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THE CITY OF ST LOUIS AND ITS TRANSPORTATION SYSTEM

THE internal transportation facilities of a great city have so strong an influence upon its development, its prosperity, its expansive forces and the daily life of its people that it is difficult to draw the line between cause and effect—to analyze the complicated actions and reactions that result in municipal prosperity and street railway prosperity so as to know whether the former has brought about the latter or the latter the former.

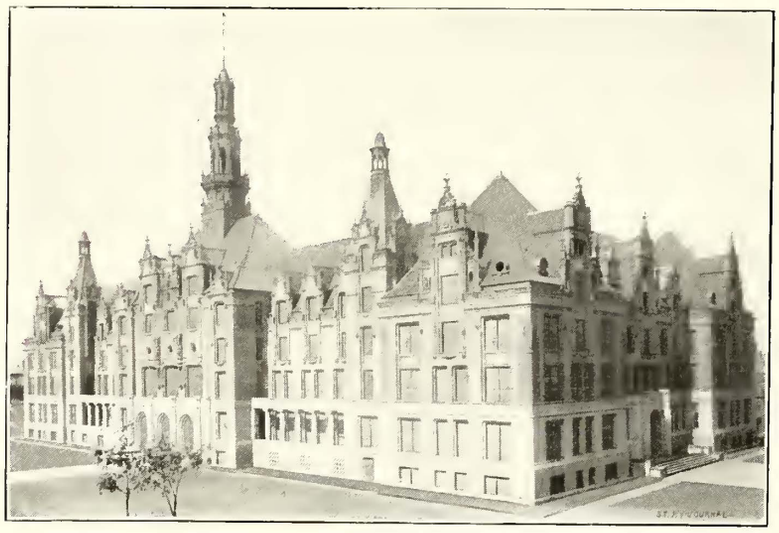
The rapid growth of American cities during the last thirty-five years is the marvel of the world. During this period the street railway systems of nearly all of these cities have been born and have been factors of tremendous importance in shaping these expanding cities and making them broad and generous and far reaching in their territorial areas, with room for thousands of individual homes—and no room nor occasion for the wretched tenement house districts so common in the small and crowded areas of European cities.

While these remarks are true of most American cities, they are especially applicable to the city of St. Louis, whose street railway system is to-day one of the most perfect, from the point of view of service to the public, to be found in the world. St. Louis has an area of 62.5 square miles, with a population of about 8000 per square mile—the smallest population density with one exception (Chicago) of the six large American cities. The city is fan-shaped as regards its lines of communication, the business heart being a small district which lies at the extreme eastern central portion of the city's area. The shuttles that weave together the business, the manufacturing and the residential areas contained within the city limits, and which have brought about a fairly even distribution of the population over this total municipal area are the rapid transit street railway lines, which have grown from a total length of 120 miles, carrying 19,600,000 passengers in 1880 to 346 miles, carrying 103,000,000 passengers in 1895 and have, during the last six years of electric traction, built up the real estate valuations in the outlying territory to an extent which would be astonishing to those not familiar with the recent history of other American cities.

THE LEVEES OF THE MISSISSIPPI RIVER AT ST. LOUIS.

In order to thoroughly understand the street railway system of St. Louis and to form some idea of the forces

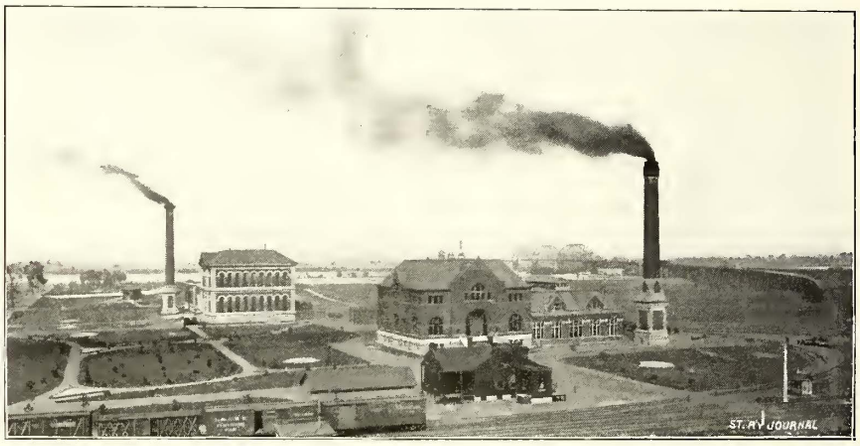
bearing upon its prosperity, it is necessary to first understand the city itself and its people. What is to be the future of St. Louis? Are her people strong, masterful, aggressive, active and cultured? Are they broad minded and generous? Are they careless of the nickels which go to make up the gross receipts of a local transportation system? What is their ancestry and how have they expressed themselves in their buildings, their municipal government, the administration of the city, and their own business? Is St. Louis to be a great metropolis in the West? All these are questions which mean much to the street railway managers of St. Louis and may well be considered in a general way before discussing in detail the physical characteristics and operating conditions of the street railway system itself.



THE NEW CITY HALL (UNCOMPLETED).

St. Louis is situated on the west bank of the Mississippi River 600 miles from New Orleans (1240 miles by river) and 265 miles from Chicago—its two nearest competitors for the business of the great West and Southwest. It is one of the greatest railroad centers in the world, no less than twenty-four great trunk systems with an aggregate mileage of over 60,000 radiating from the city. It is unquestionably the natural metropolis of the Southwest and even of more eastern cotton growing states, while not a little of the business of other states, north, east and west centers in the city.

The city has a water front of about nineteen miles on the Mississippi and rises from it in three terraces, of which the most western is about 200 ft. above the river level. The city is divided nearly in the center by the valley of Mill Creek running east and west and crossing this are a number of fine bridges connecting the north and south sides of the city. The street plan is similar to that of Philadelphia, Market Street, running east and west, being the dividing line while many of the streets running north and south are numbered. The general location of the business and residential areas is shown on another page.



THE NEW WATER WORKS.

THE COURT HOUSE.

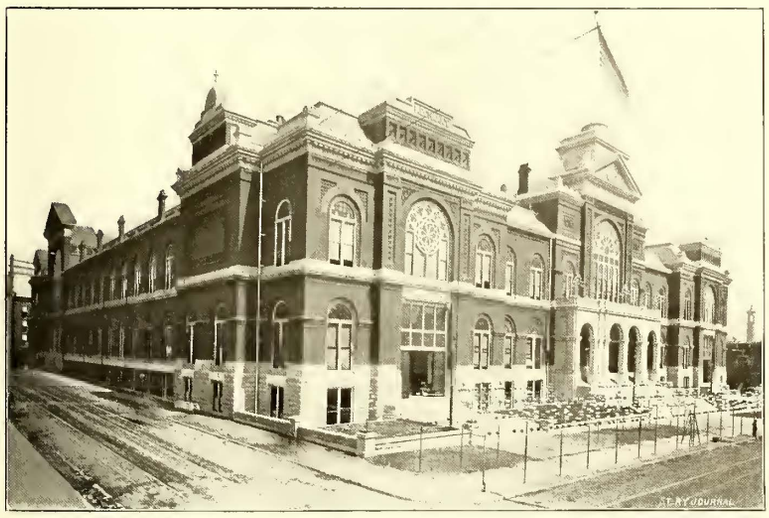
On page 563 is seen a diagram showing the rapid growth in population since 1820. As near as can be judged from the results of a house to house canvass made by the city in 1896, and by which the number of males of voting age was ascertained, the total population of St. Louis is to-day about 521,000 although 600,000 is locally claimed, The distribution of this population over the city area is shown elsewhere.

