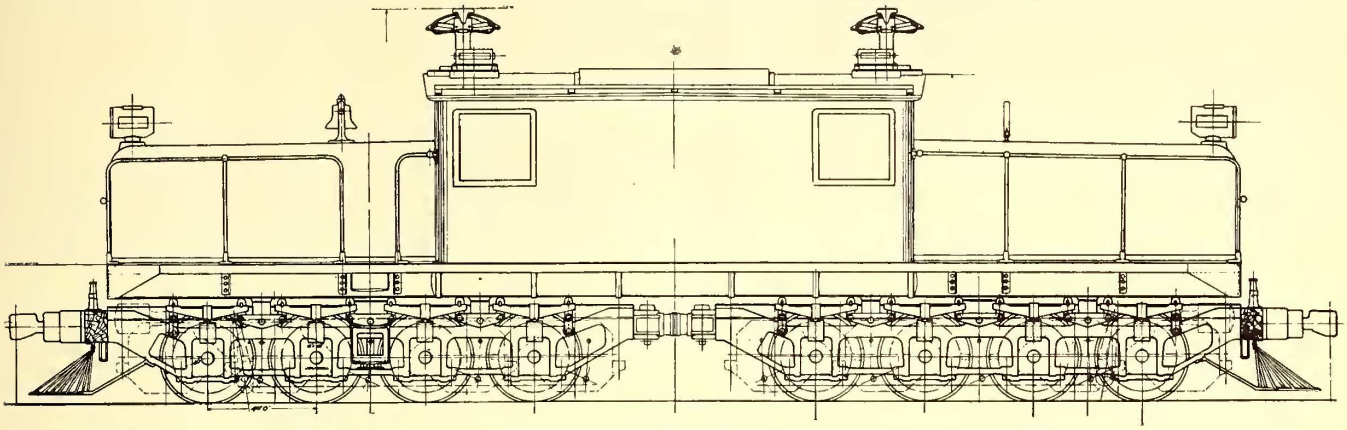


FIG. 11.—A 96-TON LOCOMOTIVE EQUIPPED WITH EIGHT GEZ 30 MOTORS

The motor armatures are wound for operation at a normal maximum of about 250 volts, and hence are connected in permanent series of two, while the field circuits are arranged for each pair of motors in a separate group, and for series-parallel grouping independently of the armature circuits, to provide for the varying flux in alternating-current and direct-current operation. Of course, the motor groups on the two trucks can be connected for series-parallel operation with direct-current supply, but with the disadvantage of using about double the amount of current at slow speeds that is required when four motors, each wound for the full potential, are in series.

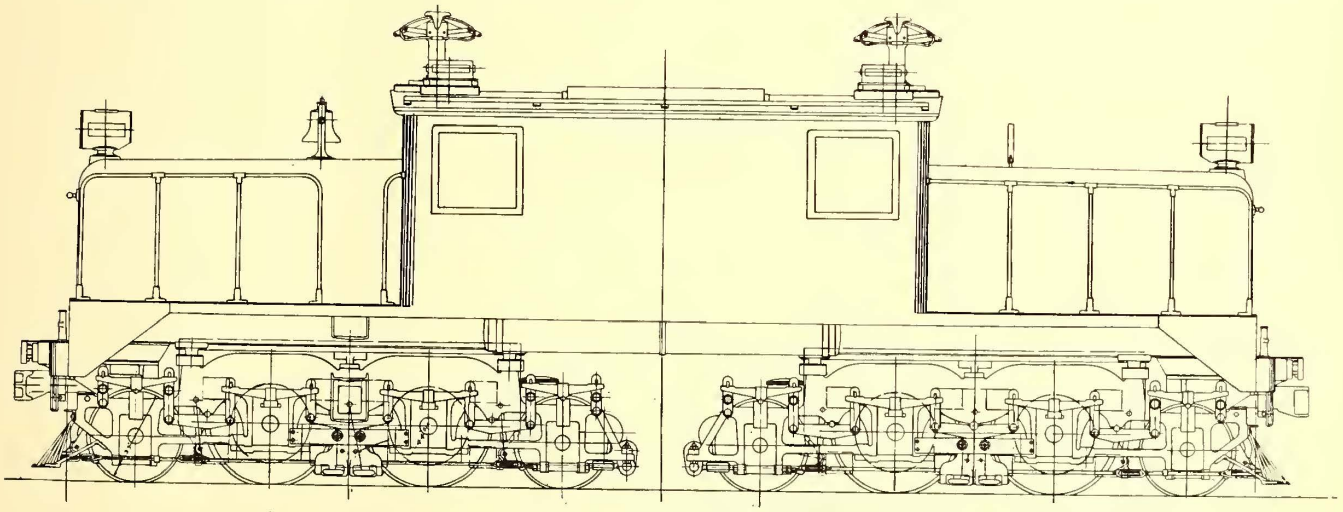


FIG. 12.—110-TON ELECTRIC LOCOMOTIVE EQUIPPED WITH FOUR GE 84 MOTORS

The first of these machines, pulling a short train, made

entry into the Grand Central Station on May 11, 1907, and in a short time the operation of equipment should be under service test.

Some question has been raised as to whether trucks with drivers of so large a diameter, 62 ins., on which are concentrated 15 tons of motors in a limited wheel-base, will track properly under all conditions of rail. Experience, however, is the final criterion.

Sometime since I made a very careful investigation of the possibilities of direct-current gearless and geared motors, the former of the bi-polar type, for the same service, a very severe one.

Both machines are of the four-axle, bogie-truck type, the trucks being linked together. The geared locomotive, Fig. 10, weighs 93 tons and the gearless, Fig. 11, 126 tons, but the weight per axle is well within the usual allowance. On each truck are four motors, connected two in series, to be operated at a maximum line potential of 1500 volts. The geared motor construction is of the usual standard, but fitted with commutating poles, while the gearless machine has modified bi-polar motors of the New York Central type.

A comparison of the efficiency curves of the two machines is interesting, these showing for each from 87 to 88 per cent on a five-hour load, and falling only to 83 per cent with 50 per cent increase, while at half this load the efficiency of the gearless machine is much higher than that of the geared. Some adequate idea of the capacity of the gearless machine may be gathered from a statement that it will maintain a drawbar pull of nearly 25,000 lbs. at a good rate of speed for several hours continuously, and with natural ventilation. These extraordinary characteristics would, for the class of service for which these machines were considered, amply warrant the additional weight because of the simplicity of the gearless machine.

A very promising type of machine, embodying many of the good features of those which had preceded it, is now under construction by the General Electric Company, for use either on direct current or with a motor-generator set supplied from an alternating-current trolley. This machine is of the four-axle free-bogie type, the drawbar pull being taken through the main frame. On each truck, and forming an integral part with it, are two bi-polar gearless motors driving the middle pair of axles, and at either end of each truck is a pair of leading wheels of similar diameter, which have a limited, spring-resisted side play. The normal wheel-base of each truck is 12 ft., the total wheel-base 32 ft., and the length over all 36 ft. This machine should be capable of an almost unmatched speed and freedom in following irregular curvatures, and with special ease of track approach.

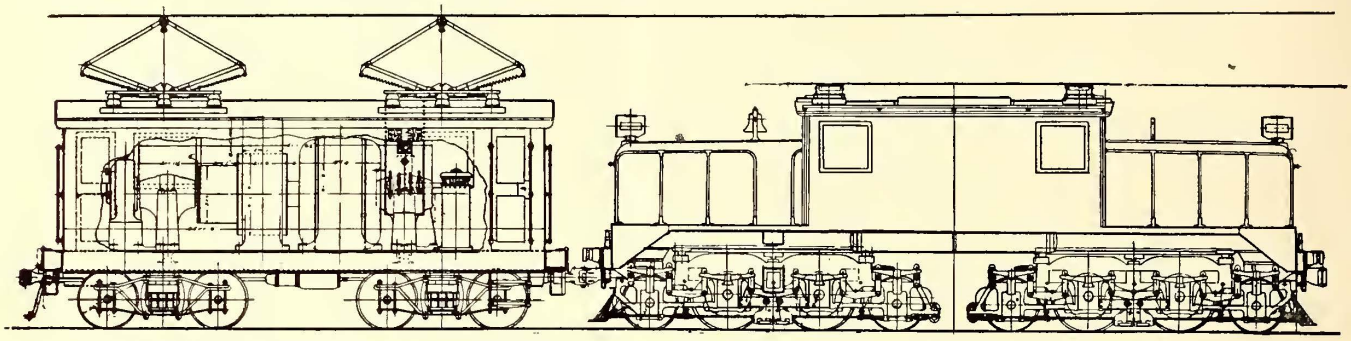


FIG. 13.—ALTERNATING-CURRENT LOCOMOTIVE MOTOR-GENERATOR COMBINATION, WITH INDEPENDENT TENDER

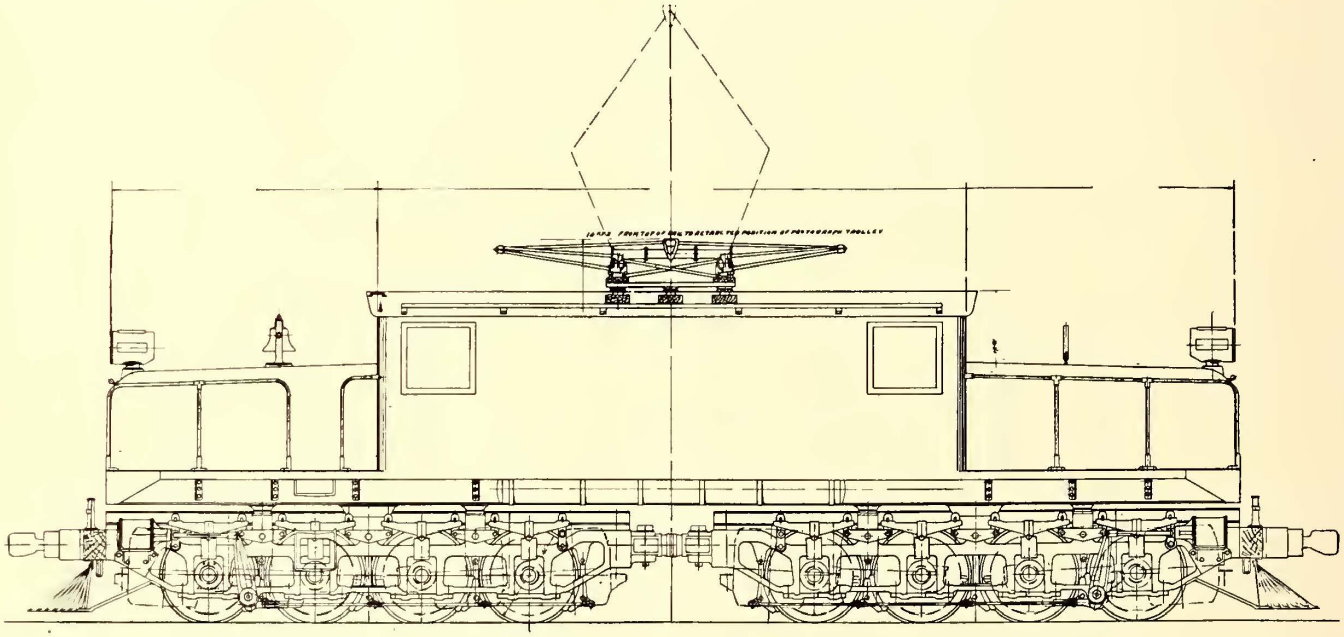


FIG. 14.—160-TON LOCOMOTIVE WITH MOTOR-GENERATOR SET CARRIED IN THE CAB

USE OF STEP-UP AND STEP-DOWN TRANSFORMERS

Where the distance is not great, as on the present proposed limited operation of the New Haven road, both step-up and step-down transformers have been omitted, and the 11,000-volt trolley line is supplied from the station switchboard. This means direct connection between an extended

system of overhead working conductors and generators operated at high potential, with one side grounded, with, of course, whatever protection lightning arresters can provide. Such are the vagaries of lightning, and the uncertainty of the very best arresters, that I cannot but feel that this practice, which subjects costly generating equipments to direct lightning attack and special grounding stress, will not obtain to any great extent, for the possibility of laying up a complete unit of great capacity, steam engine as well as generator, because of a lightning flash or accidental ground, is too great a penalty to pay for eliminating transformers, and is a special handicap upon the possibilities of transmission.

It is certain that standardization should be directed to the construction of generators. Any material increase of potential above that now common means reduced capacity and efficiency, increased danger of breakdown, and greatly increases individual cost, to say nothing of the capitalized risk of failure. Quite aside from the question of cost and efficiency, air cooling, the only possible method for generators, manifestly cannot be safely carried above that which is tolerable for static transformers, which, when wound for the higher potentials, are invariably oil-cooled. The transformer, per se, is the simplest and most flexible device for changing alternating-current volume and pressure, and its moderate cost and high efficiency, taken in connection with the like elements of moderately high potential generators, will leave the total cost and efficiency of generating equipment roughly the same. There will be the added very great practical advantage that the generators not only work at lower potentials, but on closed metallic circuits, are removed from direct contact with working conductors and earth, and have interposed between them and the line at least one set of static transformers, which practical experience has shown to be one of the best generator safeguards against lightning, and which, if broken down, do not involve large and costly units, nor wholesale sacrifice of capacity.

FIELD OF THE SINGLE-PHASE ALTERNATING-CURRENT MOTOR

No one can deny that if the single-phase motor be developed to a high state of weight-efficiency, unhandicapped by excessive weight of the collateral apparatus necessary on a car to utilize it, and if the capacity of conductors, especially steel conductors, for alternating currents can by any discovery be raised, the elimination of moving machinery in, and the simplification of sub-stations would open up a very extended and important field for the use of this type of apparatus.

It seems to me that the present principal hope of usefulness of the single-phase system is on roads of considerable extent which operate an irregular and sparse traffic, and where only a moderately expensive, or what may be called a second-class overhead construction which will keep down the ratio of line investment to that of the balance of equipment, is tolerable. As one departs from this condition, adopts more permanent construction, and faces the problems of denser traffics and higher capacities, and advantages of the single-phase system will disappear, and a superiority of the direct-current equipment, with such improvements as are in sight, become manifest. But whatever may be the future of single-phase operation under the conditions stated, any present claim for it as the preferable equipment for congested service demanding high schedules and great capacity is not worth a moment's thought, for in this field, at least, it cannot touch the direct-current system.

I see no practical necessity to formulate conclusions by averaging conditions, and I cannot conceive the responsible officers of any trunk line road being guided in their determination of what seems best for their own requirements by consideration of what some road thousands of miles removed in location and enormously removed in operating conditions may do.

In any case, the most satisfactory system will be that one which will permit of continuous all-round operation under such conditions as will utilize to the utmost all the beneficial features of electric application. If any one system can be demonstrated to meet these conditions better than all others, then that system will become pre-eminent, no matter what standards may have been adopted or recommended, and no matter what our preconceived opinions may be.