St. Louis was originally a fur-trading post established in 1764, by the New Orleans firm of Maxent, Laclede & Company. Its early settlers were French and their descendents are found to-day in some of the leading families of the city. During the comparatively brief sovereignty of Spain over Louisiana there was little or no infusion of Spanish blood in the settlements of "upper Louisiana," and Missouri was left virgin territory to await the great immigration from the New England and Eastern states of the Union which came when the title to the vast territory west of the Mississippi passed to the United States in 1804. The population grew slowly until 1840 when the rapid increase shown in the diagram commenced. In 1848 com-

menced a great accession to the German element in the population which is so marked at the present time when about one-third of the entire population is German in birth or by descent. This German element has been of the greatest value to St. Louis as the immigration consisted largely of university-bred men of progressive and highly intellectual character, who have readily adapted themselves to American institutions and who have been strong believers in education.

Among the people of St. Louis are also found great numbers of the descendents of early pioneers from New York, Ohio and the New England states, although there is perhaps less of this element than is found in some other states and cities of the West. Altogether about twenty-five per cent of the entire population of St Louis is foreign born—a proportion much larger than that found in most other American cities.

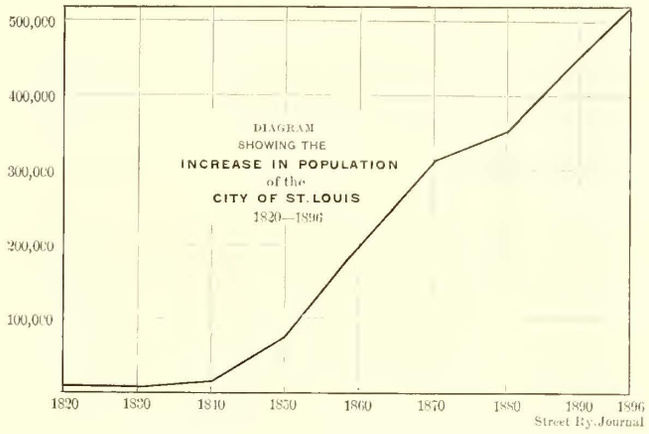
It is noteworthy, however, that only about six per cent of the total population is colored. This removes St. Louis at once from the list of Southern states and places it firmly in the North. Of the population of New Orleans, for example, thirty-six per cent is colored; of the population of Louisville,



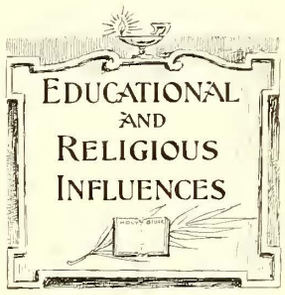
THE EXPOSITION BUILDING.

eighteen per cent; of Atlanta, forty-three per cent; and of Memphis, forty-four per cent. From a street railway point of view a colored population is both a strength and a weakness—a strength in times of prosperity and plenty, for when the colored element has money, nothing is so sure to attract that money than the street cars; a weakness in bad times when there is no employment to be had for any except the highest class of the colored people.

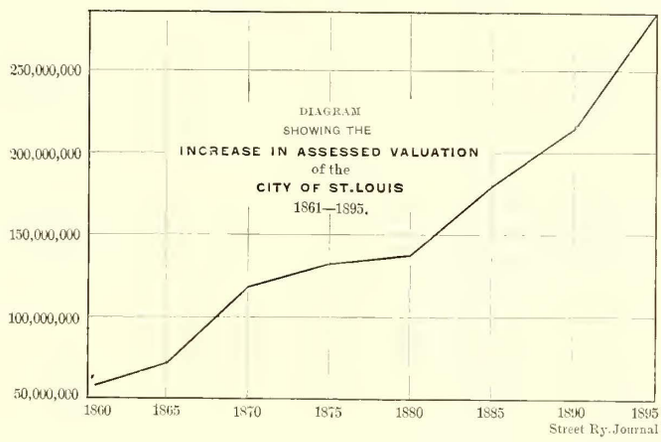
Socially, St. Louis people are among the most delightfully gracious and hospitable in the world. In a business way they have a fine talent for organization and are enterprising and ever watchful of all conditions bearing on success. In pleasure seeking they are indefatigable, the German element of the population contributing especially to the profits of the street car companies in their week day and Sunday "outings" to the parks, beer gardens, picnic grounds and other pleasure resorts of the city. In civic pride and desire for municipal expansion there has been a great awakening during the last few years and no city can boast of a stronger and more coherent force of business men that is found in the membership of the Merchants' Exchange which has done so much to advance the city's interests in every department of work. In temperament St. Louis citizens are neither volatile nor heavy, neither radical nor conservative, neither unduly economical nor



careless of small expenses. They do not, as in New York, take a street car to ride a half dozen blocks, but they do not hesitate to go *en famille* to the parks on a pleasant summer night at a cost for transportation of a good half dollar. Altogether, in this people of St. Louis is exhibited a type of citizenship which cannot be surpassed and which from a street railway profit earning point of view leaves little to be desired. No city in the United States has passed through these last four years of hard times with less strain on the commercial and financial fabric. In no city have hard times been less seriously felt by street railway companies in gross receipts as will be seen from the statement of passengers carried, as follows: 1892—1,883,-8029; 1893—95,703,632; 1894—95,701,770; 1895—102,997,772.



Systematic education was little cared for in Missouri before the war, but in 1857 the groundwork was laid for what has become one of the best and strongest public school systems to be found in any American city. It has already been said that the German element of the population has been thoroughly educated in the Fatherland and it was not hard to



arouse in the civic body an enthusiasm for popular education which has clearly manifested itself to the

lasting benefit of the city. The public school system is to-day exceptionally fine. It leads the students from the earliest beginnings in the fifty-eight public kindergartens of the city through fine primary, grammar and high schools to Washington University which is one of the most remarkable educational institutions in the country. It has an exceptionally broad charter permitting it to establish its auxiliary schools of Fine Arts, Law, Medicine, Dentistry, Botany and Manual Training—this last named said to be the first school of its kind on the American continent. The school of botany is due to the philanthropic wisdom of Henry Shaw who established and endowed the fine botanical garden which bears his name and which is conducted by Washington University. This serves not only to educate scientific botanists, but has a department devoted to instruction in market gardening and other practical lines of study. It is said that no living botanist can become acquainted with the genealogy and the growing representatives of the Cactus family without studying the immense variety to be found in the Shaw gardens. Only the parent building of Washington University is shown in the illustration, the allied schools being found in separate, and in many cases architecturally beautiful buildings.

TWO ST. LOUIS EDUCATIONAL INSTITUTIONS.

There are many denominational and sectarian colleges and universities in the city in addition to Washington University, the most noted. It is said that few residents of St. Louis think it necessary to send their children away to complete their education, while large numbers come to the city for this purpose from various parts of the West and particularly from Mexico, which annually sends not a few students to St. Louis.

Among other educational influences found in the city are innumerable private schools and night schools; several courses of lectures conducted by Washington University by some of the leading lecturers of the country; the work of the Ethical Culture Society which has established in various parts of the city wage earners' self-culture clubs and domestic economy schools for both sexes; the Mercantile Library which is a private corporation and dates from 1846; and the Free Public Library which has established substations in various parts of the city and which is administered in a broad and exceptionally able manner; together with the various non-sectarian clubs, of which St. Louis has not a few, which carry on independent lines of study to an extent probably found among American cities only in New York and Boston.

A St. Louis Sunday is a very different thing from a New England Sunday, but the 250 churches of the city nevertheless exercise a strong influence upon the life of the people, not only in a religious way *per se*, but also through the various auxiliary societies which are usually intended to bring a parish into closer touch with its church home. Architecturally, the churches are not, with one or two exceptions, remarkable, among the exceptions being the Episcopal Cathedral and the Church of the Messiah, which is thought to be the handsomest building in the city, and one of the finest church buildings in America. The first, a Congregational church, is also a stone structure, dignified and in good taste architecturally.

MUNICIPAL GOVERNMENT AND SOME ADMINISTRATIVE FEATURES

Prior to 1876 the city of St. Louis was embraced in the county of St. Louis. Both the municipal and county administrations were highly extravagant and taxes in the city came to be very burdensome. St. Louis City determined to obtain if possible a separate charter, and the work of preparing the scheme of separation was entrusted to a board of thirteen freeholders elected by the people. The scheme and charter were adopted at a special election in 1876 and the city then became wholly independent of county control—a "free city" not unlike some of the great free cities of the old world. It levies and collects its own revenue and

the state revenue within its limits and conducts its own affairs, except for the supreme power of the Legislature.

The legislative power of the city is exercised by the Municipal Assembly which consists of two branches, a Council and a House of Delegates. The Council is composed of thirteen members elected for four years on a general ticket by the voters of the city, and the House of Delegates consists of one member from each of the twenty-eight wards elected for two years by the voters of the ward.

The executive branch of the government consists of the Mayor, Comptroller, Auditor, Treasurer, Register, Collector, Recorder of Deeds, Inspector of Weights and Measures, Sheriff, Coroner, Marshal, Public Administrator, President of the Board of Assessors and President of the Board of Public Improvements, all of whom are elected by the voters of the city for a term of four years. The Mayor appoints with the consent of the Council all other administrative officers of the city. Any appointed officer may be removed by the Mayor or Council for cause, and any elected officer can be suspended by the Mayor and removed by the Council for cause.

It will thus be seen that large powers are given to the Mayor, and St. Louis was one of the first municipalities in the country to recognize the wisdom of placing upon a single executive head the full responsibility for good government. This novel scheme of city government became, at the time of its adoption, a fruitful theme for discussion among students of municipal administration, and its main features have been incorporated in the charters of other American cities. One of the interesting features of the city's charter is found in the Board of Equalization, whose duty is to judge, correct and equalize the valuation of real estate and personal property in the city, and which consists

BUSINESS STREETS IN ST. LOUIS.

of the President of the Board of Assessors "and four discreet and experienced real estate owners of St. Louis of a prior residence therein of ten years," who are appointed by the judges of the Circuit Court.

The Municipal Assembly has the right to pass upon all questions involved in the construction or regulation of street railways in the city limits, including the right of imposing *per capita* taxes, taxes on gross receipts or taxes on cars, real estate and other property, the regulation of the time and manner of running cars, the rates of fare, one miles with limestone blocks, 292 miles with broken stone, and ten miles with wood. Gravel was used only as a top dressing on macadamized streets. The limestone blocks were used chiefly in alleys, and were suitable only for very light traffic, and the broken stone pavement was extremely bad, as it was impossible to keep it clean, and its surface alternated between dust and mud, according to weather conditions.

Ten or twelve years ago a movement to improve the pavements of St. Louis commenced. The work could not

PARK SCENERY IN ST. LOUIS.

and the sale and exchange of tickets. It is also provided in the charter that any street railroad company shall have the right to run its cars over the tracks of any other street railroad company in whole or in part, on the payment of just compensation for the use thereof and compliance with such rules and regulations as may be prescribed by ordinance, "and it shall be the duty of the Municipal Assembly to immediately pass such ordinances as may be necessary to carry this provision into effect."

One of the surest tests of an efficient city government is found in the condition of its streets. Until recently St. Louis pavements have been exceedingly poor. In 1880 the total length of the streets and alleys was 450 miles, of which one mile only was paved with granite blocks, fifty-

be done with the city funds, as the limit of debt had already been reached, and a policy of assessing the property owners for the new improvement was adopted, not, however, without bitter opposition on their part. This opposition has, however, entirely passed away, as it has been found that the value of property so improved has increased far more than the cost of the improvements.

At the present time about fifty miles of the streets are paved with granite blocks, and twenty miles with asphalt and wood. Brick pavements have been used to some extent. Even yet, however, the work of repaving has not gone on so rapidly as will doubtless be the case during the next ten years.

The water supply of St. Louis is obtained from the

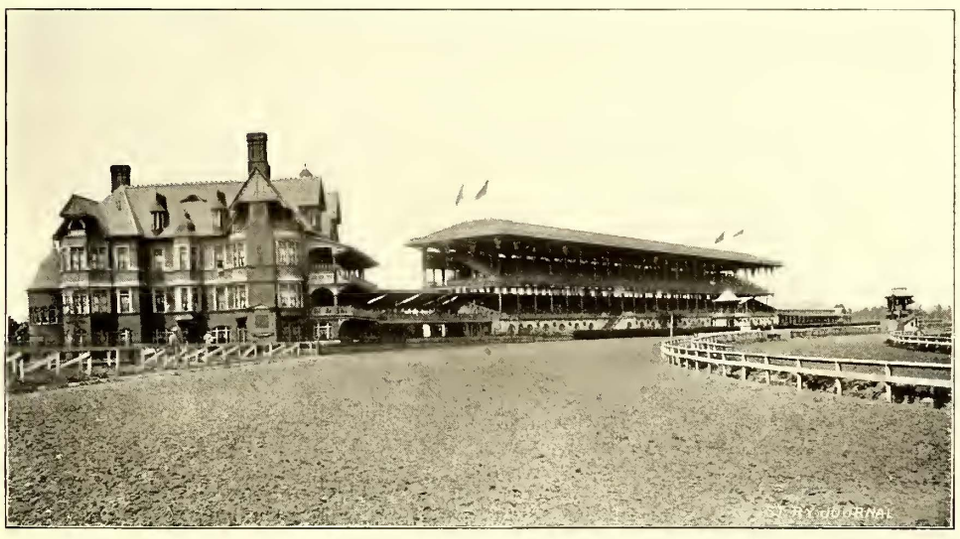
Mississippi River. It is not attractive in appearance, but it is said to be entirely free from disease germs, and with proper filtration it becomes as good drinking water as can be found in most American cities. About 50,000,000 gals. per day are used, and the gross revenue to the city is about $1,200,000 per annum.

The city is well and economically lighted by electricity, the rates paid being exceedingly low, because of the sharp competition some time ago of a number of rival companies.

It has already been said that the city is divided into north and south sides by Mill Creek Valley. Mill Creek itself was long ago filled in, but the valley has been of great value to St. Louis, inasmuch as it has furnished a means of entry to all the steam railroad systems centering in the city. The terminus of the famous Eads Bridge, crossing the Mississippi River, is connected with the Union Station, which lies in Mill Creek Valley, by a tunnel, and access to the valley is thus obtained from the east, while its upper end emerges upon the great plains broadening to the westward.

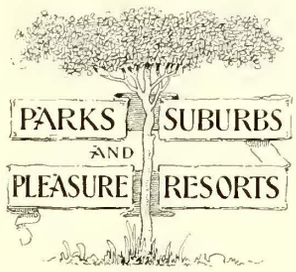
LAFAYETTE PARK AFTER THE CYCLONE OF 1896.

Now in connecting the north and south sides of the city a number of bridges and viaducts across this valley have been built by the city at a large aggregate expense. Among these are the Twelfth Street, Fourteenth Street, and Eighteenth Street bridges, the last named, built in 1884, costing $160,000; the Jefferson Avenue bridge built in 1881 and costing $80,000; and the Grand Avenue bridge completed in 1889 and costing $440,000. This Grand Avenue viaduct is a fine engineering structure, 1600 ft. in length and sixty feet in width. A number of additional bridges are building and projected.



CLUB HOUSE, GRAND STAND AND RACE TRACK AT THE FAIR GROUNDS.