DISCUSSION

W. J. Wilgus, vice-president of the New York Central Railroad, said that he agreed with so many points made by Mr. Sprague that he would hasten to point out rather those with which he disagreed. One of these was the reference to the relations between the men who are now conducting trunk line work and the electrical engineers who wish to electrify steam railroad systems. It was true that some steam railroad officials had looked down upon electrical apparatus as something not capable of handling the heavier traction problems, but recent developments had dispelled this idea, and now they were looking with keen interest into the subject with a full appreciation of the magnitude and dignity of the problem. There had been, however, too much befogging of their minds through electrical controversies about things they do not understand. He suggested that in general discussions the subject should be treated with greater broadness and that steam railroad men should be attracted to present papers on electrification from their point of view to secure an interchange of ideas. Evolution will govern rather than revolution. The railroads must move forward in those cases where the steam locomotive has proven its inability to cope with very heavy service, or where steam operation is undesirable. The New York Central electrification is an example of the success attending where electricity was applied to solve special problems, and the more recent work on the 50-mile stretch between Utica and Syracuse was another application for a somewhat different condition. In the West probably a number of places could be electrified where steam locomotives could not handle the traffic on pusher grades. He wanted it understood that the present New York Central electrical zone was not permanently fixed at Croton, but that at some future time when developments justified it would be extended to Albany, 142 miles from New York. As to the merits of different systems, he would warn the different electrical engineers not to quarrel so much as to frighten the steam men, but rather to point out that every problem had its special features which would be instrumental in the selection of this or that method. For example, direct-current operation at low potential had to be adopted in the New York zone irrespective of other considerations, because the city authorities would not permit the use of high-tension trolleys and the tunnel clearances were also insufficient for overhead construction. As another example, he cited the case of a double track tunnel where the competing companies were offered the widest latitude in the choice of systems. A comparison of the bids showed that for that particular installation direct current was the cheapest in first and annual cost; in fact, 20 to 25 per cent less than its nearest a. c. competitor. Much has been said

also about the cost of overhead single-phase construction, but only a year ago one authority had estimated it at $16,000 per mile, but the actual cost had been $50,000. Even if the a. c. construction is the cheaper it must be borne in mind that the current losses are greater and this extra current is a constant charge. It can be set off against the higher cost of some other form of construction more economical in current. He heartily agreed with Mr. Sprague about multiple-unit systems, for the New York Central had already reaped its reward by the elimination of train delays at the Grand Central Depot formerly caused by the constant shifting to and fro of steam locomotives. Already the station capacity had been increased 33 per cent, and the more rapid acceleration has resulted in the ability to maintain the schedule with a reduced rate of speed between stations. Therefore, in making a selection of a system, relative aceleration should be compared, not only for suburban service, but also for through service. In conclusion, Mr. Wilgus pointed out that the cost of electrification was not the only thing to be considered by a steam railroad wishing to change its motive power, but that many other factors of cost came in train. One of these was the necessity to change the signal system and the expense of this one item was so great that it would surely hinder many possible electrifications unless some radical reductions are made possible in the cost of signal systems for electric lines.

Mr. Stillwell said that he took issue with the author in regard to certain of his opinions. For interurban service the speaker has used, and may continue to use for some time to come, direct-current equipment. For trunk line operation he believes that the 15-cycle single-phase system possesses controlling advantages as compared with any direct-current system that has been suggested or is liable to be developed into an operating system. He regretted that further information was not given in regard to 1200-volt motors. He thought the comparison shown in Mr. Sprague's diagram of a d. c. motor and 25-cycle a. c. motor was defective for several reasons. (1) It compares two motors of equal weight. Had the comparison brought together two motors of equal type the ratio of weights would have been far less than is the ratio of output when equal weights are considered. (2) The weight of the d. c. motor (23 lbs. per hp on the one-hour rating) is very light and indicates that in respect to the relation of weight to output the motor is superior to anything in general use. The latest 200-hp motors offered within the last sixty days to the Interborough Rapid Transit Company by the leading manufacturers of the country weighed, respectively, 28 and 30 lbs. per horse-power on the one-hour rating. On the other hand, the a. c. motor shown in the diagram has a much higher relation of weight to output than other single-phase motors of comparable output in the market. (3) The comparison is for a 25-cycle motor and not for a 15-cycle motor, as recommended by the speaker and Mr. Putnam. The speaker had obtained last week from the engineers of one of the leading manufacturing companies comparative figures relating to 15-cycle single-phase a. c. motors of 200 hp at one-hour rating and 600-volt d. c. motors of the same output. These motors are practically identical in speed when delivering 200 hp. The data in which he was particularly interested were the maximum vertical dimensions and the weights of these motors. The maximum vertical dimensions of the a. c. motor is 36½ ins., that of the d. c. motor 1⅝ ins. less. The weight of the a. c. motor is 6280 lbs.; that of the d. c. motor 6000 lbs.; both of these weights are exclusive of gear, gear case and pinion. The a. c. motor requires a wheel-base 1 ft. longer than is necessary with the d. c. motor. The ratings in the case of both motors are based upon the same rise of temperature without forced ventilation. If in Mr. Sprague's diagram the 15-cycle a. c. motor and the 1200-volt d. c. motor had been compared, the speaker believed there would have been little, if any, difference in dimensions or weight. In some recent estimates made on the cost of the 1200-volt d. c. and the a. c. systems to average trunk line railway conditions operating both freight and passenger service, the first cost of the electrical equipment of the d. c. system exceeded that of the a. c. system by about 50 per cent.

W. B. Potter, chief engineer of the railway department of the General Electric Company, said that he wanted to make clear that neither he nor any of the engineers associated with him had any leaning toward one system as a cure-all. As engineers, they looked at each problem as something to be considered on its own merits. As an example of recent progress in motor manufacture, he mentioned the use of commutating pole motors, and expressed his confidence by stating that he believed this type to be the principal direct-current motor henceforth used for railway work. Several thousand were now being made by his company and other thousands had been ordered. The matter of commutation had limited single-phase development, but he was pleased to say that a single-phase motor could now be produced in which the commutation is as good, if not better, than the ordinary d. c. motor, and in which the armature speed will not be more than 15 per cent higher with a larger air-gap than ordinary. Other advances would also make it more comparable with the present d. c. motor, and this without introducing extraneous resistance, yet would increase the efficiency several per cent and the rating 25 per cent on the hour basis. As to higher d. c. voltage, he wished to suggest, for the sake of simplicity, that 1200 volts should be the next step and not potentials between 600 and 1200. Taking up again the question of "rival" systems, it seemed to him that a sufficient explanation of the standpoint of his company lay in the fact that it was now building 600 and 1200-volt d. c. motors, 6000-volt three-phase motors and 25-cycle single-phase motors.

C. F. Scott, consulting engineer of the Westinghouse Electric & Manufacturing Company, agreed with Mr. Potter in the statement of so-called rival systems. Taking up the paper of the evening, he said he was interested in the author's method of arriving at conclusions so at variance with those of other engineers. To be sure, if Mr. Sprague's assumptions were taken for granted, his conclusions are logical enough, but he did not agree that those assumptions were correct. He showed, for instance, that the alternating-current motor has at light loads a much higher speed than the d. c. motor under the conditions he had taken. There is an apparent conclusion, therefore, that the a. c. motor is lacking in many of the excellent characteristics possessed by the d. c. motor, but the author had failed to call attention to another point, namely, the ready adjustability of speed by means of voltage taps from the transformer. This latter advantage enables the attainment of different torques at different speeds, and thus the a. c. motor may have different acceleration characteristics under the control of the motorman. Another point was that of rail loss. Although the loss per ampere is greater with a. c., the loss per kw may be much less. It would seem that the author assumed the characteristics of the d. c. motor as ideal, and where the other motor has different char-

acteristics valuable in their way he had ignored them. Mr. Sprague had also laid very little stress upon the relative merits of the two systems between the power house and the train. The subject of braking had also been referred to by him with a reference to the supposed inferiority of a. c. motors in this connection. He thought it would be of interest, therefore, to tell the members that a paper had been prepared for the annual meeting of the Institute dealing with electric braking with single-phase motors, in which it has been found that this type lends itself admirably to braking, doing far more than has been possible with the d. c. motor or any other hitherto.

The remarks of N. W. Storer, electrical engineer of the Westinghouse Company, were devoted largely to a consideration of what Mr. Sprague had called differences between direct-current and the alternating-current single-phase motors. These are published in the abstract of the paper in this issue.

(1) "The input of current in one is continuous, in the other, intermittent;" quite true, but the draw bar pull is quite as effective in one case as in the other.

(2) The direct current motor has a solid frame like the single-phase motor. It has further two or more laminated poles bolted in and if the interpole construction is used has as many more relatively small and delicate poles. The a. c. motor as built by the Westinghouse Electric & Manufacturing Company has, in all sizes up to a diameter of 38 ins., field punchings made in a single piece and built up and keyed in the frame, making it as solid a construction as an armature on its spider. A claim for less rigidity in the single-phase motor is hardly sustained.

(3) Coils in contact with iron will dissipate heat much faster than when in the open air. This is especially true of coils in an enclosed motor. The speaker said he had repeatedly noticed motor field coils which had been removed on account of roasting out had shown the insultation in contact with the pole pieces to be in good condition, while other sides were badly roasted. In respect to ventilation of field coils the single-phase motor is superior to the direct current motor. Smaller cross section of coils also allows the heat to be radiated, better with the single-phase motors, and the fact that a large part of the loss in the motor is concentrated in the field iron will enable the motor to dissipate a much larger amount of heat for a given temperature rise than a direct-current motor.

(4) Many thousands of direct current motors are to-day in operation with a clearance of ⅛-in. to 3/16-in. between poles and armatures and in practically all cases where more than 3/16-in. clearance is used it is for electrical reasons. Further, while the smaller air gap used for single-phase motors was at first much feared, the fears have proved to be without foundation and the present clearances of from 0.1-in. to 0.15-in. have proved to be ample and fully as good as 0.15-in. to 0.25-in. on direct current motors because there is no unbalanced magnetic pull.

(5) The torque of an armature is the pull it will exert at one-foot radius. It, therefore, makes no difference in the result whether it is obtained with large flux and few armature conductors, or vice versa.

(6) The armature diameters for a. c. motors ordinarily run from 5 to 15 per cent larger than for d. c. motors of corresponding output. The armature speeds of the earlier single-phase motors were much higher than the speeds of corresponding direct-current motors. At the present time, however, the speed at the nominal rating of the motor is practically the same as that of direct current motors and the maximum operating armature speeds are within the safe limits set for direct-current motors.

(7) Gear reduction, of course, depends upon the speed and the same gear pitch is used for single-phase motors as for direct current motors of the same capacity.

(8) A number of instances have occurred where the single-phase motor has broken down in service on a direct current section of the line, but when the car reached the alternating current section of the line it has been again connected in circuit and operated satisfactorily, indicating that the electrical strains on alternating current are less severe than with direct current.

(9 and 10) In a recent discussion before the Institute, Mr. Potter called attention to certain characteristics of the torque exerted by an alternating motor, especially when it reached the slipping point of the wheels. It was stated that there was an apparent advantage in the pulsating torque because, when the motor starts to slip it does not immediately decrease its mean torque as is done in the case of the direct current motor, but slips in a series of jerks apparently regaining the hold on the rail at every pulsation.

(11) No direct current motors built in the last fifteen years, except those on the New York Central locomotives, have less than four poles. The single-phase motors built by the Westinghouse Electric & Manufacturing Company have four poles for all sizes up to and including 125 hp. The largest single-phase motor thus far built has a capacity of 500 hp. It has only twelve poles.

(12) Concerning "a high torque while standing still." Railway motors are designed to move a train rather than hold it at rest. At the same time, we know that the single-phase motor is amply protected against mistakes of motormen in leaving the current on the motor for a half minute or so with brakes set.

(13) The resistance leads in single-phase armatures are for the purpose of reducing the loss due to the transformer action in the short circuited coil to a minimum. The efficiency is higher than it would be if they were not used.

(14) This is discussed below. We shall have something to say further on.

(15) There is one type of construction to which the single-phase motor is not adapted. This is so far employed in only a single case.

More or less has been said in the paper concerning the lower efficiency of the single-phase motor and inference might be drawn that it is about 10 per cent lower than that of the corresponding direct-current motor. The following table shows the efficiencies of corresponding sizes of direct and alternating current motors at different percentages of their full load torque:

Per Cent of Full Load Torque	D. C. 90 H.P. Motor	A. C. 25 Cycle 100 H.P. Motor	D. C. 200 H.P. Motor	A. C. 15 Cycle 250 H. P. Motor
125	86.25	82	88.8	87.3
100	86.8	85	89	88
80	87	86	89.2	88.3
60	86.5	86.8	88.8	87.7
40	85	86	87	85
25	82	82.5	84	82

From this it does not appear that within the ordinary range of tractive efforts exerted by railway motors the single-phase motor is so far deficient. In fact, it comes remarkably close to that of the direct-current motor.

Concerning the comparison between the 125-hp and the so-called 240-hp motor contained in the paper, I take issue as to the fairness. , Motors should be selected on the basis of their speed time curves and in accordance with their par-

ticular characteristics, rather than upon the simple horse power basis. If the author in seeking to compare the two types of motors had taken the 25 cycle, 75-hp single-phase motor referred to later on in the paper his conclusions might have been quite different. The weight which he assigns is 4199 lbs. The weight of corresponding direct current motors is 2,500 to 4,200 lbs. Moreover, if the single-phase motor to which he refers were operated on 15 cycles instead of 25 its output would be 90 to 95 hp, which would lead to conclusions quite at variance with others in the paper. The weight of a quadruple equipment of 90-hp d. c. motors furnished by the Westinghouse Electric & Manufacturing Company would be approximately 20,000 pounds. The corresponding weight of a quadruple equipment of 90-hp, 15 cycle motors with oil insulated transformers equipped for 11,000 volts would be approximately 27,500 pounds; an increase of about 37.5 per cent. This extra weight added to a 40 ton car would amount to about 10 per cent and owing to the greater efficiency in the control of the single-phase motors, the power consumption of the car, including transformers, would in most classes of service be approximately the same as that of the direct-current motor at the trolley and would be much less at the power house. A car for passenger service can be equipped with two 200-hp, 15 cycle single-phase motors giving ample clearance on 37-in. wheels, and that these two motors will operate a car with the same power consumption per car mile as the car on runs as long as five and six miles as would be obtained with a car of the same capacity operated with an equipment of 200-hp direct-current motors. On shorter runs the relative power consumption would be less.

G. R. Henderson, consulting engineer of New York, complimented the speaker on his paper, especially for his statement that electrification is not a panacea for all railroading ills, but that when applied to individual cases intelligently and found suitable for such treatment, satisfactory results may be expected. The speaker cited the cases of certain steam railroads where the load factor was not 10 per cent as being unsuitable for electrification. He also thought the item of first cost a very important one. The cost of a steam locomotive is about $10 per horse-power, while that of power house and lines is about $100 per horse-power. Electric locomotives themselves cost double that of steam locomotives and as the average cost of coal in the United States does not exceed $1.50 to $2 a ton little may be expected from fuel economy. He was pleased to learn that multiple-unit control was not considered feasible for freight operation, and did not consider it wise to attempt to handle heavy trains on steep grades with one man. He believed that electric locomotives would decrease rapidly in number and favor and that, each in its own proper sphere, steam and electric operation would co-operate to the advancement of transportation and the increase in prosperity.

William McClellan, of Westinghouse, Church, Kerr & Company, of New York, expressed his disappointment that so little had been said in the paper about 1200-volt d. c. motors. As to 11,000-volt single-phase operation, however, he was glad to say that from his experience in operating such equipments he had found no difficulties. He did not agree that capacity was so important as the author of the evening's paper would make it, as he felt that in many cases multiple-unit control would be the equipment of future trains. Certainly electrification on a large scale could not come through any 650-volt proposition, but rather would have to be along the lines of high-tension single-phase. Considering the great number of contradictory statements and the general chaos on the subject of heavy electric traction systems he would suggest that the Institute appoint a special committee to study this subject just as it had previously appointed one on high-tension transmission. This method it seemed to him was the only one that would bring the subject on an authoritative basis.

A. H. Armstrong said that he was in cordial agreement with Mr. Potter's remarks about so-called rival methods and about the recent improvements in a. c. and d. c. motors. A few days since he had witnessed the test of a 25-cycle 125-hp single-phase motor which ran at 50 per cent overload with perfect commutation and with only half the usual complement of brushes. One objection that appeared to him with regard to Mr. Stillwell's advocacy of 15 cycles was that so large a proportion of the alternating current generated to-day was at 25 cycles.