The city has a very extensive sewer system and through Mill Creek Valley, following the channel of the old creek itself, runs the main trunk sewer. The city's garbage, however, is not, as was formerly the case, thrown into the Mississippi River to the disgust and injury of the towns and cities lower down on the river, but is now turned into commercial products and forms a source of revenue to the city and of private profit to contractors.



The suburbs of St. Louis without its city limits have not, until within the last two or three years, played much part in the life of the people, chiefly because of lack of communication except by a comparatively infrequent railroad service. Now, however, there are rapid running electric lines to Clayton, the county seat, to Kirkwood and Meremec Highlands, ten and twelve miles away, and to Florissant, an old French village fifteen miles northwest of the city. All these lines pass through most delightful farming country, covered with fine trees and giving passengers beautiful vistas of valley and hill scenery. Now, therefore, St. Louis is beginning to reach out for pleasuring beyond its own beautiful park system and it is not improbable that there will be a good deal of residence building along these lines of electric communication, although the city itself is so large in area and contains so much as yet unoccupied territory suitable for residence purposes that a still further expansion into St. Louis County is not by any means certain as far as the immediate future is concerned.

The parks of St. Louis are perhaps its chiefest charm. In no other American city, with the single exception of Philadelphia, is the area of parks so large, and in few cities are the parks more delightful, some because of careful cul-

tivation and wise attempts at beautifying, others, such as Forest Park, because nature has been left largely free to work out her own effects. There are no less than eighteen of these parks and squares large and small, from little Gamble Place containing not much over an acre of land, to Forest Park containing 1372 acres. The total park area is 2150 acres of which about 1700 have been acquired by purchase, and nearly 300 by private donation. Altogether the city has spent in purchase and improvements of these parks about $4,000,000.

Forest Park, the largest of all, is situated in the extreme western part of the city and is reached by several of the street railway systems of the city, which naturally derive a large revenue from the summer traffic. This park has twenty or thirty miles of excellent drives, and considerable money has been spent in making beautiful lawns in various places. The river Des Pères flows through the park and forms a prominent feature in its scheme of ornamentation. Tower Grove Park was donated to the city by Henry Shaw with the provision that a certain sum of money should be spent on its improvement. The landscape gardening in this park is exceedingly fine. Shaw's gardens are not included in the park area referred to, as they form really, as before stated, a department of Washington University in connection with its school of botany.

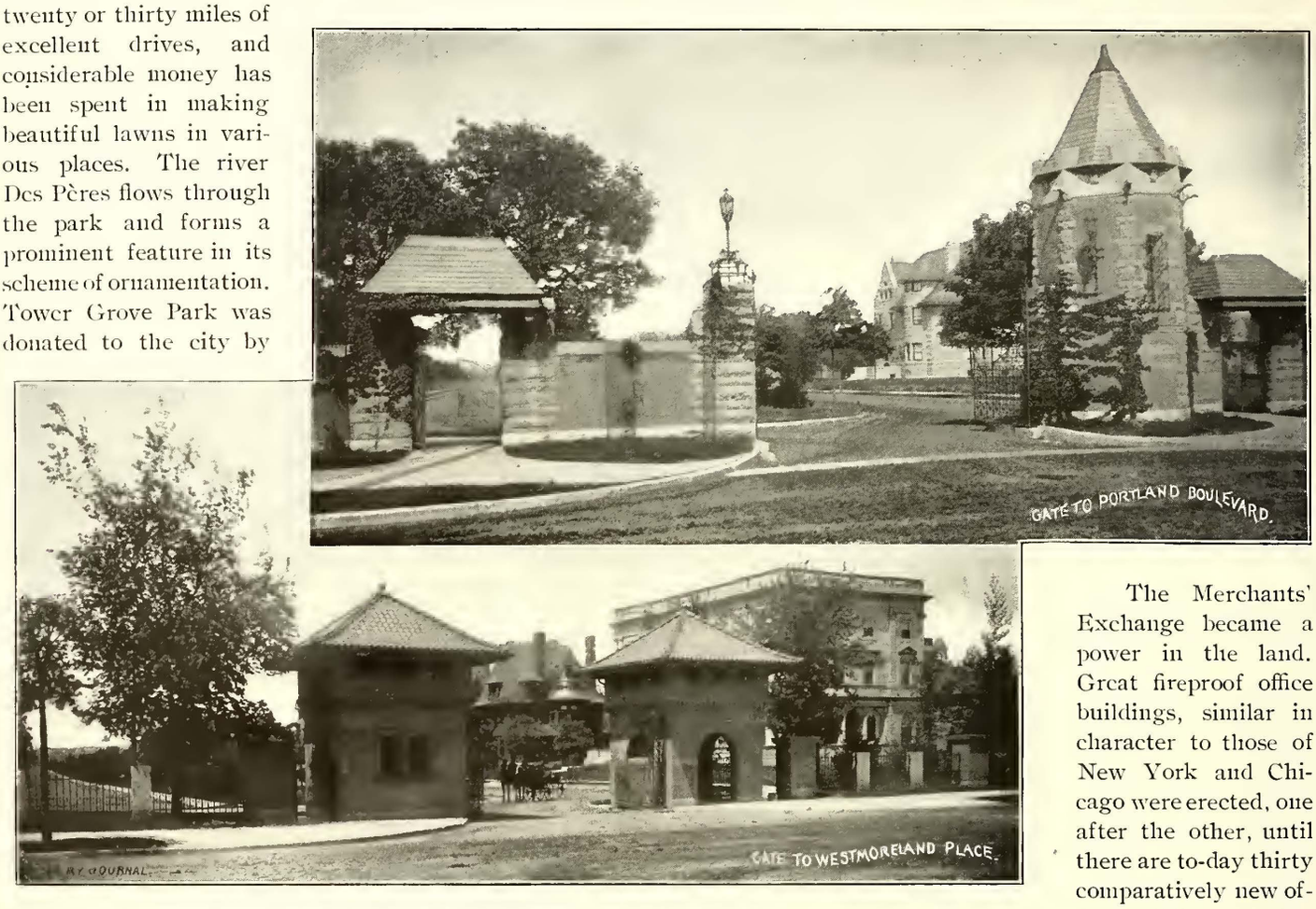
The tears of the city have been freely shed during the last six months because of poor Lafayette Park which was, until the cyclone of 1896, one of the most beautiful and best loved garden spots in the city, but in which the cyclone did its worst work, breaking down trees of fifty years' growth as if they had been mere shoots of the present and leaving a scene of devastation heartrending to those who love trees and shrubs almost as human beings.

O'Fallon Park and Carondelet Park are also large pleasure grounds of the city and are attractive, but not particularly "improved."

Among other popular resorts in the city may be mentioned Jefferson Barracks, a United States army post where a grand parade is held at noon on Sunday, numerous beer gardens patronized in the summer, and the theatres, of which there are eight or ten varying in quality and character of performances.

HOSPITALITY AND ENTERPRISE

Some eight or ten years ago there came a great awakening in St. Louis, a realization of the possibilities of the future, an ambition to be counted among the great cities of the world, and an all conquering determination to break down every obstacle in the way of a larger civic life.



GATES TO PRIVATE PLACES IN ST. LOUIS.

The Merchants' Exchange became a power in the land. Great fireproof office buildings, similar in character to those of New York and Chicago were erected, one after the other, until there are to-day thirty comparatively new office buildings costing $500,000 or upwards, each, among them the Union Trust Building, the Security Building, the Wainwright Building, the Equitable Building, the Laclede Building and the Turner Building, all giving to the heart of the business district a solid and substantial character and an air of prosperity.