Prof. C. P. Steinmetz contributed the final remarks of the evening. He said that so far as the motor was concerned the direct current was more satisfactory than the alternating current, because of the saving of the energy lost in the hysteresis of the field and the transformer loss on the commutator. With the same temperature rise it was possible with the direct-current motor to get either a higher output or a cheaper construction. He thought that the class of service where a. c. motors would be most desirable was where there was a long railway with frequent and irregular service and a considerable amount of freight traffic which is of a fluctuating nature; in other words, where a rotary converter sub-station would show a very poor load factor. He did not share the often expressed objection to the rotary converter. It is an advantage in a system to eliminate some of the links of the chain, but it is desirable to eliminate the weakest link, and that is not the rotary converter, but the motor; the rotary converter is about the strongest link in the chain. Engineers may differ as to the conditions under which a. c. or d. c. is most desirable. The principal thing to guard against is not to adopt any system which will forever preclude going to the other or any specialty such as an odd frequency. At present, after many years of work, all frequencies have practically been eliminated except the 60-cycle and the 25-cycle. At the present time all the heavy power of the country is transmitted at 25 cycles. At this frequency it is not so formidable to use the a. c. motor and then find d. c. motors would be better or to change from d. c. to a. c. But it would be serious to be forced to go to 15 cycles, because that would mean giving up the possibility of securing the benefits of a vast amount of power which is available in the country at 25 cycles. It would be an odd system and as unfortunate as the 40-cycle system finds itself to-day. He said that the commutation of the 1200-volt d. c. motor was infinitely superior to that of any a. c. motor with which he was acquainted except one that he had seen last week and to which Mr. Armstrong had referred. The commutation of this motor was actually sparkless and was just as good as the standard d. c. motor, or probably a little better.

Mr. Sprague, in conclusion, stated that he would reply to the remarks later in a written communication to be inserted in the Proceedings.

The Rio de Janeiro Tramway, Light & Power Company has received two of the six generators ordered from the Westinghouse Company to be used in its water-power development, and the remaining four will be delivered by July 1. The generators are of 8000 hp each.

MEETINGS OF COMMITTEES OF THE AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION

On Monday and Tuesday, May 20 and 21, meetings of a number of important committees of the American Street & Interurban Railway Association were held at the headquarters of the association at 29 West Thirty-Ninth Street, New York. An account of these meetings is published below.

EXECUTIVE COMMITTEE

The executive committee of the association met at 2 p. m. on Monday. The following were present: Messrs. Beggs, Shaw, Brady, Tingley, Adams and Swenson.

It was announced that letters had been received from Messrs. Goodrich, of Minneapolis, and Bradley, acting president of the Claim Agents' Association, that they would be unable to be present at the meeting.

The past presidents of the association had been invited to attend the meeting, and five of them were present. These were the following: Joel Hurt, of Atlanta, Ga., president during 1894-95; H. M. Littell, of New York City, president during 1895-96; Albion E. Lang, of Toledo, president during 1897-98; C. S. Sergeant, of Boston, president during 1898-99, and Jere C. Hutchins, of Detroit, president during 1902-03. Two of the other past presidents of the association, H. H. Vreeland, of New York, president of the association during 1901-02, and W. Caryl Ely, president during 1903-04-05-06, fully intended to be present, but were prevented by important business at the last moment.

The secretary presented a report in which were considered a number of matters relating to the association work.

The active membership has increased from 200 companies on Oct. 1, 1906, to 242 companies at the present day. The associate membership has increased from 113 individuals on Oct. 1, 1906, to 164 at the present time. A financial statement was presented which showed that the association had received more money from a larger number of active and associate members than had been received up to the 20th of May, 1906.

The secretary stated that the annual reports of the four associations containing the proceedings of the Columbus convention had been published and sent out to the various member companies and to associate members. Five hundred copies of the report of each of the four associations had been bound in paper covers and each member company was supplied with one set of these paper-covered reports. They are all of uniform style and octavo size.

The American Association report contains 472 pages, the Accountants' report 352 pages, the Engineering report 255 pages, and the Claim Agents' report 253 pages. In addition to the paper-covered volumes, the four annual reports have also been bound up in two cloth-covered volumes; the first contains the proceedings of the American and Engineering Associations and the second those of the Accountants' and Claim Agents' Associations. This arrangement of the volumes was made because associate members receive the reports of both the American and Engineering Associations, whereas the reports of the Accountants' and Claim Agents' Associations are reserved for member companies only. Reprints have been made of the address of the presidents before the various associations, of the report of the committee on municipal ownership and of the report on the standard code of rules.

The executive committee considered a number of matters relating to the association work and the plans for the 1907 convention were given particular attention.

The report of the committee on subjects was presented by the chairman, Richard McCulloch, of St. Louis, and accepted. This committee, whose work is referred to in detail below, has provided for a number of most interesting and valuable papers relating to many of the most important problems which are now before street and interurban railway companies.

It was decided to make a departure at the 1907 convention from the custom of recent years of having two sessions a day. It is proposed that the American Association have but one session a day on Wednesday, Thursday and Friday, these sessions being from 9:30 a. m. to 1:30 p. m. It is expected by this arrangement that there will be a large attendance at all sessions and that ample opportunity will be given to all to examine the exhibits of the manufacturers during the afternoon hours of these days.

The question as to whether or not there should be a banquet was discussed at some length, and the general sentiment expressed was that a banquet should be given at the 1907 convention.

THE COMMITTEE ON SUBJECTS

The general committee on subjects, as provided in the by-laws of the American Street & Interurban Railway Association, consists of one representative from each of the affiliated associations and an equal number of representatives from the American association. This committee has charge of the general arrangements of the programs for the Atlantic City convention. In addition to this general committee, each association has its own committee which has direct charge of its specific convention program, including the reports of the committees, the papers to be read, etc.

The meeting of the general committee on subjects was held on the morning of Monday, May 20. Those present were Messrs. Richard McCulloch, of St. Louis, Mo., chairman; Ernest Gonzenbach, of Sheboygan, Wis., representing the American Association; H. H. Adams, of Baltimore, Md., representing the Engineering Association, and Peter C. Nickel, New York, representing Claim Agents' Association.

Among the matters discussed, were the following:

(a) Meeting days of the different associations.

(b) Committee reports and papers to be presented at the various conventions.

(c) Convention halls to be used by the different associations.

(d) Number of sessions to be held by the various conventions and the general arrangement of these sessions.

A bulletin will be issued in the near future from the secretary's office which will contain a preliminary announcement as to the programs of the various conventions, giving outline of the papers which will be presented, the exact dates of meetings, etc.

The Engineering and Claim Agents' Associations will probably meet on Monday afternoon, Tuesday morning and Wednesday afternoon. The Accountants' Association sessions will probably occur on Tuesday morning and afternoon and on Wednesday afternoon and Thursday morning. The American Association convention sessions, as stated, will probably be held on the mornings of Wednesday, Thursday and Friday.

EXECUTIVE COMMITTEE OF MANUFACTURERS ASSOCIATION

The meetings of the executive committee of the Manufacturers' Association were held on the morning and afternoon of Monday. Those present were Messrs. Randall, Ellicott, Evans, Garland, representing Mr. King, of Mans-

field; Martin, McFarland, Peirce, Sisson, Partridge, representing Mr. Wharton, of Philadelphia; Wilson and Baker.

The contract for the use of the Steel Pier was read and approved. The question of the price of space to be charged for exhibit space on the pier was then considered. Full details on this point will be published by Secretary Keegan about June 1 and will be mailed to members of the association.

The Marlborough-Blenheim hotel was selected as headquarters at Atlantic City.

The other principal actions taken were the appointment of Mr. Ellicott as chairman of the finance committee; Mr. Wilson as chairman of the printing committee, and Mr. Peirce as chairman of the badge committee. The treasurer was also made ex-officio a member of all committees having anything to do with the disbursement of moneys.

COMMITTEE ON STANDARDS

The meetings of the committee on standards of the Engineering association were held on May 20 and May 21. There were present the Messrs. Wallerstedt, Larned, Fairchild and Blake. Mr. Adams attended several of the meetings as president of the Engineering Association. Geo. L. Fowler and F. W. Lane, of New York, were also present by invitation. The chairman of the committee announced that a number of previous meetings had been held by the New York members of the committee, and that several tables of statistics had been drawn up containing the information obtained in the data sheets received from member companies. These tables showed in complete form the data on rails, brake-shoes, wheels, etc., supplied by those answering the inquiries.

The subjects of flanges and treads of wheels, brake-shoes, journals and rails were taken up. In the latter investigation the committee will receive the assistance of the maintenance of way committee. A long communication was received from Mr. Evans, of Indianapolis, a member of the committee on standards, outlining the work up to date of the committee on standardization of the Central Electric Railway Association. The chairman announced that another meeting of the committee would be called next month, the place and exact date to be announced later.

COMMITTEE ON CAR HOUSE CONSTRUCTION

This is a special committee appointed by President Beggs to confer with a similar committee of the National Fire Protection Association for the purpose of formulating a set of rules and regulations governing the construction and equipment of modern car houses. The committee consists of the following: H. H. Adams, superintendent of shops, United Railways & Electric Company, Baltimore, Md., chairman; E. J. Cook, chief engineer, Cleveland Electric Railway Company, Cleveland, Ohio; Charles F. Ferrin, architect, Twin City Rapid Transit Company, Minneapolis, Minn.; L. H. Parker, engineering department, Stone & Webster Company, Boston, Mass.; A. V. Porter, architect, New York City Railway Company, New York, N. Y., and Thomas Pumfrey, civil engineer, International Railway Company, Buffalo, N. Y.

The meeting of the committee was called to order at 10:30 on the morning of Tuesday, May 21. A conference with the committee of the National Fire Protection Association was held first, and continued through the greater part of the forenoon. At this conference a tentative set of rules was discussed in a general way by the members of both committees.

After the first conference with the committee from the National Fire Protection Association, the committee of the American Association held a separate meeting which continued until the middle of the afternoon. At this meeting the proposed rules for the construction of car houses was the subject under discussion. Later in the afternoon a second conference was held between the two committees and an agreement was arrived at concerning the rules which had been formulated to govern the construction of modern car houses.

It is the understanding that these rules will be placed before the convention of the National Fire Protection Association on Thursday, May 23, for approval. If approved at that meeting, they will also be brought up for approval at the annual convention of the American Street & Interurban Railway Association next October.

BANQUET

On Monday evening the executive committee and the others in attendance at the meetings of the different committees in session were entertained at a banquet by the Manufacturers' Association. The dinner was given in one of the private dining-rooms at the Engineers' Club, and about thirty in all were present. Vice-President Randall presided in the absence, on account of illness, of President McGraw, and made a most acceptable toastmaster. Speeches were delivered by Messrs. Beggs, Shaw, A. W. Brady and Adams, of the executive committee, by all of the ex-presidents of the association present, by Ex-President D. M. Brady, of the Manufacturers' Association, and by Mr. Peirce, chairman of the entertainment committee of the Manufacturers' Association. Mr. Peirce also entertained the guests with a number of his inimitable dialect stories. It was a most enjoyable affair and lasted until late in the evening.

ELECTRICITY IN TURKEY

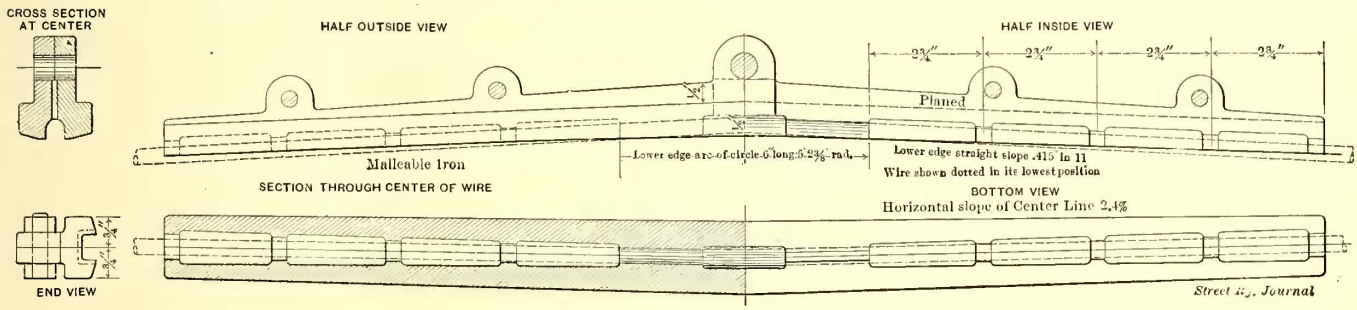
Turkey is practically a virgin soil for electrical enterprise. Up to a year ago there was not a single city or town in the 800,000 square miles of Turkish possessions which could boast of a telephone system or of a central station for electric light or power purposes. Now Damascus and Beirut have their electric central stations, however queer it may seem that the former ancient city should lead in progress the important and quasi European cities of Constantinople, Smyrna, and Salonica. Quite recently concessions were granted for electrical light and traction in Constantinople, Salonica, and Brussa. Smyrna, the second city in the Empire, and perhaps the first in commerce and future prospects, seems to have no immediate future for electrical appliances, although perhaps no city feels more the need of them. It is rumored, however, that permission has been granted for the electrification of the 2-mile tramway line between Smyrna and the suburbs on the southern shore of the gulf. Aside from a few isolated plants in mines and private residences, the concessions referred to represent the sum of electrical work in Turkey. Belgium has so far taken the lead in securing large contracts, while Germany, with the exception of the Constantinople concession, nearly monopolizes the smaller business, the material for which has to be imported by special permission from Constantinople. The prohibition now covers everything relating to electricity, even the serviceable electric bells, which cannot be imported except with the approval of the direction of customs in Constantinople. It is persistently rumored that this unaccountable prohibition of electrical apparatus will be raised in the near future, and the concessions lately granted tend to confirm these rumors.

A NEW FORM OF SUSPENSION FOR SLIDING BOW CONTACT

A new form of suspension for contact wires has been designed and patented by Joseph Mayer, of New York, an abstract of whose paper on "Steam vs. Electric Railway Operation for Trunk Line Traffic" before the American Society of Civil Engineers was published in this paper on Dec. 1, 1906. It is described in Mr. Sprague's paper and also in a pamphlet published by the inventor, from which the following description has been abstracted:

The new features of the suspension consist of a new suspender or hanger and a new strain adjuster. The former is designed to greatly reduce the bending strains in the contact wire at the suspenders; the latter reduces the variation in the sag due to changes of temperature and the consequent variation and the maximum amount of tension in the wire. The inventor claims that his hanger is so designed that the bending strains and tensions in the contact wire can be accurately calculated and that spans of 250 to 330 ft. can be safely used without catenary support and without unsafe strains in the contact wire. The proper length of span depends on the amount of ice which may occur on the contact wire and on the amount of variation of temperature of the locality.

The hanger, as shown in the accompanying engraving,



NEW TYPE OF SLIDING BOW EAR FOR LONG SPANS

consists of two pieces bolted together forming a central clamp firmly holding the wire and two terminal channels. The central clamp corresponds to the ordinary trolley ear. The terminal channels forming the new feature are an addition for the purpose of preventing the sharp bending of the wire at the clamp produced by changes of temperature and by wind pressure. In these channels the wire can bend vertically and laterally in circular curves of large radius. The radius of these curves, which is determined by the shape of the side walls and upper walls of the channels, is calculated so that the bending strain and tension in the wire combined will not exceed a safe limit. The length of the channels is calculated so that the maximum strain in the wire after it leaves the suspender does not exceed this limit. The proper length of the hanger and the curvature of the channel walls, therefore, depend on the amount of ice, the changes of temperature, the length of span and the size and strength of the wire. About one in twenty of the hangers will be a strain adjuster.

The ordinary hangers must be so attached to brackets or span wires that they can move a short distance in the direction of the track from their normal position, so that the change in the length of the contact line produced by the strain adjuster will be approximately equally distributed over all the spans. The hanger illustrated is designed for use with a sliding bow, and to distribute the wear on the bow are staggered alternately 3 ft. each side of the center of the track.

The inventor claims that the suspension is suitable for the highest speeds and severest climates, and that much smaller wires than with other methods of suspension become practicable at moderate speeds. He also claims that the cost of the carrying structure with his suspension is about half that with catenary suspension, while the maximum strains in the wire are much less than in all previous methods. He endeavors to prove all these claims in his pamphlet, which is illustrated by three inset plates and by cuts.

RAIL SPECIFICATIONS FOR CHICAGO

The Board of Supervising Engineers, of Chicago, representing the city and companies in the rehabilitation of the city system, has awarded a contract for rails to the Lorain Steel Company. The type of rail adopted is that specified by the ordinance of the Council passed Oct. 8, 1906. It is of the grooved section and weighs 129 lbs. per yard. The groove is 1¼ ins. deep and 1¾ ins. wide. The head of the rail is 2¾ ins. wide, and consists of a tread 2 ins. wide with a slight inclination toward the groove and a bevel at the outer edge of the rail ¾ in. wide. The groove is flaring, as in the Trilby rail, but the lip is ¼ in. below the head of the rail. The web of the rail is ½ in. thick, the base is 6 ins. wide, and the height is 9 ins. The specifications under which these rails will be supplied are as follows:

SPECIFICATIONS FOR RAILS FOR CHICAGO STREET RAILWAY TRACKS

1. Type—The rails are to be of the grooved-girder type.

2. Section—The section of the rail shall conform to the specification contained in the revised municipal code of Chicago, as amended by ordinance passed Oct. 8, 1906. A variation in height of 1-64 in. under or 1-22 in. over that specified, and ⅛ in. total variation in width of base only will be permitted, except that 5 per cent of the first 5000 tons may be furnished with a total variation in width of base of not more than ¼ in. The section of rail shall conform perfectly to the fishing dimensions.

3. Weight—The weight will be maintained as nearly as possible (after complying with paragraph A) at the specified weight of 129 lbs. per yard. A variation of 0.5 per cent for an entire order will be allowed. Rails shall be accepted and paid for according to actual weight.

4. Process of Manufacture—A. The entire process of manufacture and testing shall be in accordance with the best current practice, and special care shall be taken to conform to the following instructions:

B. Ingots shall be kept in a vertical position in the pit-heating furnaces until ready to be rolled, or until the metal in the interior has time to solidify.

C. No bled ingots shall be used.

D. Sufficient shall be discarded from the top of the ingot to insure sound rails.

E. Care shall be taken to avoid overheating the steel, and under no circumstances shall a "cinder" heat be allowed; that is, a heat high enough to cause the cinder to run off the steel as it is being drawn from the furnace. This does not apply to cinder which may be sticking to the underside of the steel when drawn from a horizontal furnace, or to the bottom of an ingot when drawn from a soaking pit.

F. The number of passes and speed of train shall be so regulated that on leaving the rolls at the final pass, the temperature of the rail will be the same as the temperature of the 141-lb. rail rolled for the Philadelphia Rapid Transit Company. But this temperature shall, in no case, exceed 2000 degs. F. (this clause to apply to the first 5000 tons of present order only).

5. Chemical Composition—Rails shall conform to the following limits in a chemical composition:

	Per Cent
Carbon (Ave. 0.55 per cent)	0.50 to 0.60
Sulphur not to exceed	0.08
Phosphorus not to exceed	0.10
Silicon not to exceed	0.20
Manganese	0.80 to 1.10

6. Tests—A. One drop test shall be made on a piece of rail not less than 4 ft. and not more than 6 ft. long, selected from each fifth blow of steel. The test piece shall be taken from the top of the ingot. The test rail shall be placed head upward on the supports and shall be subjected to the following impact test under a free falling weight, the height of drop to be 20 ft. If any rail breaks when subjected to the drop test, two additional tests may be made of the other rails from the same blow of steel, also taken from the top of the ingots. If either of these latter rails fail, all the rails of the blow which they represent will be rejected. If both of these additional test pieces meet the requirements, all the rails of the blow which they represent will be accepted.

The drop-testing machine shall have a tup of 2000 lbs. weight, the striking face of which shall have a radius of not more than 5 ins., and the test rails shall be placed head upward on solid supports 3 ft. apart. The anvil block shall weigh at least 20,000 lbs. and the supports shall be part of, or firmly secured to, the anvil. The report of the drop tests should state the atmospheric temperature at the time the test was made.

B. Instead of the drop test, the following may be substituted at the inspector's option: While the heat is being cast, two test ingots shall be made, the first from steel going into the first regular ingot, the other from metal representing the last one. These test ingots shall be 3 x 3 ins. and not less than 4 ins. long. From these, bars at least ½ in. square shall be drawn at one heat by hammering. Each bar, when cold, shall be bent, without breaking, to not less than a right angle. Should one bar from a heat fail, and the other stand the test, a third bar may be taken from a bloom rolled from the ingot represented by the failed one. If this stands the test, it shall be accepted in place of the failed one. If the manufacturer choose, more than the two test ingots may be taken, but they must be from the steel of the first and last regular ingots. If this is done and a test bar fails, another one may be drawn from the duplicate ingot and tested, and, if it stands, accepted.

7. Length—The rails shall be 56 ft. and 58 ft. in length, with 20 per cent of shorter lengths in multiples of 1 ft. down to 35 ft. Rails to be paired as to lengths before shipment.

8. Drilling and Punching—Drilling and punching specifications shall be furnished to the manufacturer from time to time, and will include joint-bolt holes, tie-rod holes, and brace-bolt holes. All holes shall accurately conform to the drawing and dimensions furnished in every respect, and must be free from burrs.

9. Finish—The rails must be free from all mechanical defects and flaws, and shall be sawed square at the ends, and the burrs made by the saws carefully chipped off, particularly under the head and on top of the flange. They shall be smooth on the heads, straight in line and surface when finished, without any twist, waves or kinks, particular attention being given to having the ends without kinks or drop. No. 1 rails shall be free from injurious defects and flaws of all kinds.

10. Straightening—Care must be taken in hot straightening the rolls of the rails so that gagging under the cold press will be reduced to a minimum and so applied that the rails will not be made lumpy. The distance between supports of rails in the gagging press shall not be less than 40 ins.

11. Branding—The name of the maker, the weight of the rail, and the month of the year of manufacture shall be rolled in raised letters and figures on the side of the web, and the number of blow shall be plainly stamped on each rail where it will not be subsequently covered by the splice bars.

12. Inspection—The inspectors representing the railway company, or the Board of Supervising Engineers, shall have free entry to the works of the manufacturer at all times while this contract is being filled, and shall have all reasonable facilities afforded to satisfy them that the rails are being made in accordance with these specifications. All tests and inspections shall be made at the place of manufacture prior to shipment. The manufacturer shall furnish the inspector daily with the carbon determinations of each heat and a complete analysis every 24 hours, representing the other elements contained in the steel. Such analysis shall be made from the average drillings taken from test ingots.

The inspectors shall have authority to reject rails from insufficiently sheared blooms, or from heats, the test pieces of which have failed, or from badly poured heats, or from chilled heats, or from bled ingots. The rails made from insufficiently cut blooms, if otherwise perfect, to be afterwards received as No. 1 short rails, if, after sufficient lengths they have been sawed off, to make them conform to specifications, they shall exceed 35 ft. in length. By "badly poured" heat is meant one, which, from any cause, has been "teemed" without the control of the operator. A "chill" heat is one which by reason of the chilling of the steel has to be either pricked or poured over the top of the ladle. A "bled" ingot is one from the center of which the liquid steel has been permitted to escape. Imperfectly drilled, straightened (except lumpy rails), or chipped or filed rails shall be rejected, but will be accepted if subsequently properly finished. Rails failing to comply with the requirements of paragraph No. 2 will be rejected.

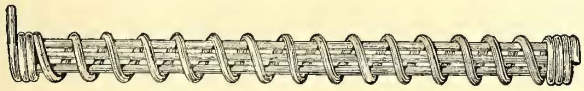
13. No. 2 Rails—Rails that possess any injurious defects, or which, from any cause, are not suitable for first quality, or No. 1 rails, shall be considered No. 2 rails. Provided, however, that rails which contain any physical defects which impair their strength or usefulness and fail to comply with the requirements of paragraph No. 2, shall be rejected, and rails rejected under the drop test will not be accepted as No. 2 rails. Both ends of all No. 2 rails shall be painted while in order to distinguish them. No. 2 rails will be accepted up to 10 per cent of the whole order, at a reduction of $2 per ton in price below that specified in the contract.

Francis H. Dewey, president of the Worcester & Blackstone Valley Street Railway Company, states that through cars will be run between Worcester, Mass., and Providence, R. I., as soon as the track connection between the Worcester & Blackstone Valley and the Uxbridge & Blackstone Street Railway Companies' lines can be made at Plummer's Corner, in Northbridge, Mass. From Providence to Worcester via the steam route is 44 miles, and the electric routes are about the same length. Present arrangements require the trolley passenger going through between Providence and Worcester to change cars from three to five times, according to the route selected. The steam schedule is one hour and forty-five minutes, but the electric cars require three and one-half hours via the Woonsocket short line, or a half hour longer via Pawtucket. The electric lines making up the system are the Rhode Island Company, including the old Pawtucket and the Cumberland Street Railways between Providence and Cumberland Hill, or the Rhode Island and the new Providence & Burrillville road, between Providence and the Woonsocket city line; the Woonsocket Street Railway from either Cumberland Hill or Woonsocket to Millville, Mass.; the Uxbridge & Blackstone road, from Millville to Plummer's Corner in Northbridge, Mass., and the Uxbridge & Blackstone Valley, from the last-named point to the city line of Worcester, into which place the cars are operated over the tracks of the local Worcester system. Excepting the Providence & Burrillville, none of these lines is a high-speed road. With the same exception, they are largely built in the highways.

ANTI-WASTE GRABBER

A device to prevent waste in journal boxes from being carried around by the rolling of the journal and then wedging up between the lug of the box and the journal, depriving it of lubricating oil, has recently been put on the market by the V. O. Lawrence Company, of Philadelphia. The device is called an anti-waste grabber, and is meeting with success in the steam railway field as a preventive of hot boxes.

It is made from copper wire, in the form of a coil, and is stiffened by having three wires soldered on the inside

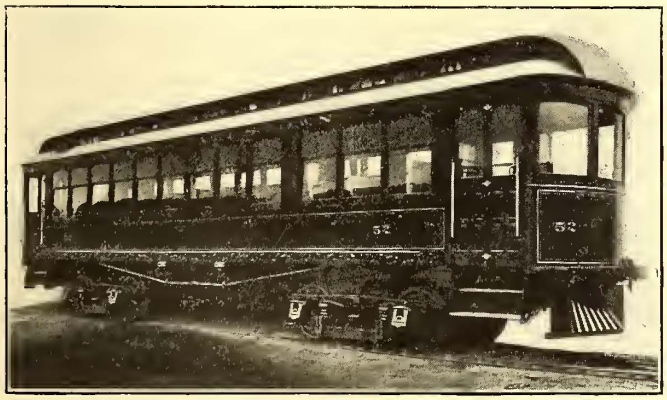


WIRE ANTI-WASTE GRABBER

to each turn of the coil. At one end of the grabber the wire projects from ¼ in. to ½ in. This projection holds firmly in the waste and prevents the grabber being lost in case a journal box should be open. Its use insures care being taken in packing journal boxes. They cannot be jammed full of waste, as it must be placed evenly and room must be left for the grabber. Again, the weight of the grabber itself has the tendency to hold the waste down, and if it does raise a trifle the grabber will strike the lug of the box and bearing first, preventing further movement. When in this position it is impossible for the waste to get beyond the grabber. Under these conditions, it is claimed that the journals will run at a lower temperature, due to the fact that oil is more freely applied to the journal at all times.

NEW CARS FOR THE WARREN-JAMESTOWN RAILWAY

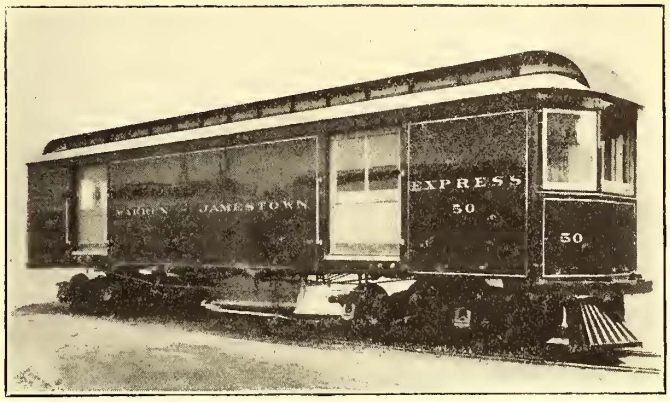
A number of interesting interurban cars of the Brill grooveless post, semi-convertible type have lately been added to the equipment of the Warren & Jamestown Street Railway. This system, although a small one, operating



EXTERIOR OF PASSENGER CAR FOR WARREN & JAMESTOWN LINE

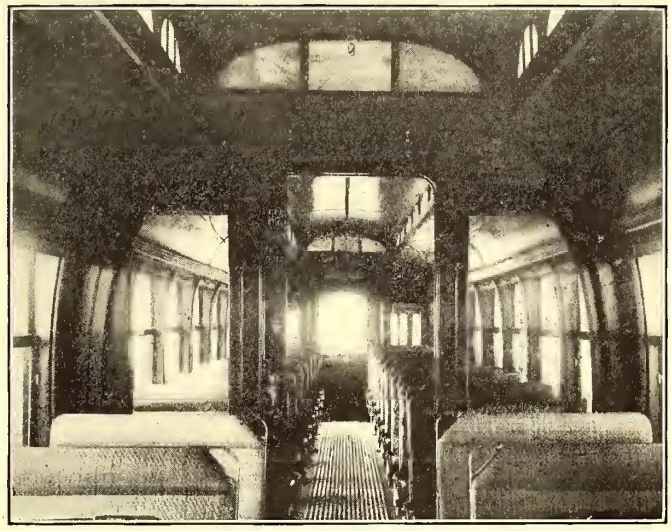
ten cars over about 20 miles of tracks, is of considerable importance, as it forms the connecting link with the Chautauqua Lake region. On arriving at Jamestown, passengers from Warren can board the cars of the Chautauqua Traction Company, which has its terminus at Westfield, passing the town of Chautauqua en route. Another interurban line running out of Jamestown is the line connecting Lakewood, Celeron and Falconer.

The new cars are of the passenger and smoking type, the seats for the non-smokers being upholstered in leather; those in the smoking compartment in rattan; all seats have high backs and head rolls. The bottom framing is braced with under trusses and the two needle beams are double trussed. The unusual height of the car body from the



EXPRESS CAR FOR WARREN & JAMESTOWN LINE

rails, as shown in the engraving, is due to the fact that the car body was bolstered up on the trucks temporarily for photographic purposes pending their proper adjustment; this makes the pilot conspicuously high from the ground in the picture. The platforms are flush with the floor of the car, and other features are the double steps and steam coach roof. The ventilator and transom sashes have arched tops and are filled with art glass. The inside finish is of golden oak; the ceilings are of three-ply birch. The trucks are of the M. C. B. type. The car company's "Dumpit" sand boxes, angle-iron bumpers and other specialties form a part of the equipment. The chief dimensions follow: Length over end panels, 34 ft. 4 ins.; over crown pieces, 44 ft. 4 ins.; length of smoking compartment, 9 ft. 2 ins.; width over sills, including sheathing, 8 ft. 4 ins.; height from



INTERIOR OF WARREN & JAMESTOWN CAR

floor to ceiling, 8 ft. 5⅝ ins.; from track to under side of sills, 36⅞ in.; size of side sills, 4¾ in. x 7¾ in., with 3½-in. x 6-in. x ⅜-in. angle iron; center sills, 4½ in. x 6 in.; intermediate sills, 3½ in. x 4¾ in.; end sills, 5¼ in. x 6 13/16 in.; sill plates, 15 in. x ⅜ in.