In 1890 came the competition among American cities for the Columbian Fair and the greatest possible effort was made by St. Louis to capture the prize. The city failed, but not until the world learned to know that another great American city disputed the palm of Western supremacy with Chicago. The failure to secure this prize led to other consequences. The merchants of St. Louis determined that it should not again be said that their hotel facilities and powers of entertainment are inferior to those of any other city in the world. The "Autumnal Festivities Association" was organized to provide for St. Louis an annual festival rivaling the Mardi Gras of New Orleans and a systematic effort to advertise the city all over the

world was inaugurated as a part of the work of the Merchants' Exchange. Committees of the latter were appointed to deal with questions relating to the improvement of the Mississippi River, the railroad transportation conditions, the postal facilities and the increase of trade with all parts of the world. Arrangements were made with the principal newspapers of the country and with the Associated Press for an increased news service from St. Louis, while the local newspapers—among which the *Globe-Democrat* and the *Republic* are among the most influential in the country—lent every assistance in the movement towards a larger civic growth.

Not a little of this awakened energy and push radiates from the great St. Louis clubs which form a prominent feature in the business and social life of the city. The Mercantile Club has a membership of over 1000 and many meetings of a semi-public character are held in its fine building. The Commercial Club is closely interested in municipal government and municipal growth. The Business Men's League is incorporated under the laws of Missouri and has for its object the guarding of the interests of St. Louis in every possible way. Among other clubs in St. Louis are the University, St. Louis Club, Country Club, Union Club and the Jockey Club. The latter owns a magnificent race track at the fair grounds which cover 140 acres and at which the autumn festivities are held during the first week of October, these festivities including the "Procession of the Veiled Prophet." On the "Big Thursday" of fair week, the fair grounds are frequently visited by from 125,000 to 150,000 people.

The St. Louis Exposition has been held annually for fourteen years, and is similar in character to the Mechanics' Fair of Boston, although a large number of the exhibits are in the form of agricultural products from the West and Southwest. The Exposition is held in a special building costing $1,000,000, and it is said that a profit has been realized in every year since the beginning—a very unusual thing. The original stockholders were actuated by motives of public spirit in subscribing for the company's stock, but the bonded debt has been cleared off and small dividends are now being paid.

The hospitality and good cheer which are characteristic of St. Louis society are exemplified in its hotels, which are among the finest and best managed in the country. For many years the Southern Hotel has been, perhaps, the best known hostelry in the Southwest and has been the scene of hundreds of political and other gatherings as well as the place at which the cotton planters of the South and Southwest annually repaired to dispose of their crops. It has been the headquarters of several conventions in this great convention year and one of these will be that of the American Street Railway Association this month.

Three or four years ago a large sum of money was raised among the citizens of St. Louis to be donated to capitalists who should build a large fireproof hotel to cost not less than $1,000,000, and from this beginning the Planters' Hotel costing $2,000,000 and giving accommodation to about 1500 guests has been built. Other hotels are the St. Nicholas accommodating 250, the Lindell 800, the Laclede, the St. James, the Terminal, etc.

PRIVATE RESIDENCE "PLACES" OF ST. LOUIS.

ARCHITECTURE IN THE BUSINESS AND RESIDENTIAL SECTIONS

The era of the modern fireproof business blocks and elegant. and architectually beautiful residences dates back to 1885, at the time when St. Louis began to put forth new life. Some of the older buildings are good, notably the St. Louis Court House, which is

built in the form of a Greek cross and, with its dome 300 ft. high, is dignified and interesting. Domestic architecture was originally an adaptation of the Southern planter's house, and spoke of generous hospitality and good cheer, but many unattractive and even ugly buildings began to mix in with these, and the uninteresting character of the churches and civic buildings combined with these to bring about unpleasant and sometimes even repellent architectural effects. When a firm of Boston architects built the Church of the Messiah and the Crow Memorial Hall the people of St. Louis began to wake up to the possibilities of the architectual profession and nearly all of the newer buildings have been in appropriate and beautiful designs in spite of such exceptions as the new City Hall and one or two poorly designed office buildings. The new Union Station is said to be the largest in the world and it certainly is massive and dignified in outside appearance and well planned and beautifully decorated inside.

In the residence sections of St. Louis are found, of course, all types of structures from the modest $1000 cottage of the laboring classes to the magnificent dwellings of the wealthy. The finest specimens of domestic architecture are found in the region of Forest Park, especially in three or four reservations or places which are peculiar to St. Louis and which deserve a special description.

Some years ago a group of business men who desired to build homes in the newer section of St. Louis purchased a tract of land equal in area to several city blocks and proceeded to develop it on novel lines. They first laid out a double roadway, enclosing a narrow space between, which they grassed over and planted with trees, shrubs and plants of various kinds. On both sides of this twin roadway they laid out building lots, some of which they took themselves and the remainder sold to those who would pledge themselves to put up houses of a value not less than $50,000. The entire reservation was enclosed at its sides by fences and at its ends by beautifully designed stone "gates" and the whole formed "Vandeventer Place" one of the most beautiful spots in the city. It contains a row of magnificent residences costing from $50,000 to $300,000. The entire reservation being private property, an annual assessment is made on each property owner for maintaining the roadways and garden spot between, to-

ST. LOUIS CLUB.

YOUNG MEN'S CHRISTIAN ASSOCIATION.

COLUMBIA CLUB.

COUNTRY CLUB.

gether with expenses for watchmen, etc. Heavy teaming is not allowed within the place, but there are no restrictions upon the public coming on foot or in carriages.

Similar reservations have been made elsewhere, such as Portland Place, Bell Place and Westmoreland Place.

Another fine residence section is found around Lafayette Park and in the vicinity of Compton Hill Reservoir, while Olive Street and, in general, the section between Forest Park and the business section contains many beautiful specimens of architecture.

COMMERCIAL AND INDUSTRIAL DEVELOPMENT

St. Louis is one of the greatest manufacturing cities in America. There is no question about this, and there is no necessity for drawing upon the imagination in speaking of this feature of the city's importance. The fact that coal is obtained in great abundance from the neighboring coal fields of Illinois and even from Missouri itself, and at prices ranging from $1.10 to $1.25 per ton delivered, has evidently been appreciated by capitalists desiring to establish manufacturing enterprises. There are so many branches of industry in which St. Louis stands first, second or third, among American cities, that only a few can here be specified.