Along with these semi-convertibles the American Car Company also shipped a 44-ft. baggage and express car of standard character and dimensions and mounted on the same type of M. C. B. trucks.

FINANCIAL INTELLIGENCE

Wall Street, May 22, 1907.

The Money Market

There has been no material change in the local money market during the past week. The tone was, if anything, a shade easier, but rates for all classes of accommodations remained practically the same as those heretofore quoted. The easier tendency was due to a falling off in the demand from stock commission houses, resulting from a dull and declining securities market, rather than to any pressure of funds upon the market. The banks and other large lenders of money are not disposed to offer with any degree of freedom, the general belief being that better rates will obtain in the near future. The developments of the week were such as to strengthen this belief. Corporate borrowing continued on a rather large scale. The new securities announced during the week include an issue of $5,000,000 5 per cent five-year notes by the North American Company. Of the total amount $2,500,000 have been sold to a syndicate, and the remainder will be retained by the company for future use. The Delaware & Hudson Company has authorized the issuance of $10,000,000 equipment trust notes, and the General Electric Company has decided to issue $13,000,000 5 per cent convertible debenture bonds. The latter issue will be offered to stockholders at par and interest, and payments are to be made, one-half on July 20 next, and the remainder on Jan. 20, 1908. In addition to the above the Interborough-Metropolitan Company contemplate an issue of $15,000,000 three-year 5 per cent collateral trust notes. These notes will not be sold at present, the company, it is said, having provided for immediate requirements by borrowing $3,000,000 for six months at 6 per cent from various banks and trust companies.

The sharp advance in rates for sterling in the local market, together with a decline in sterling and harder discounts at Paris, have increased the probability of gold exports to France. No engagements of the yellow metal have yet been made, and unless the Bank of France should decide to offer interest on the gold while in transit, it is not likely that shipments will be begun this week. It is also the belief in some quarters that should gold exports to Europe become imminent, the Secretary of the Treasury would at once withdraw the special Government deposits made with the banks last winter, which would undoubtedly result in checking the outflow of gold from this side. The European money markets have not changed appreciably, and apart from the slight hardening in discounts at Paris, referred to above, rates at the other principal European centers are practically the same as those prevailing at the close of last week.

The bank statement published on Saturday was decidedly favorable. Loans decreased $1,414,900 and deposits increased $1,681,800. Cash increased $3,406,900, and the reserve required was $420,450 larger than in the preceding week, making an increase in the surplus reserve of $2,986,450. The surplus now stands at $11,472,675, as compared with $10,129,275 in the corresponding week of 1906 and $8,219,975 in 1905.

Money on call loaned at 3 and at 2 per cent, the average rate being about 2½ per cent. Money for fixed periods was obtainable at 4 per cent for sixty and ninety days, 4¼ per cent for four months, 4½ per cent for five months, 4¾ per cent for six months, and 5¼ per cent for nine to twelve months.

The Stock Market

Following upon an almost uninterrupted decline in securities prices for the last ten days, a collapse occurred at the close of the week, which brought a number of prominent issues to, or actually below, the lowest prices of the so-called March panic. A number of the inactive shares and bonds, some of them in the high priced category, fell to the lowest levels within six years. The pronounced long continued stagnation in the market for railway and other bonds has recently compelled syndicates to take over allotments that could not be carried by outside holders, and undoubtedly very large amounts of money are tied up in these loans to capitalists. While the decline was largely the result of professional short selling, still it was evident that forced liquidation was in progress in certain quarters of the market. Public interest in the market continues extremely small, judging from the volume of commission house business, while operations for foreign accounts were unimportant. The crop news was more favorable. Warmer weather was reported in the winter wheat States west of the Mississippi, while in the spring wheat sections planting was making better progress. Notwithstanding these favorable changes in the crop situation trading in the local and Western grain markets continued excited, with prices at the highest in several years. The advance in prices of wheat probably had much to do with the slump in stock values, but sentiment was also chilled by the continued huge borrowings on the part of corporations. While money rates have so far failed to reflect the heavy demands for funds from that source, it is considered only a question of time when rates for accommodations will respond to the heavy demands for new capital. A comparatively small part of these new securities is to be provided for in the near future, the bulk of the payments falling due in the late summer, or at a time when the outflow of money for crop-moving purposes is usually well under way. One factor in the monetary situation which is perhaps causing more apprehension than any other at present, is the strength in sterling exchange. During the week rates for sterling have advanced to the highest points of the year, and on the present basis of exchange here and at Paris gold can be shipped to the French capital. The margin of profit on such transactions, however, is insignificant, but if the Bank of France should allow interest on the gold while in transit, as is not unlikely, shipments of the precious metal will be made. The favorable developments of the week in addition to the improved crop conditions, included unabated activity in the iron and steel trades and continued strength in the copper metal market. Railroad earnings were good and reports from all sections of the country were of continued activity in all branches of trade. These favorable developments were practically ignored, and while prices rallied sharply at the close from the low level the improvement was due largely to short covering.

The traction stocks moved in sympathy with the general market. The news from Albany to the effect that the Utilities bill will become a law practically in its original form was pretty well discounted. The Interborough-Metropolitan has authorized an issue of $15,000,000 three-year 5 per cent collateral trust notes.

Philadelphia

Trading in the local traction issues was comparatively quiet during the past week, and prices continued to move with more or less irregularity. At times pronounced strength was displayed in the active issues as a result of some good buying, but this was followed by a general recession in values. Philadelphia Rapid Transit was the conspicuous feature of the utility shares, both as regards activity and price fluctuations. In the early dealings strong buying advanced the stock from 24⅜ to 25½, but near the close the price ran off to 22½. In all about 15,000 shares were traded in. Union Traction moved in sympathy, and after selling as high as 60 yielded under rather slight selling to 57½. Philadelphia Traction ran off from 94 to 91¾, and United Companies of New Jersey sold at 250 and 249¾. Lehigh Valley Transportation was steady at 23, as was Consolidated Traction of New Jersey, which sold in small amounts at 73¼ and 73½. American Railways sold at 49½, Philadelphia Company at 44, and Philadelphia Company preferred at 45½.

Chicago

It is expected that the necessary 75 per cent of the stocks of the traction companies under the ordinance will have been secured before the time limit expires this week. It is understood that more than 32,000 shares of North Chicago stock have been deposited, which is considerably more than is necessary, but it is said that the deposits of West Chicago shares are somewhat below the required amount. The certificates of deposit issued by the Central Trust Company in New York have been admitted to the unlisted department of the New York Stock Exchange.

Trading in the local traction shares during the week included a large number of issues, but the individual transactions were small. They were Union Traction at 2⅞ and 3¼, City Railway at 180, West Chicago at 28, South Side Elevated at 83 and 84, Chicago & Oak Park common at 3¾, preferred at 13¼; Metropolitan "L" common at 24¼, preferred at 64¾; Northwestern "L" at 23 and 23 ¼,and the preferred stock at 58.

Other Traction Securities

The market for traction issues at Baltimore was quiet. About the only activity was displayed by United Railway incomes, which sold to the extent of about $90,000 at prices ranging from 54½ to 53¾, United Railway 4s sold at 87⅛ and 87, and the refunding 5s brought 83½. City & Suburban 5s changed hands at 109, and Macon Railway & Light 5s sold at 94½. The Boston market was fairly active and decidedly irregular. Early in the week Massachusetts Electric advanced from 17 to 19, but subsequently lost all the improvement, while the preferred, after a sharp rise from 57¾ to 63, reacted and closed at 61¾. Boston Elevated declined from 137 to 136. West End sold at 87 and 87½, and the preferred at 104½ and 105. Boston & Worcester was steady at 26⅞ and 27.

Considerable activity has been shown in Cleveland Electric the past week on the Cleveland Stock Exchange, but at figures ranging from 50 to 51. The last sale of any moment was a 200-share block, buyer 60 days, at 51½. Just before that, 200 shares went at 50. There is a felling that the company will be successful in its contentions with the city. Aurora, Elgin & Chicago remains steady at 34, while Washington, Baltimore & Annapolis securities were in fair demand around prices that have prevailed for some days.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	May 15	May 22
American Railways	49½	49¼
Boston Elevated	136	136
Brooklyn Rapid Transit	60	53¾
Chicago City	180	180
Chicago Union Traction (common)	3	3¼
Chicago Union Traction (preferred)	13½	14½
Cleveland Electric	50	50
Consolidated Traction of New Jersey	74	73¾
Detroit United	70	—
Interborough-Metropolitan	22½	19
Interborough-Metropolitan (preferred)	56⅞	54
International Traction (common)	50	50
International Traction (preferred), 4s	71¾	71¾
Manhattan Railway	138½	133¼
Massachusetts Elec. Cos. (common)	17	17
Massachusetts Elec. Cos. (preferred)	57½	57½
Metropolitan Elevated, Chicago (common)	23	22
Metropolitan Elevated, Chicago (preferred)	63	63
Metropolitan Street	—	—
North American	72½	69
North Jersey Street Railway	40	40
Philadelphia Company (common)	43½	43
Philadelphia Rapid Transit	24¼	23¼
Philadelphia Traction	93½	92½
Public Service Corporation certificates	64	64
Public Service Corporation 5 per cent notes	94	94
South Side Elevated (Chicago)	83	83½
Third Avenue	109	109
Twin City, Minneapolis (common)	94	89½
Union Traction (Philadelphia)	59¾	57½

Metals

According to the "Iron Age" the Illinois is the leader in booking orders for forward delivery, and during the week entered 95,000 tons additional, bringing the total for 1908 delivery up to about 250,000 tons. There are some additional large inquiries in the market. Buying for 1908 delivery has been a feature in other departments of the trade. On the whole the foundry iron market has become stronger during the week, although the feeling in the trade persists are unduly high, and that a lower level, if it could be safely reached, would be far less dangerous.

Copper metal continues firm at unchanged prices. Spot Lake is quoted at 25½c. and Electrolytic at 25¼c.

NEW WORK TO BEGIN ON PENNSYLVANIA TUNNELS

Contracts have been let for the only section of the Pennsylvania Railroad tunnels not already begun. They are for building the eastern portals and approaches in Long Island City, and a short stretch of cut-and-cover tunnel just west of the portals. The work for which contracts are let extends to the end of "Sunnyside Yard," the largest electric car yard in the world. The new contracts, known as sections A and B, were awarded to Naughton & Company and Arthur McMullan. The work will be done as a part of the East River division, under the direction of the chief engineer, Alfred Noble. The contracts cover the distance between Thompson Avenue, Long Island City, and the contract of S. Pearson & Son. Under the East River itself considerably more than 40 per cent of the four separate tunnels has been completed.

REPORT OF THE INTERBOROUGH COMPANY FOR THE YEAR—COMPANY BORROWS $3,000,000 AND AUTHORIZES THE SALE OF $15,000,000 BONDS

The Interborough-Metropolitan Company, of New York, reports earnings as follows for the year ended March 30, 1907:

	1907	1906
Gross receipts	$43,353,841	$40,693,671
Operating expenses	21,841,884	21,044,516
Net earnings	$21,511,957	$19,649,155
Other income	1,187,464	1,215,781
Total income	$22,699,421	$20,864,936
Charges	17,956,552	16,766,926
Balance	$4,742,869	$4,098,010
Met. bond int.	3,150,000	2,800,000
Balance	$1,592,869	$1,298,010
Met. St. Ry. div.	666,368	3,639,888
Balance	$926,501	def. $2,341,878
Inter. Met. div.	2,273,990	.....
Deficit	$1,347,489	353,100

The Interborough-Metropolitan Company has borrowed about $3,000,000 on six months notes bearing 6 per cent interest and has authorized the sale of $15,000,000 three-year 5 per cent collateral trust coupon notes. The shorter notes and whatever other similar loans may be made meanwhile will be retired on the flotation of the three-year $15,000,000 issue. The company, it was said, expects that it will be able to place the larger issue on more advantageous terms prior to the maturity of the six months' notes.

The $15,000,000 three-year 5 per cent notes, which it is expected will be placed within six months, are secured by collateral of the face value of $15,368,300, but of a much greater market value deposited with the Mercantile Trust Company as trustee. The collateral consists of $8,000,000 three-year 6 per cent improvement notes of the Metropolitan Street Railway Company, of itself a new note issue; 59,700 shares of the 6 per cent guaranteed stock of the Third Avenue Railroad Company; 430 shares of the 18 per cent guaranteed stock of the Forty-Second Street & Grand Street Ferry Railway Company; 5028 shares of the 15 per cent guaranteed stock of the Central Crosstown Railway Company; 1570 shares of the 9 per cent guaranteed stock of the Second Avenue Railway Company, 6955 shares of the Electric Storage Company.

The Interborough Rapid Transit Company raised money early in the year for its own extension and improvement work and the present financing is to supply the needs of the New York City Railway and its subsidiary companies alone. The principal need for the new money arises from the decision to electrify various of the cross-town lines, and it is calculated that the money will be more than sufficient for the purpose, so that President Shonts will have funds to carry out all the improvements he proposes.

CHICAGO TRACTON MATTERS

President Rawson, of the North and West Chicago Street Railway Companies, has sent to the stockholders of these companies a letter notifying them of the extension of time in which they could deposit their stock in order to take advantage of the ordinances recently passed by the Council. The Union Traction Company stockholders already have made the necessary deposits, but there still is a majority lacking on the part of the underlying companies. The letter reads:

"Owing to the large number of stockholders of the North and West Chicago Street Railroad Companies who have signified their intention and desire to the committee and Union Trust Company to deposit their stock with it, to be turned over to the Chicago Title & Trust Company, as outlined in the circular of the committee under date of April 20, 1907, in order to participate in the benefits derived under the ordinances passed by the City Council under date of Feb. 11, 1907, to the Chicago Railways Company, a part of which acceptance necessitates a deposit of a majority of the capital stock of the West and North Chicago Street Railway Companies (excluding the portions of the capital stocks of said companies deposited with the Illinois Trust & Savings Bank, as trustee), the committee has authorized the Union Trust Company to extend the time of receiving the above mentioned stocks up to and including May 22, 1907. You are, therefore, notified that the Union Trust Company will receive for deposit stocks of the North and West Chicago Street Railroad Companies up to and including Wednesday, May 22, 1907.

"Upon presentation of your certificate, indorsed in blank to the Union Trust Company, trustee, Tribune Building, Chicago, Ill., a negotiable receipt will be given for the same. Your stock certificate can be sent with the form of letter appended hereto.

"Yours truly,

"Union Trust Company, Trustee.

"By Rufus F. Chapin, Secretary."

THE CLEVELAND SITUATION

In the face of a temporary restraining order the Low Fare Railway Company operated cars for 3 hours, Saturday, on Euclid Avenue to East Fourteenth Street, supposedly on the authority of the franchise railroaded through the Council at Cleveland two weeks ago. A temporary cross-over was laid at Fourteenth Street, so that the cars could change from one track to the other. D. C. Westenhaver, an attorney for the new companies, had the cross-over removed as soon as he learned what had been done.

The Cleveland Electric has notified the Low Fare Railway Company that it will not enter into negotiations for the joint use of its tracks in the down-town district with it or either of the other companies. A tender of $13,500 for the use of the Euclid tracks to East Fourteenth Street was refused Friday. The reason given is that these companies have no rights in any of the streets of the city. In an open leter to the City Council the company also refused the offer of the Low Fare Company to restore the tracks on Quincy Street and Central Avenue, and operate cars over them or to allow it to operate cars over the streets at its own rate of fare pending a decision in the cases now in court. A counter proposition was made to the effect that the Cleveland Electric would at once restore the tracks on those streets and operate its cars if given a franchise at seven tickets for a quarter, and in case the cases are decided against it, sell the tracks at cost to the company which is declared to have a legal franchise.

In Judge Sanders' argument before Judge Phillips in the Isom injunction case last week, he brought out the point that the Legislature had required that consents for a majority of the foot frontage be secured in order to protect people, from the City Council. He said that the Legislature had anticipated just such things as are occurring in Cleveland, and put an obstacle in the way of Councils using the streets as they see fit. Judge Phillips, on Wednesday, May 22, ruled that the Low Fare Company has not a sufficient number of valid consents to make the grant on Central Avenue legal. He has given the company until Friday to restate its case.

At the instance of the Cleveland, Painesville & Eastern, the Cleveland Electric Railway Company was stopped by a restraining order, issued Tuesday, from tearing up its tracks on East Ninth Street, south of Prospect Avenue. This is the line that this and a number of other interurban roads use to reach their freight station and they say they have a contract with the Cleveland Electric for operating over it, which would be violated by the tearing up of the tracks.

B. R. T. FINANCING IMPROVEMENTS OF CONSTITUENTS

Mortgages aggregating $25,000,000 are about to be executed by two of the constituent companies of the Brooklyn Rapid Transit Company to secure the latter corporation upon cash advances made and to be made by it to the subsidiary companies for additions, betterments and improvements. The financing plan is explained fully in the following statement issued Saturday, May 18, by C. D. Meneely, secretary and treasurer of the Brooklyn Rapid Transit Company:

Notices have been or will shortly be sent to the stockholders of the Brooklyn Union Elevated Railroad Company and of the Nassau Electric Railroad Company of special meetings to be held June 10 and 11, respectively, to authorize a mortgage on behalf of the Brooklyn Union Elevated Railroad Company for $20,000,000, and one on behalf of the Nassau Electric Railroad Company for $5,000,000, to secure certificates of indebtedness heretofore or hereafter issued by those companies to the Brooklyn Rapid Transit Company for cash advances from that company to enable the railroad companies to make necessary additions, betterments and improvements to their railroads and equipments.

This is in pursuance of the system of financing adopted some years ago by the Brooklyn Rapid Transit Company, which was, in brief, that instead of each separate company of the system attempting to finance its own requirements by issues of securities, the Brooklyn Rapid Transit Company would raise the necessary funds by the sale of its own bonds, and with the proceeds advance moneys to the constituent companies from time to time and take in exchange the notes or other obligations of the constituent companies for such advances. The reason for this method of financing was primarily that, inasmuch as many millions of dollars would be necessary for the proper extension and development of the railroad system, one form of security with which the investing public would become familiar would be much more marketable than a miscellaneous collection of securities issued by the various companies.

In pursuance of this plan the Brooklyn Rapid Transit Company issued its mortgage dated July 1, 1902, to Central Trust Company of New York, as trustee, for $150,000,000, of which about $61,000,000 were reserved to take up at or before maturity the underlying bonds of the Brooklyn Rapid Transit Company and its constituent companies. The remainder of the bonds were to be issued from time to time to furnish proceeds for improvements, additions, extensions, etc., of the constituent companies, and up to and including March 9 last there had been issued and sold of such bonds $28,107,000, and the proceeds of such sale had mostly been applied to purchasing from the constituent companies their certificates of indebtedness, payable on demand for the actual cost of improvements, additions, extensions, etc.

It was the intention at the time of the execution and delivery of this large Brooklyn Rapid Transit mortgage that the certificates of indebtedness to be purchased from the constituent companies would be secured by the mortgages of the companies issuing the same, otherwise the Brooklyn Rapid Transit Company, as the owner of such certificates, and the Brooklyn Rapid Transit bondholders having a lien on such certificates would be in no stronger position than that of any general creditor of the constituent companies.

This will now be accomplished in the following manner:

The Brooklyn Rapid Transit Company has entered into agreements with most of its constituent companies to furnish from time to time within the next ten years such moneys as each of tbese companies shall require for extensions, improvements, additions, etc., up to a maximum amount and to take in exchange therefor the certificates of indebtedness of such companies payable on demand, upon condition that not only the certificates of indebtedness thus to be issued and sold to the Brooklyn Rapid Transit Company, but also the certificates heretofore issued, shall be secured by the mortgages of the railroad companies issuing such certificates as collateral security thereto. The Board of Railroad Commissioners has already authorized such mortgages by the Sea Beach Railway Company, the Canarsie Railroad Company and the South Brooklyn Railway Company, and after the approval by the stockholders of the Nassau Electric and Brooklyn Union Elevated Railroad Companies will be asked to give its consent also to the mortgages to be issued by those last named companies.

The mortgages for which consent is requested to the extent that they secure past expenditures do not add one dollar to outstanding capital charges. To the extent that they secured expenditures hereafter to be made they carefully limit such expenditures to the actual cost of additions, improvements and extensions. The certificates of indebtedness cannot be issued at less than par, and must represent such actual cost. Under the terms of the Brooklyn Rapid Transit Company's mortgage, bonds issued under that mortgage must be issued at par for the par of such certificates of indebtedness, and any deficiency arising from the sale of Brooklyn Rapid Transit bonds at less than par must be made up out of the earnings of the company.

DECISION OF MASSACHUSETTS BOARD ON FENDERS

The Massachusetts Railroad Commission issued its decision on the long-pending question of street-car fenders and wheel guards Tuesday, May 21. The question is settled on a basis of compulsory experiment by the companies, and notice is given that the Commission will require various types of fenders and wheel guards on various lines, according as the companies operate in the country or suburbs where roadbed conditions are imperfect and speed is high, or in the city streets, where roadbed is smoother and speed relatively low. The circular follows:

COMMONWEALTH OF MASSACHUSETTS IN BOARD OF RAILROAD COMMISSIONERS.

May 21, 1907.

Circular to Street Railway Companies.

FENDERS AND WHEEL GUARDS

In its annual report of 1904 the Board expressed a lack of confidence in the car fenders and wheel guards then in use upon our street railways and advised experiment with new types. While companies gave some attention to this suggestion during the year that followed, there was manifest on the whole a general indisposition toward any change in equipment. The Board then took up the matter and, having secured an appropriation from the Legislature of 1906, completed in December last an investigation of fenders and wheel guards at home and abroad, concluding the inquiry with a series of tests in Newton. Companies were thereupon requested to give notice to the Board, on or before the first day of this month, of their preferences in respect to these safeguards. That time, subsequently extended two weeks, having now expired, the Board issues the following statement of views and requirements.

PFINGST FENDER

In 1895, after an exhaustive inquiry, the then members of this Board issued a circular stating their conclusions and defining the general principles which should govern the equipment of street cars with safety devices. Although the Pfingst fender was not recommended as better than others, it was one of a class of fenders which, under this circular, companies could use and was the one which they very generally selected.

As stated in our last report, "The record of the Pfingst fender shows many instances when persons have been saved from injury. This, of course, happens when accidents are prevented and therefore when public attention is not drawn to the fact through newspaper paragraph, police report or inquest. On the other hand, this fender has frequently failed to do its work. Upon a large percentage of the surface cars in Boston the fender is useless from the fact that projecting parts of the car so reduce the available area of the platform as to leave no room for catching or holding a person who falls or is thrown upon it."

Notwithstanding the multiplication of patents and the ingenuity of experts, we know of no device in use or exhibited through sketch or model that, attached to a street car moving at varying speed, can be relied upon to always trip a standing person or pick up a prostrate body without injury. It must remain unsafe for young children to play in streets that are occupied by railway tracks, or to cross them unattended, and unsafe for older persons to step carelessly in front of cars. Meanwhile there is need of more effective car fenders and wheel guards. Although applications for the most part call for a further endorsement of the Pfingst fender, we do not share the confidence expressed in it, and cannot approve it to the exclusion of other devices.

AUTOMATIC SAFEGUARDS.

The newer devices are, as a rule, automatic. In passing upon them it is necessary to bear in mind the distinguishing characteristics of the service upon various lines of railway. For example, we believe it would be hazardous to attach to the front end of high-speed interurban cars, operated under conditions commonly met, automatic fenders which might upon occasion so fall or be thrown in the way of the car as to cause a derailment. On the other hand, there would be no such hazard in the use of an automatic wheel guard upon cars as ordinarily operated in city streets. The Board will therefore require an experiment with these wheel guards, though at times in winter snow and ice will undoubtedly interfere with their success.

DROP DEVICES

A fender or wheel guard that must be dropped by the motorman in case of threatened accident is open to the criticism that it complicates his duties at a time when he ought to give paramount attention to the stopping of the car. On the other hand, this device possesses an advantage over the automatic in that it is dropped only when needed and by intelligent action, and so can be carried at a height such as to eliminate risks from contact with obstructions. A very important change in this type of fender or wheel guard is that by which the application of the emergency brake itself drops it into position. A trial of these devices will also be required.

LIVERPOOL LIFEGUARD

Climate and roadbed make it possible in Liverpool to use a guard which is carried so close to the surface of the track as to be very successful in its one purpose of preventing bodies from passing under the wheels. While weather and roadbed construction prohibit upon many of our railways the use of a guard carried so close to the ground, wheel guards have been brought to our notice which possess some of the features of the Liverpool device and which are apparently capable of good work. The Board will require the use of these wheel guards upon selected cars.

RIGID FENDERS

Rigid devices projecting in front of cars are suited to the conditions upon some of our railways, but this type ought not to be confined to the straight platform fender. Whenever any such fender is hereafter used it must be attached to the car at a height of not less than 12 ins. above the track so that it will pass over a prostrate body without maiming or injury. Among fenders of this type are several designed to make it sure that a person tripping and falling upon them will remain there until the car is stopped. Lines of cars will be specified upon which these devices are to be used.

CONCLUSION

It is the purpose of the Board, in the enforcement of these views, to secure actual experience with different types of fenders and wheel guards that promise results better than those attained in the past.

Companies must complete designated changes in equipment on or before the first day of December, 1907, unless prevented by reasons beyond their control, in which case the necessary additional time will be allowed.

The details of the new equipment will be taken up with the Boston Elevated, the Boston & Worcester, the Boston & Northern and Old Colony, and with the Worcester, Springfield and Berkshire systems on Monday, the twenty-seventh day of May, at half-past 10 o'clock, and with other companies at a time to be hereafter named.

The plan of action proposed in this circular is of course subject to any change which may be rendered necessary should the Legislature in the measure now pending before it restrict the power of the Board.

(Signed) JAMES F. JACKSON,
GEORGE W. BISHOP,
CLINTON WHITE,
Commissioners.

A true copy.
Attest: C. E. MANN, Clerk.

OHIO ELECTRIC RAILWAY COMPANY ORGANIZED

The Ohio Electric Railway Company, of Cincinnati, has been incorporated with a capital stock of $100,000, by E. H. Berry, D. J. Downing, S. M. Murray, W. H. Schunert and C. Wilson, most of whom are connected with the Cincinnati Traction Company or the Schoepf offices, and the impression prevails that this is the company that will later control all the Schoepf roads in Ohio. At present the Schoepf properties are divided into three groups. The Indiana, Columbus & Eastern controls the roads about Columbus and Springfield, to the west from Dayton and northwest by way of Lima and Defiance; the Lima & Toledo is in the extreme Northern part of the State, and the Cincinnati Northern commands the situation between Cincinnati and Dayton. It is thought that these three systems will be combined under the new company. The application for its charter states that the termini will be Zanesville, New Paris, Richmond, Ind., Cincinnati, Toledo, Columbus, Washington Court House, Springfield, Defiance, Dayton, a point near Union City, Ind., on the Ohio and Indiana State line; Lima and Ft. Wayne, Ind. The counties through which it will pass are Muskingum, Licking, Franklin, Madison, Clark Greene, Butler, Warren, Montgomery, Preble, Hamilton, Champaign, Logan, Augliaze, Allen, Putnam, Defiance, Henry, Wood, Lucas, Pickaway, Fayette, Darke and Van Wert Counties in Ohio, and Wayne and Allen Counties, Ind. There are to be branch lines from Miamisburg to Germantown, Medway to New Carlisle, Hebron to Buckeye Lake and Newark to Granville.

STRIKE AT BIRMINGHAM

The employees of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., are on strike. President Jemison, of the company, declares that the union will be fought to the end. The city is very quiet, labor demonstrations being prevented by the police. A few cars are being operated on each line, guarded by deputies, and no attempt is being made to operate at night without sufficient police protection.

INDIANA INTERURBANS EXEMPT FROM 2-CENT FARE LAW

In response to a request from the Railroad Commission, Attorney-General James Bingham, of Indiana, has given an opinion to the effect that the 2-cent fare law, passed by the last General Assembly, does not apply to interurbans, but only to steam roads. The question has been raised by various individuals and corporations, several letters having been written to the Attorney-General. He referred them to the Commission, which, in turn, referred them back, and requested an official opinion.

The Attorney-General's opinion is based on the assumption that the Legislature did not intend this law to apply to interurbans; also, on the position that interurbans and steam roads were reckoned as being two distinct classes of transportation companies. Therefore a rate law applying to one need not necessarily apply to the other. The opinion continues:

"The purpose of the act in question was to reduce passenger rates, and it is a notorious fact that the passenger rates on interurban railroads were, at the time of the passage of the act in question, almost without exception, below the passenger rate named in the act, to wit: 2 cents; and it is quite evident that the legislation was not enacted with reference to rates that were already below, or at least not in excess of the maximum rate named, while on the other hand, the steam railroads in the State of Indiana were universally charging a passenger rate of 3 cents a mile.

"It is a part of the history of legislation that amendments to the bill were offered at the time when it was on its passage and under discussion in the General Assembly, by which it was sought to extend the same to interurban railroads and limit the passenger rate of such interurban railroads to 1 cent a mile, and these amendments were defeated on the theory that the act should not be made to extend to interurban railroads; and it is also a matter of common knowledge that interurban railroads are able to operate at much less expense than steam railroads, and to carry passengers at a lower rate a mile than can steam railroads, and it is in view of these facts that the interurban railroads have been enabled to give the cheap passenger rate which has made them popular throughfares for the local travel.

"It is, therefore, my opinion that the act in question has no reference to the interurban, electric or street railways of the State."

The Attorney-General's decision is being criticised and the question will be determined in the courts.

Two questions were thus involved. The first is, whether there is any real difference between the two sorts of railroads, and, second, whether (if there is not) the 2-cent fare law applies to both. The law is comprehensive in its terms. We quote:

"It shall hereafter be unlawful for any common carrier engaged in the carriage of passengers upon a railroad or railroads, between points in this State, to charge in excess of 2 cents per mile for the carriage of an adult passenger, or in excess of 1 cent per mile for the carriage of a passenger between 5 and 12 years of age."

THE STRIKE SITUATION IN SAN FRANCISCO

The United Railroads of San Francisco is now operating eight of its lines with 136 cars, the number being increased steadily since the strike began on May 5. Before the strike, 350 cars was the average in operation. The award of the board of arbitration, announced in March last, was to increase the wages of the men an average of 21 per cent, or to 31, 32 and 33 cents per hour, and payment in accordance with this award from September, 1906, of approximately $50,000, was made by the company in April. The company offered to continue this arbitration scale for one year from May 1, but the men demanded $3 for 8 hours work, or 37½ cents per hour. It is stated that the company can secure all the men necessary to operate its cars, providing sufficient protection is given to the company's property and its patrons. At the hour of going to press it is stated that the company will open five lines, which have been completely tied up since the trouble began. This indicates a complete victory for the company. The officers declare that the United Railroads will operate as a non-union road.