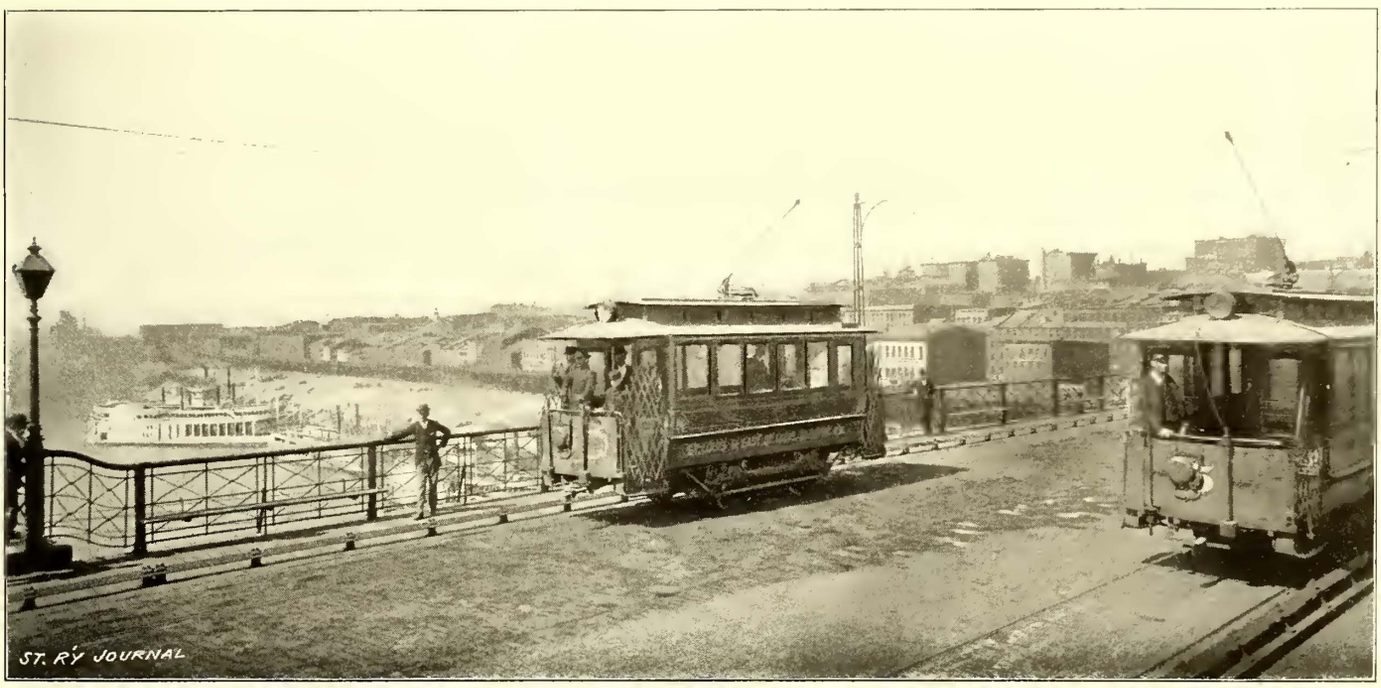
In the manufacture of tobacco St. Louis is probably without a rival. It is said that there are about 9000 people employed in its tobacco factories at high rates of wages, and the annual sales exceed $30,000,000. The largest tobacco factory in the world, that of the Leggatt-Myers Company, is now nearing completion and will have a capacity of 2,000,000 lbs. a year. The brewery interests of St. Louis are very large and the city also contains the largest establishment in the world devoted to this industry. The total output of beer in 1895 was 60,823,844 gals., for which 2,124,126 bushels of barley were received. In the manufacture of chemicals St. Louis is said to stand first among American cities and in the wholesale drug and proprietary medicine business, second only to New York. The woodenware and hardware business both in manufacturing and jobbing is extensive and constantly growing and it is estimated that the volume of the hardware business reaches $13,000,000 per annum, exclusive of business done by iron and steel houses.

In the manufacture of steam railroad freight cars and street railway passenger cars St. Louis has no rival in the West and probably does the largest business of any single city in America, measured by output in number of cars. This is due largely to the importance of St. Louis as a hardwood lumber market which gives unusual facilities to car builders.

Among other lines of manufacturing and jobbing business in which St. Louis takes a leading position may be mentioned dry goods, both wholesale and retail, boots and shoes, the annual trade in which is said to amount to over $30,000,000, clothing, hats and caps, furniture, groceries, crackers, shot and white lead.

STREET RAILWAY TRAFFIC IN ST. LOUIS

Passing now from the more or less indirect influences bearing upon street railway prosperity as found in the characteristics of the city and citizens of St. Louis, to a study of the physical and financial features of the system itself, it will be found that a brief sketch of the way in which the city and its street railway system have together come to their present development will serve to throw some light upon the reasons why St. Louis claims to-day the best street railway service in America.



EADS BRIDGE AND THE LEVEES.

FIFTY YEARS OF MUNICIPAL EXPANSION

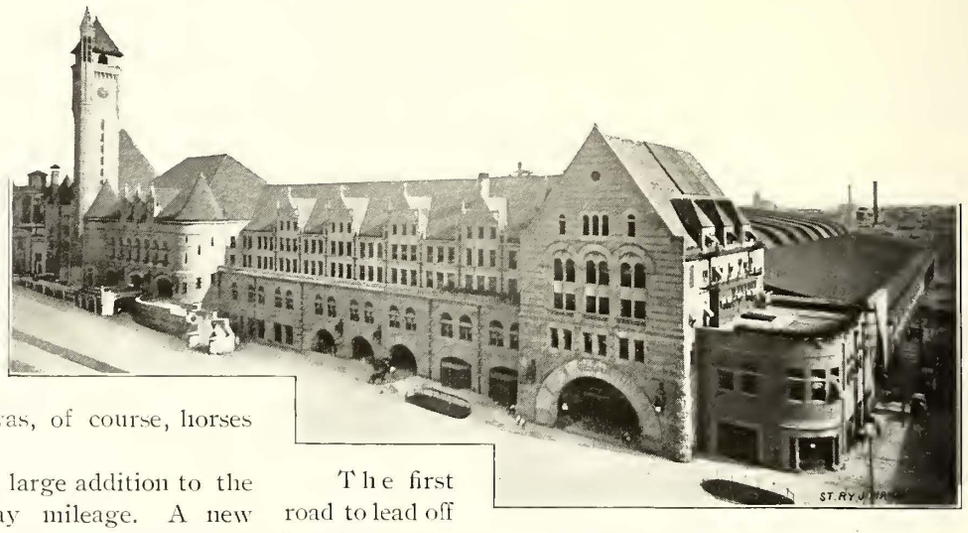
The first street railway charters in St. Louis were granted in 1859. The map on page 576 shows the city limits as they existed in 1860, together with a distribution of the population, much more even over the area within these limits than was probably the case as a matter of fact, since the resident popula-

tion must have been gathered more closely together in the vicinity of the river than further westward, at a time when means of communication were so conspicuously lacking. But as the wards of the city then extended from the river westward to the city limits, it is now impossible to ascertain the relative densities of population except in the manner shown in the map. Two lines only of street railway were then actually built, and these, as intimated above, had just been put in operation.

Between 1860 and 1870 came a large increase in the street railway mileage together with an extension of the city limits so as to take in additional area north and south. The distribution of the population and the street railway system in 1870 is also shown on page 576. The motive power was, of course, horses entirely.

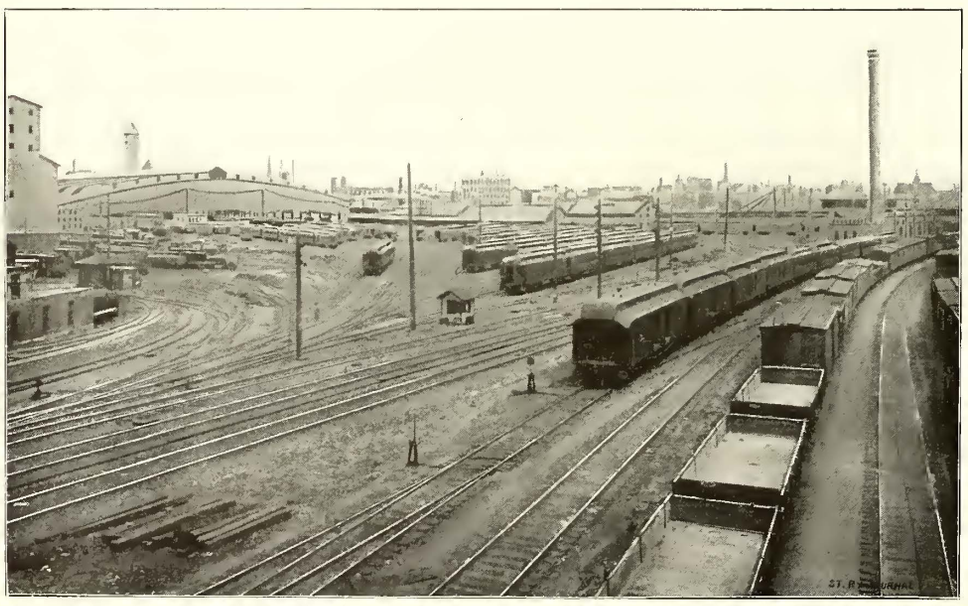
Between 1870 and 1880 came a large addition to the city area and to the street railway mileage. A new charter went into effect in 1876, and the city limits established in that year were practically the same as they exist to-day. The distribution of population and street railway system in 1880 are shown on page 577. It will be seen, of course, that the population density in the older parts of the city was becoming greater and greater from decade to decade, while the outlying sections to the west were also building up more and more rapidly under the impetus given by improving street railway facilities.