GENERAL ELECTRIC COMPANY ORGANIZES

At the annual meeting of the General Electric Company, held May 14, at Schenectady, N. Y., these directors were elected: Gordon Abbott, Oliver Ames, T. Jefferson Coolidge, Jr., Frederick P. Fish, George L. Gardner, Henry L. Higginson, Robert Treat Paine, 2d, all of Boston; C. L. Coffin, J. Pierpont Morgan, S. L. Schoonmaker, Charles Steele, all of New York; W. M. Crane, of Dalton, Mass.; Marsden J. Perry, of Providence, R. I.; J. P. Ord, of Albany, and E. W. Rice, Jr., of Schenectady.

On May 15, at the directors meeting in New York, the following officers were elected: C. A. Coffin, president; A. W. Burchard, assistant to the president; E. W. Rice, Hinsdill Parsons, B. E. Sunny, J. R. Lovejoy, vice-presidents; M. F. Westover, secretary; H. W. Darling, treasurer and assistant secretary; I. S. Keeler, second assistant secretary; H. P. Schuyler, assistant treasurer; Ed. Clark, general auditor; John Riley, assistant general auditor; S. L. Whitestone, assistant general auditor.

The duties of the various vice-presidents remain the same as before the election.

PHILADELPHIA & WESTERN SOLD

The Philadelphia & Western Railroad Company was sold at auction Monday, May 20, at Westchester, Pa., to Frank H. Brewster, of New York, for $1,000,000. Mr. Brewster, who was the only bidder, acted in the interest of William C. Sheldon & Company and Mackay & Company, of New York, who hold practically all of the stock and the entire $2,149,000 outstanding bonds of the company. The sale was conducted by the Trust Company of North America, a Philadelphia institution, which is the trustee of the $15,000,000 mortgage, and was a friendly proceeding.

"William C. Sheldon & Company and Mackay & Company will be the new syndicate managers," said Joseph S. Clark, general counsel of the company, "and will reorganize the company as soon as the legal formalities have been completed. This will require about three weeks. The new company will put out about $4,000,000 of bonds and bring the capital stock more on a parity with the bond issue than it is at the present time. George J. Kobusch, of St. Louis, while having disposed of the major portion of his holdings to the syndicate, will, however, retain a minority interest. The Philadelphia & Western will open for traffic on Wednesday."

CONSOLIDATION NEGOTIATIONS OF C. P. & E. AND NORTHERN OHIO TRACTION COMPANIES

Negotiations are under way for the consolidation of the Cleveland, Painesville & Eastern and the Northern Ohio Traction & Light Company, both owned by Henry A. Everett and E. W. Moore and their associates of Cleveland. The plan is to exchange the $2,000,000 common stock of the Cleveland, Painesville & Eastern for a like amount of the common stock of the Northern Ohio Traction & Light. The company has outstanding $1,631,000 bonds. Of these, $500,000 debentures bearing 6 per cent interest will be due July 1 of this year. The stockholders will probably take care of this by the purchase of a like amount of 5 per cent consolidated bonds which have been held in escrow for this purpose. This will reduce the interest expense of the company. The capital stock of the Northern Ohio Traction & Light Company is $10,000,000, of which $7,939,900 has been issued. The absorption will take up the greater part of this stock.

The Cleveland, Painesville & Eastern is made up of the Cleveland, Painesville & Eastern and the Cleveland, Painesville & Ashtabula. The latter is a comparatively new property and was taken over only a comparatively short time ago. The length of the two roads is 75 miles, which gives the Northern Ohio Traction & Light system a total of 285 miles of track. Willoughbeach Park is owned by the Cleveland, Painesville & Eastern. Originally it consisted of 100 acres of land, purchased at $500 an acre. Some time ago 20 acres were sold at $1,100 an acre and the remainder is valued at the same. The park proper takes up but 30 acres.

EARLY REPORTS OF THE AMERICAN STREET RAILWAY ASSOCIATION

Secretary Swenson, of the American Street and Interurban Railway Association, has collected and is now offering for sale bound sets of reports of the meetings of the American Street Railway Association from 1884 to date, as well as sets for a lower price with the first, second and third reports missing. Single copies of a number of the reports can also be secured from the secretary.

NEW STREET RAILWAY SYSTEM IN SAN FRANCISCO

A syndicate composed of New York and San Francisco capitalists is said to have been organized in San Francisco and will soon make an application to the Board of Supervisors of that city for a franchise for a system of electric street railways. In the syndicate are Leopold Michels, the Meyersteins and the Brandensteins, of San Francisco, and New York capitalists represented by Leopold Wallach.

Agents of the New York interests have been in San Francisco for several weeks and have completed a study of the streets and the engineering problems to be met in the construction of the proposed new system. Maps have been drawn and every detail said to be arranged. The syndicate lacks only the franchise to make its plans complete. The projected system contemplates a network of lines to cover the city from the ferry to the beach. Franchises for conduits in some places and for the overhead trolley in other streets will be sought. It is stated that a feature of the project calls for a subway. While the exact location of the proposed lines has not been announced, it is known that representatives of the syndicate have made a study of the grades from the ferry out Pine Street into the western addition and from the western addition along Franklin and Gough Streets into the Mission.

PROGRESS OF CONSTRUCTION OF MILWAUKEE NORTHERN RAILWAY

Such excellent progress has been made on the construction work of the Milwaukee Northern Railway, which will open up communication between the Eastern Wisconsin towns of Sheboygan, Port Washington, Fond du Lac, West Bend and numerous others in this populous district and Milwaukee, that the road will probably be ready for operation on at least one division by early summer. Except for short distances in the centers of some of the larger towns, the Milwaukee Northern roadbed is located on its own right of way, and in almost a straight line. There is but one curve on the line between Port Washington and Grafton, and that is one of only 2 degrees. For the rest of the distance almost without variation, except where the road crosses the tracks of the C., M. & St. P. and the C. & N. W. Railroads, the right of way follows a straight line. The absence of grade crossings is a feature which will insure safety from accident and permit a high-speed schedule. Where the road crosses twice, both the Northwestern and St. Paul tracks, subways of steel bridging and masonry abutments or viaducts are used. Just south of the depot at Port Washington the line runs under the Northwestern tracks, and again about a mile and a half outside the Milwaukee city limits. At Grafton the line passes over a steel viaduct 765 ft. long over the St. Paul tracks, and again over a viaduct of similar construction 454 ft. long at Mequon.

The complete power equipment was purchased from the Allis-Chalmers Company, of Milwaukee, and is of standard Allis-Chalmers design, both for gas engines and alternators. The electrical features of the equipment may be briefly described as follows: Three-phase alternating current will be generated in the power house at 405 volts by three direct-connected alternators, each of 1000-kw normal capacity, driven at 107 r. p. m. by Allis-Chalmers twin tandem gas engines, each with a rated capacity of 1500 hp. This equipment, when in operation, will enjoy the distinction of being the largest installation in America of gas-engine driven electric generating units for traction purposes. The main power house is located at Port Washington, and sites for sub-stations have been provided at the following points: Burleigh, Cedarburg, Georgia Avenue, Marblehead, Brown Deer, Cedar Grove, West Bend and Campbellsport.

WORKING MODEL OF NEW MONO-RAIL SHOWN TO ENGLISH ENGINEERS

Descriptions are contained in the English technical press of the new mono-rail system invented by Louis Brennan, C. B., of which a working model was exhibited at the meeting of the Royal Society in London on Wednesday, May 8, and about which sensational stories were published in the daily press here as a result of cable dispatches purporting to describe the system. The editor of "The Engineer," of London, at the invitation of Mr. Brennan, recently visited his house at Gillingham to witness some trials there of a model line, which he thus describes in his own paper:

"Briefly stated, the model mono-railway may be said to consist of a circular section rail laid on wooden sleepers on the ground, or it may be laid on piles, as would be required on the slope of a steep hill. In places the track consists only of a stout steel rope tightly stretched to represent the construction of a bridge across a ravine. The car somewhat resembles in shape a large pontoon or barge. Part of the inside is arranged for passenger accommodation and part for goods. The car is carried on two bogies, one at each end. These bogies are so pivoted that they allowed the car to turn easily on curves, and also vertical movement. By this means it is claimed that the vehicle can run upon curves of even less radius than the length of the vehicle itself, or on crooked rails, or on rails laid on uneven ground, without any fear of derailment.

"Each pair of wheels is coupled, and one in each set is driven direct through gearing from electric motors carried on the bogies. The power for propulsion is derived from a number of small secondary cells placed inside the car. But by far the most interesting part of the carriage is the means adopted for maintaining equilibrium, for it must be at once apparent that the center of gravity of the car is much higher than the center of buoyancy, and consequently it is an unstable body. To overcome this Mr. Brennan has introduced two gyroscopes, mounted on bearings, which run in a partial vacuum. These gyroscopes work in a vertical plane and run in opposite directions; they are connected together by suitable gearing so that their peripheral velocities are equal. This arrangement overcomes the difficulty which would be experienced in turning were they not so constructed. Special means are provided for advancing the precession of the gyroscopes and thereby causing them more quickly to return to the horizontal plane. The gyroscopes were motor-driven and ran at a speed of from 7000 to 8000 revolutions. This mechanism occupies little space, and it was stated that in larger cars it will only be about 5 per cent the total weight of the vehicle.

"The model was built essentially to illustrate the value of the invention for military use, and was therefore designed with a low speed—about 7 m. p. r.—but with good hill-climing capabilities. The trials, which lasted for some time, were successfully carried through. The car was loaded with weights representing 20 tons, and, in order to prove its stability, a weight corresponding to that of fifteen men was thrown suddenly on to the side of the car, and the side of the car on which the weight was thrown gradually rose to restore the position of equilibrium. To show how well the car could turn, an ordinary steel rope, about ⅝ in. in diameter, was laid on the lawn, and round the many turns specially arranged for the purpose the little car wended its way very gracefully. It appeared to experience no difficulty in climbing gradients of 1 in 5, and on one occasion the bank was said to be 1 in 2½; however, this was shot, and the car had a "rush" at it. But, loaded as it was, the climb up 1 in 5 was an excellent performance for so small a car. At the conclusion of the trials one gentleman, weighing nearly 10 stone, was given a ride round the minature track, and he finally crossed the wire bridge, which had a somewhat considerable span. That so small a car could take the weight it did and run so well shows that, whatever be the future of this type of mono-rail, there can be no question as to its success on the small line we had the pleasure of inspecting."

Mr. Brennan is at present engaged upon the construction of a full-sized vehicle, 12 ft. in length, similar to the model just described. It will, however, be driven by a petrol engine of 100 hp direct coupled to a motor. The gyroscope will be 2 ft. 9 ins. diameter, and will have a speed of from 2000 to 3000 revolutions per minute. The road wheels will be power driven, and change gears provided to facilitate hill climbing.

THE BINGHAMTON STRIKE PETERS OUT

The strike of the employees of the Binghamton Railway Company, of Binghamton, N. Y., has completely petered out. The regular schedule of cars is in operation, and the few men who went out are now seeking to be reinstated. Of the 150 platform employees in the service of the company on Friday, April 26, when the strike was declared, only fifty failed to report for duty. Briefly, on Wednesday, April 24, the management of the company learned that an organizer was in the city for the purpose of unionizing the employees, and subsequently was appraised of meetings held that night and the following day. As a result of these meetings a committee composed of three employees of the Binghamton Railway Company, and one Fitzgerald, of either Albany or Troy, as spokesman, called upon the company Friday morning, April 26. As the company refused to treat with the men with outsiders present, the committee withdrew, and at 5 p. m., as before mentioned, the strike was declared. Employees not affiliated with the union were afraid to take out the cars and their fears seemed not to be groundless, in view of the fact that the attempt to maintain service during the evening was followed by considerable disorder. The company, however, immediately engaged new help and with the assistance of the men who did not go out resumed a full schedule of cars within a very few days and now has all its cars in regular operation both day and night. Despite a general boycott in force throughout the city, conditions are improving daily and travel is fast regaining its normal condition. For the first ten days, however, the company did not operate cars after dark, and when strikers and their sympathizers became violent upon any division, cars were withdrawn from that particular line. The contention upon the part of the union has narrowed itself down to recognition, the questions of wages and hours having been waived.

SEMI-ANNUAL A. S. M. E. MEETING

At the semi-annual meeting of the American Society of Mechanical Engineers, to be held in Indianapolis, May 28 to 31, a wide range of subjects will be taken up and discussed. Accommodations for transportation and Pullman car service can be arranged for by addressing the secretary of the society. One of the professional sessions devoted to superheated steam will be held at Purdue University, and an opportunity will be given the guests after the session of going over the university. On Wednesday afternoon, May 29, a visit will be made in special cars to the Atlas Engine Works and the National Motor Vehicle Company. Another excursion on the same afternoon has been arranged for the D. N. Perry Manufacturing Company and to Nordyke & Norman Company.

MICHIGAN UNITED RAILWAYS ARRANGES TO TAKE OVER ADDITIONAL LINES

The Michigan United Railways, of Lansing, Mich., which operates 155 miles of electric railways in Kalamazoo, Battle Creek and Lansing, and connecting Lansing, St. Johns, Jackson, Battle Creek and Kalamazoo, has arranged to acquire, through W. N. Coler & Company, at a cost, it is understood, of about $1,250,000, practically the entire capital stock of the Jackson Consolidated Traction Company, including the holdings of W. A. Boland, and will purchase the minority shares on the same basis. The Jackson company owns and operates 30 miles of track in Jackson and vicinity, including interurban lines to Grass Lake, Wolf Lake, Michigan Center and Vandercook, and has outstanding $1,000,000 capital stock and $712,000 of an issue of $1,000,000 first mortgage 5 per cent bonds, due May 1, 1934. The two companies are to be merged under the name of Michigan United Railways.

PENNSYLVANIA LEGISLATURE ADJOURNS

The last few days of the legislative session at Harrisburg there developed some feeling between the Senate and House over the smothering in Senate committee of several bills in which Speaker McClain and his friends in the House were interested, and the House left "outside the breastworks" 64 Senate bills. One of the bills killed in the Senate was that permitting cities of the third-class to tax the real estate of electric and steam railways and other public service corporations. The Senate passed the Fahey trolley bill, companion measure for the bill drafted to carry out the provisions of the merchants' plan for rapid transit in Philadelphia. This bill had been defeated, but a motion was made by Senator Tustin, of Philadelphia, seconded by Senator Quail, of Schuylkill, both of whom had voted against the bill when it was up before, to reconsider the vote by which the bill failed on final passage. This motion was carried, after which the bill went through the Senate on its way to the Governor. This is the bill which prohibits the granting of charters to any street railway company until it shall first have obtained rights of way and the franchises from local authorities to construct the road.

The House bill fixing 5 cents as the maximum fare which can be charged by electric railway companies in cities of the second class passed the Senate, but the bill requiring electric railway companies to equip their cars with vestibules failed.

The Senate also passed the bill authorizing street railways to divert their routes and tracks. One of the Senate bills which fell in the House was the Brown bill, authorizing street railway and motor power companies to enter into contracts for the sale of electric power.

The Senate passed the House bill authorizing street railway companies to issue bonds for a longer period than thirty years.

The giving to electric railway companies of the right of eminent domain and the privilege of carrying freight, noted last week, are the most favorable measures that were enacted.