On page 577 is shown the condition of the city in 1890. By this time St. Louis had begun to take on new life and building was going on rapidly all over the city. The change of motive power from animal to mechanical traction had commenced. The old horse roads had been highly profitable and were locally considered excellent properties, the dividends being constant and reasonably large. But the general uneasiness in the street railway world due to the great success of the cable system in Chicago and other places, and to many interesting and promising experiments in electric traction, announcements of which were being constantly made, had begun to be felt in St. Louis, although it is probable that no one had any idea at that time what a potent influence on real estate values and the rearrangement of population would be exerted by improved methods of motive power.



THE UNION STATION—FRONT VIEW.

The first road to lead off in these improvements was a narrow gauge steam railroad line running from St. Louis to the old French town of Florissant. This road secured in 1885 a franchise down to Sixth Street in the heart of the city, with the provision that it was to be operated by the cable system, and this was installed in a poor and cheap way and operated for about three years when it passed into the hands of a receiver and was sold under foreclosure of mortgage, the purchasers converting it into an electric road—now the St. Louis & Suburban Railway.



THE RAILROAD YARDS AND TRAIN SHEDS AT THE UNION STATION.

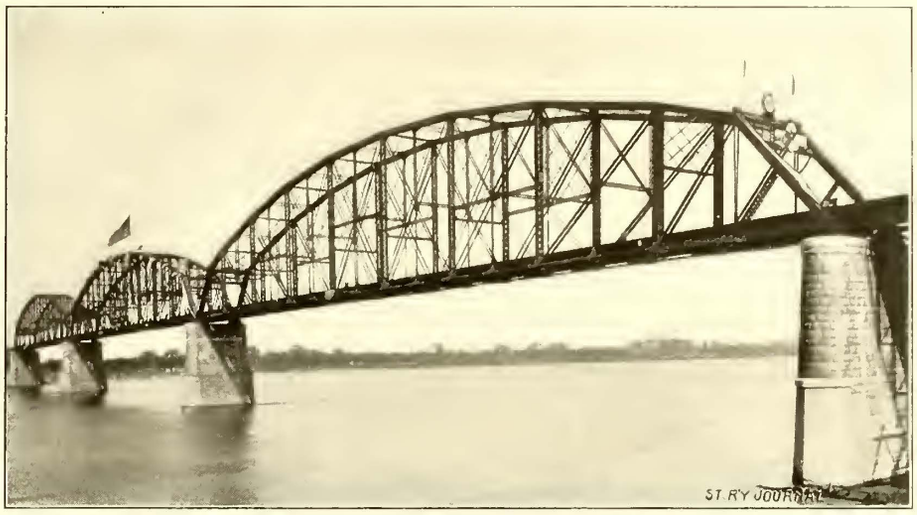
One or two years later a number of the St. Louis lines were purchased by a syndicate of Chicago capitalists interested in the Chicago cable lines, and the cable was introduced on certain of these newly purchased lines. About the same time the Lindell Railway Company commenced equipment by electricity, and within a brief period nearly every street railway company in St. Louis was planning to do away with horses and was making the financial arrangements necessary for the adoption of either the cable or electric systems. Since 1890 this process of conversion has been joined to one of rapid extensions, so that the total street railway mileage is today far greater than in 1890 and nearly every section of St. Louis' large area is reached by rapid transit lines. The outlying sections have been built up with great rapidity not only with the low priced houses of the wage earner, but also, in the neighborhood of the parks, with the costly palaces of the rich who have migrated westward to reach the purer air away from the smoke-tainted manufacturing sections.

The number of building permits issued in 1895 was 3642, calling for the expenditure of about $14,000,000.

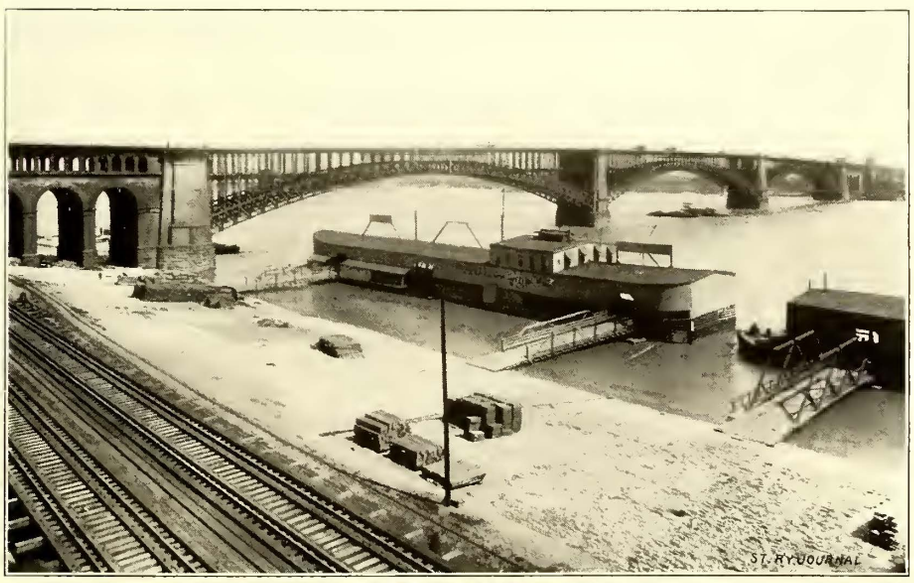
PRESENT DISTRIBUTION OF POPULATION

On page 578 is shown the distribution of population as it exists to-day, this distribution being based on the police census before referred to.

A glance at the map on page 579 will lead to a better understanding of the traffic conditions in St. Louis which have brought about the unusual financial success of its street railway systems. It should be remembered in the first place that the distances represented by this map are unusually large, the city area being considerably larger, both actually and relatively, than most of the other large cities of America. Now the business heart of this entire territory is found, as before stated, in a small area in the eastern central part near the river. Here are contained the business offices of many of the factories, railroads, breweries, etc., which are spread far up and down the river and in Mill Creek Valley to the westward. Business communication between these offices and factories is frequent throughout the day, and to this is added the travel called forth by the fact that all the banks are also located in this business section. This kind of travel is found only in a few large cities—not in those where the business and manufacturing areas are concentrated within relatively smaller areas.



MERCHANTS' BRIDGE.



EADS BRIDGE FROM THE LEVEES.

The morning and night travel on the street railway lines between the business and manufacturing areas on the one hand, and the residential areas on the other, is unusually heavy. Nearly every citizen is forced to use some means of transportation on account of the long distances in the city. The use of the bicycle is growing rapidly, but the pavements in St. Louis are such as to make riding in any except the pleasantest weather less attractive than in better paved cities, and so far street railway companies have not seriously felt its effects. Competition has brought about the use of beautiful, easy riding and attractive cars in St. Louis, and the half-hour ride to and from business, with paper in hand, is one of the pleasures of the day, instead of a task. For similar reasons the pleasure traffic pure and simple in St. Louis is a very large factor in street railway prosperity, and is cultivated with great care. Every company has upon its lines some attractive pleasure resort, and where natural ones in sufficient numbers are missing the defect has been supplied by special efforts on the part of the different managers. St. Louis cars are almost as crowded on a pleasant summer evening between the hours of 7:30 and 11 as in the rush hours of the day, and on Sundays the receipts are hardly less in amount than on week-days. Trolley parties in special cars are frequent, and altogether the fluctuations of street railway traffic in St. Louis from day to day and from season to season are, perhaps, less pronounced than in most other American cities.