UNION ELECTRIC COMPANY AND GENERAL RAILWAY SUPPLY COMPANY CONSOLIDATE

The Union Electric Company and the General Railway Supply Company, both of Pittsburg, have consolidated, and the combined organizations will be operated under the name of the Union Electric Company, with a capital stock of $250,000. The Union Electric Company was organized in 1905 and the General Railway Supply Company in 1896. The offices and warehouses of both concerns are now located at No. 31 Pittsburg Terminal Warehouses. The new company will continue the sale of lighting, railway, power, telephone and marine supplies, and will also continue the agencies carried by the General Railway Supply Company, namely, R. D. Nuttal Company, gears, pinions and trolleys; International Register products; G. E. line material and rail-bonds; Crouse-Hinds arc headlights; Locke high-tension insulators and Wilson trolley clutches, also motor and controller parts for Westinghouse and General Electric apparatus. The officers of the new company are: George W. Provost, president; Percy R. Frost, vice-president and manager of the lighting department; J. P. Provost, treasurer; L. H. Keller, secretary. Thomas M. Cluley has been appointed manager of the railway department.

INDUSTRIAL ENGINEERING & SUPPLY COMPANY ORGANIZED

The Industrial Engineering & Supply Company, S. A., of Mexico City, has recently been organized by a number of prominent business and financial men who have a large acquaintance with the requirements of Mexican trade, to do a general machinery and supply business, and has acquired the four-story building at Alcanceria No. 27, where it will carry a large portion of its stock of goods and where it will make its general headquarters. The president of the company is W. W. Wheatly, formerly president and general manager of the Mexico City Tramway Company, who is also prominently identified with other important business and banking interests in Mexico City and Guadalajara. The general manager is James A. Peirce, who was formerly general superintendent of the Mexico Tramway Company, and who, at one time, was with Rossiter, McGovern & Company, of New York. The general sales agent, William C. Benbow, has been in Mexico many years engaged in selling mining, milling and manufacturing machinery and electric supplies, and is well known in these lines of trade throughout the country. The branch office of the Wellman-Seaver-Morgan Company has been moved from its former location at Second Dolores 10 to Alcaiceria 27, and W. C. Benbow will hereafter act as sales manager for both the Wellman-Seaver-Morgan Company and Industrial Engineering & Supply Company, S. A.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 41 Park Row, New York.]

UNITED STATES PATENTS ISSUED MAY 7, 1907

852,468. Motor Controller; Emmett W. Stull, Norwood, Ohio. App. filed July 30, 1906. The controller is provided with a plurality of drums with segments geared together and arranged so that the "full on" position of the controller may correspond to different speeds for city and suburban traffic.

852,525. Fluid Pressure Brake; William H. Sauvage, New York, N. Y. App. filed Nov. 21, 1906. Consists of the combination with the usual cylinder, piston and brake rigging, of a second cylinder and piston, a pipe extending from a port in the side wall of the first cylinder to a port in the pressure head of the second cylinder, a gripping device connecting the second piston with the brake rigging when the said piston is forced outward and means for releasing the gripping device when the second piston completes its return stroke.

852,628. Automatic Electrical Train Stop; Hiram G. Sedgwick, Mill Valley, Cal. App. filed Nov. 24, 1905. An automatic train stop for use with railroad crossings. Circuits are adapted to set the train stops on one track when trains approach in either direction on the other track.

852,629. Electrical Switch Lock for Railways; Hiram G. Sedgwick, Mill Valley, Cal. App. filed Nov. 24, 1905. Means whereby an approaching train will lock the switch automatically and release the same when the train has passed.

852,630. Railway Signal; Hiram G. Sedgwick, Mill Valley, Cal. App. filed Nov. 24, 1905. Relates to modifications of the above.

852,633. Train Stopping Apparatus; Hiram G. Sedgwick, Mill Valley, Cal. App. filed June 14, 1906. A block system in which sectional track rails are energized by direct potential, and operating rails set the semaphores when they are short-circuited by the axles of a passing train.

852,634. Electrical Train Stop; Hiram G. Sedgwick, Mill Valley, Cal. App. filed June 14, 1906. Relates to modifications of the above.

852,635. Automatic Electrical Train Stop; Hiram G. Sedgwick, Mill Valley, Cal. App. filed Jan. 2, 1907. Contact brushes on the locomotive complete circuits to the air brake apparatus so as to automatically stop the engine in case signals are disregarded.

852,767. Convertible Car; John A. Brill, Philadelphia, Pa. App. filed Nov. 20, 1906. The car has stanchions and movable side panels beyond the floor limits, and a filler for the space between the panel and floor, said filler being hinged to said panel.

852,768. Convertible Car; John A. Brill, Philadelphia, Pa. App. filed Nov. 20, 1906. A filler for closing the space between the panel and floor, consisting of a sliding plate, and projections on the opposing faces of the stanchions for supporting the plate, the car being provided with a horizontal recess below the surface of the floor for receiving the filler.

852,774. Car; Samuel M. Curwen, Haverford, Pa. App. filed Nov. 26, 1906. Means for facilitating the removal of the windows and the storing of the same in roof pockets.

852,782. Convertible Car; Harry E. Haddock, Collinwood, Ohio. App. filed July 7, 1906. A filler for the space under the windows between stanchions comprising a longitudinal plate having depending tongues which are provided with elongated slats and bolts securing the tongues to the stanchions through the slots.

852,808. Metallic Car; Warren M. Smith, Borough of Prospect Park, Pa. App. filed Sept. 17, 1906. Relates to detail of construction of a metallic "semi-convertible" car.

852,816. Car; Charles W. Benjamin, New York, N. Y. App filed Dec. 31, 1906. A "semi-convertible" car providing one sash with a pivot and holding flanges for the other sash so that when the sashes are moved abreast they may be swung together into chambers provided for them, or, vice-versa, they may be swung out of the chambers and into proper grooves to close the windows.

852,849. Fare Register; Adolph O. Schmolinski, St. Louis, Mo. App. filed May 31, 1906. A fare register so constructed that the inspector can impress or print his number or designating mark on a strip of paper arranged inside of the register and thereafter cause the register to become operative by inserting an operating handle therein.

852,851. Motor Controlling Rheostat; Frank J. Seabolt, Schenectady, N. Y. App. filed Jan. 14, 1907. A supporter for electric motors having two separate series of resistance contacts. Provides means whereby one resistance is short-circuited while the other is being varied.

852,912. Car; Warren M. Smith, Prospect Park, Pa. App. filed Sept. 15, 1906. Relates to means for fastening the window sashes in the roof of the car.

852,927. Rail Clip; Charles F. Clawson, Mount Pleasant, Iowa. App. filed Oct. 26, 1906. Comprises an integral bent steel member having apertured sides terminating in jaws adapted to grip the rail base, and a bolt passed through the apertures of said sides to draw the latter together. The clip abuts against the side of the tie.

852,933. Automatic Brake Hanger; Samuel M. Curwen, Philadelphia, Pa. App. filed March 19, 1906. Means for preventing "chattering" of the hanger.

852,969. Trolley Circuit Former; Gerald R. Livergood, St. Joseph, Mo. App. filed Jan. 29, 1906. A lever on the trolley pole is displaced by levers arranged adjacent the trolley wire so as to close the circuit for a sign actuator in the car.

852,978. Trolley; Alfred J. Reif, Allegheny, and Albert L. McCormick, Knoxville, Pa. App. filed June 2, 1906. Clips mounted on the trolley harp and adapted to close over the wire are normally held closed by a spring, but yield when hangers are engaged.

853,126. Rail-Spread-Indicating Device; Joseph A. Shires, Denver, Col. App. filed Oct. 31, 1906. A beam supported beneath the car has a pair of pins depending just outside the track rails. In case of spreading of the rails the pins are pushed outwardly to thereby close an alarm circuit on the beam which is telescoping.

853,135. Combined Railway Cattle Guard and Metallic Cross-Tie; Christopher Switzer and Frederick Sundman, Doe Run, Mo. App. filed Feb. 28, 1907. Details.

853,188. Automatic Curtain Hook and Release for Vestibule Cars; Clyde McCoy and William Morton, Los Angeles, Cal. App. filed April 4, 1906. Provides a bracket adapted to be fastened to abutting ends of cars for automatically releasing one of the ends of the vestibule curtains when cars are uncoupled or separated from each other.

PERSONAL MENTION

MR. JOHN H. DONNELLY, formerly master mechanic of the Toronto Railway Company, is dead.

MR. GEORGE FLETT, managing director of Dick, Kerr & Company, of London, is in New York on a short trip.

MR. F. L. REED, treasurer of the Shelburne Falls & Colrain Street Railway Company, has been elected manager of the company to succeed Mr. E. V. Maling, resigned.

MR. A. E. REYNOLDS, of Crawfordsville, Ind., has been elected president of the Indianapolis, Crawfordsville & Western Traction Company, to succeed the late Mr. A. F. Ramsey.

MR. WILLIAM S. HURLEY, of Brooklyn, N. Y., has been appointed a member of the New York Rapid Transit Commission in the place of Mr. Lewis Cass Ledyard, resigned.

MR. F. A. BAILEY, of the Columbus Railway & Light Company, of Columbus, Ohio, has been appointed superintendent of the Camden lines of the Public Service Corporation of New Jersey.

MR. FRANK SHORTON has been appointed superintendent of the Evansville & Eastern Traction Company, of Evansville, Ind., which will be opened for service between Evansville and Rockport, June 1.

MR. EVERETT F. KYLE has resigned as superintendent of the street railway department of the local division of the Consolidated Railway Company, at Norwalk, Conn., to become superintendent of the Sterling Salt Company's plant at Cuylersville, N. Y.

MR. ROBERT O'BRIEN, formerly in charge of the Claiborne street line of the New Orleans Railway & Light Company as superintendent, has been appointed to the position of division superintendent of the company with headquarters at the Arabella car house.

MR. R. N. BARROWS, formerly purchasing agent of the Washington Railway & Electric Company, and manager and purchasing agent of the Robertson Electric Company, of Buffalo, has recently been appointed Southern sales agent of the

Atha Steel Casting Company, of Newark, N. J., with office in Richmond, Va.

MR. JOHN HANF has tendered his resignation as master mechanic of the International Railway Company, to take effect June 15, 1907, or as soon thereafter as his successor can be familiarized with the company's system. Mr. Hanf was formerly connected with the Philadelphia Rapid Transit Company, the Hestonville, Mantua & Fairmont Park Railway, the J. G. Brill Company and the Wilmington City Railway Company. He has been connected with the International Railway Company since Jan. 18, 1900, and a number of important improvements to the company's property have been carried out under his supervision, the most notable work probably being the rebuilding of the Cold Spring shops, described some time since in these columns. Mr. Hanf, whose resignation from the Buffalo company was due to the necessity of his relinquishing for a time active managerial duties so as to fully recover his health, will again take up railway work after a short rest.

J. HANF

MR. E. M. RAVEN has resigned as superintendent of the local city lines of the Ft. Wayne & Wabash Valley Traction Company to become superintendent of the Ft. Wayne city lines of the company and will be succeeded at Logansport by Assistant Superintendent Rider, of the Ft. Wayne city lines.

MR. DAVID YOUNG, of Newark, N. J., has been elected president of the Lehigh Valley Transit Company, of Allentown, Pa., to succeed Mr. H. C. Trexler, resigned. Mr. Young is well known in street railway circles, having formerly been general manager of the North Jersey Street Railway Company, now part of the Public Service Corporation of New Jersey. More recently he has been with Brown Brothers, of New York, bankers, as an expert street railway adviser. Mr. Young was born in Scotland, but came to this country when a young man and settled at Newark. He at once entered public life and at the age of twenty-six was elected to the Council, and at twenty-eight was made president of that body. Subsequently he served as a member of the General Assembly of the Legislature.

MR. J. N. SHANNAHAN has resigned as general superintendent and purchasing agent of the Fonda, Johnstown & Gloversville Railroad, and as president of the Adirondack Lakes Traction Company, of Gloversville, N. Y., to become general manager of the Washington, Baltimore & Annapolis Railway, now under construction between the cities mentioned in its title and soon to be placed in partial operation. Mr. Shannahan was graduated from Rensselaer Polytechnic Institute in 1894. Entering the employ of the Government he worked for nine months as a draughtsman at the Watervliet Arsenal. This position he resigned to enter the service of the New York Central Railroad at Rochester, N. Y., as inspector of signals. After several years service with this company he became connected with the Fonda, Johnstown & Gloversville Railroad as chief engineer. This was in 1899 and just about the time the Fonda, Johnstown & Gloversville Railroad was being partially equipped for electric operation. In this way during the next four years Mr. Shannahan had charge of building the double-track electric line between Gloversville and Schenectady, and the single-track line between Amsterdam and Hegeman. Jan. 1, 1903, Mr. Shannahan was made general superintendent of the company, in charge of both steam and electric operation and at the same time was elected manager of the Edison Electric Light & Power Company, of Amsterdam. Early in 1904 he was elected president of the Adirondack Company. For several years Mr. Shannahan has taken an active interest in the affairs of the New York State Street Railway Association, of which body he is at the present time the president, having been elected to that office in June, 1906. Mr. Shannahan also is an associate member of the American Society of Civil Engineers and during 1905 and 1906 served as president of the Rensselear Society of Engineers. He will be succeeded in the Fonda, Johnstown & Gloversville Railroad by Mr. W. H. Collins, master mechanic of the company.

J. N. SHANNAHAN

MR. A. C. MURRAY has been appointed assistant general superintendent of the Southern division of the Illinois Traction Company, with headquarters at Staunton, Ill. Mr. Murray was formerly assistant to General Manager Fisher, of the Illinois Company. At one time Mr. Murray was purchasing agent and assistant general manager of the Indiana Union Traction Company.

MR. JOSEPH BUDREAU has resigned as superintendent of construction of the Consolidated Railway Company's lines at Hartford, Conn., to become superintendent of construction of the Scranton Railway Company, of Scranton, Pa. Mr. Budreau was connected with the Hartford Company thirteen years and supervised the work of installing electricity on a number of lines in that city. At Scranton Mr. Budreau will be associated with Mr. Frank Caum, the general manager of the Scranton Company, who formerly was connected with the Hartford company.

THE IMPROVED CONDITIONS brought about in Pennsylvania through the passage by the Legislature of the electric railway bills referred to in the last issue of this paper will undoubtedly result in increasing prosperity for both the country residents and the railway companies of that State. The credit for this reform belongs in large part to the educational campaign conducted by the Temporary Street Railway Association of the State of Pennsylvania in collecting statistics from other States to show the value of interurban roads to the country resident, and draws attention to this organization and its president, Mr. W. E. Harrington. Mr. Harrington is a native of Pennsylvania, having been born in Wilkesbarre in 1866. He was graduated in 1887 with the degree of B. S. from the University of Pennsylvania, where he was the holder of a scholarship awarded by the City of Philadelphia and won by him in competitive examination. Since his entry into the electric railway business he has made a successful record as a street railway operator and engineer. For the eight years ending in 1904 he was general manager and vice-president of the Camden & Suburban Railway Company. After the lease of this company to the Public Service Corporation of New Jersey, Mr. Harrington occupied, for a short time, the position of manager of the New York-Philadelphia Railway and its allied properties, but in July, 1905, accepted the position of operating manager of the electric railway, lighting and gas properties of J. G. White & Company, of New York. In this capacity he was called upon to develop the properties of the Eastern Pennsylvania Railways Company, which owns the gas, electric lighting and railway interests centering at Pottsville, Pa. He is now president of the Pottsville Union Traction Company, the Edison Electric Illuminating Company, of Pottsville and Tamaqua, the Minersville Electric Lighting Company, the Citizen's Gas Light Company, of Tamaqua, and some twelve subsidiary companies. In 1904-05 Mr. Harrington was a member of the executive committee of the American Street Railway Association and has served for a number of years on the standing rules committee and the committee on the promotion of traffic of that body and its successor, the American Street and Interurban Railway Association. He was largely instrumental in the organization of the Temporary Street Railway Association of Pennsylvania and made a number of addresses at Harrisburg before legislative committees on the four electric railway reform measures which have just passed the Legislature. These bills grant, among other privileges, the right of eminent domain and the right of electric railway companies to carry light freight.

W. E. HARRINGTON