All these influences have worked together to bring about an annual street railway movement in St. Louis of enormous proportions. In 1895 the eleven companies in St. Louis carried 102,997,772 passengers, an average of 196 rides per capita, if we count the population as 520,000. Comparing the population movement in St. Louis with that of other large cities we find the following results, the population used in every case being that of 1890, while the "passengers carried" are assumed to be twenty times the passenger receipts.

	Population.	Rides per capita.
New York	1,515,301	296
Chicago (principal systems)	1,099,850	228
Philadelphia (principal aystems)	1,046,964	186
Boston (and suburbs)	848,740	214
Brooklyn	806,343	235
St. Louis	451,770	228
San Francisco	298,997	249
Buffalo	255,664	104
Pittsburgh	238,617	250

It will be seen that St. Louis stands well up in the list among these great cities of the country in rides per capita.

The Street Railway System of To-day

On the map between pages 580 and 581 are shown in colors the principal individual systems of St. Louis, and a general idea of the territory from which these systems draw their business will be obtained from this map and from those on pages 578 and 579 showing the distribution of population and the manufacturing, business and residential sections. In the table on page 580 the principal financial features of these systems are set forth and will serve, together with the maps, as a basis for a brief discussion of the comparative values of these systems as operating properties.

MERCANTILE CLUB.

National Railway Company's System.—The Chicago syndicate already referred to as owning several St. Louis properties is incorporated as the National Railway Company, of Chicago. It is not an operating company, but holds in its treasury the entire capital stock of the Cass Avenue & Fair Grounds Railway Company, 9985 shares out of 10,000 of the Citizens' Railway Company and 6270 shares out of 20,000 of the St. Louis Railroad Company. It also controls by ownership of stock the Northern Central Railroad, the Union Railroad, the Baden & St. Louis Railway and the Southwestern Railway. These companies are operated to a certain extent independently, never having been consolidated, but are under one management.

These lines compose the largest system in the city. The St. Louis Railroad is a cable line on Broadway, the principal business and manufacturing street of the city, extending north and south, parallel to and near the river, and this line obtains a larger amount of short distance traffic than any other single line in the city. It is operated by two power stations, one on the north side and one on the south. These power stations give little trouble, but are not fitted for the most economical operation. The conduit on Broadway might have been made shallower to advantage as the deep conduit system has been found to be unnecessary in St. Louis' climate and conditions of service, and a considerable part of the initial cost might thereby have been avoided. Nevertheless, the capitalization of this road is not excessive and the percentage of interest charged to gross receipts amounts to 17.9. The gross receipts per mile of track of the cable section alone—this section being about one-half of the total mileage—is probably, in good times when the factories are busy, not much less than 30,000. The electric extensions on the north and south ends run through less profitable territory, of course, and may be considered merely as feeders to the cable line.

The Citizens' line was originally a horse road, and on its purchase by the National Railway Company was converted to a cable line which was, in turn, re-equipped a few years ago with electricity in order to meet the competition of parallel electric lines. The results of this re-equipment have been, not that the company has largely increased its gross receipts, but that it has held its own in a competition for business the character of which is to some extent evident from inspection of the map showing the parallel lines of different systems leading out into the same residential territory. Owing to these various changes the Citizens' Railway Company is capitalized somewhat more heavily than the Broadway line on the basis of mileage, and its interest charges amount to 24.4 per cent of the gross receipts. The character of the territory may be inferred from the gross receipts per mile of track, which amount to $22,400, a figure exceeded only by the Olive Street cable line, presently to be described.

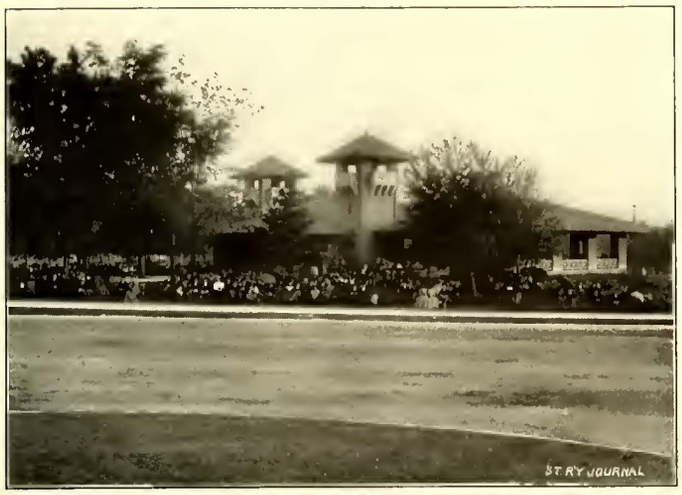
The lines of the Cass Avenue & Fair Grounds Railway cover a large area to the north and west. Cass Avenue itself is a business street which runs from the river clear to the city limits—the only one of its kind in St. Louis. This section of the National Railway Company's system is earning $13,800 per mile of track and its interest charges amount to about twenty per cent of the gross receipts.

The electric lines of the National Railway system are operated from a power station which is probably one of the best arranged and most economical in the country, considering the conditions of operation found in St. Louis. A large portion of the track is laid with sixty foot rails and cast welded joints and is in excellent condition. A variety of cars is found on these lines, some of them of the older types, but a large proportion modern and attractive to passenger traffic.

The gross capitalization of the National Railway Company's system amounts to $119,700 per mile of track, of which $71,000 is funded debt calling for 21.2 per cent of the gross receipts in the form of interest. The gross receipts amount to $17,600 per mile of track, an amount exceeded by two only of the other St. Louis systems.

Union Depot Railroad.—The system of the Union Depot Railroad Company reaches almost all parts of the city of St. Louis. From the business heart of the city it

operates lines to the northwest reaching the Fair Grounds, Bellefontaine Cemetery, and a residential territory excellent from a street railway point of view; to the west and south tapping the manufacturing district in Mill Creek Valley as well as the residential areas; and in the central part of the city operating two crosstown lines of which the more important is the line of the Grand Avenue Rail-



STREET RAILWAY TERMINAL STATION IN FOREST PARK.

way Company which is controlled by parties interested in the Union Depot Railroad Company and which enables the latter's cars to form a belt line around the city. Only a portion of the track on Grand Avenue is owned by the Grand Avenue Railway Company, trackage rights having been secured by process of law on the lines of several other companies originally laid on short sections of this street.

The Union Depot Railroad system proper is capitalized at $97,200 per mile of track—the smallest total capitalization, with one exception, of any of the important systems of the city—the bonded debt is $43,600 per mile, which is also moderate, and the percentage of interest charges to gross receipts is 17.8. The gross receipts amount to $14,200 per mile of track which is a rather low average and indicates either that the company's territory is somewhat poorer than many of the other St. Louis systems, or else that in the general competition for business the company is at some disadvantage.

The company's lines are operated from two power stations. One of these recently received serious injury from the cyclone, but was quickly put into operating shape again. Some of the latest generating apparatus, together with considerable of the old, is used in this station. Its general economy is probably very good.

Lindell Railway.—The lines of this company extend from the business section westward to Forest Park in the city limits and serve a territory which has great possibilities for future development as well as large present value. The whole West End district is building up rapidly with residences of all kinds from the humblest to the most expensive. The Lindell cars are among the handsomest and most attractive to passenger traffic in the city, and its downtown terminal facilities are excellent. For all these reasons, principally the first, the company's traffic is increasing by leaps and bounds as will be seen by the following table:

Year.	Number of trips.	Passengers carried.
1889	474,908	4,339,099
1890	435,390	5,549,729
1891	546,386	10,944,585
1892	632,020	12,411,794
1893	1,124,656	14,270,478
1894	1,283,108	17,425,971
1895	1,281,024	20,237,599

The company is wisely pursuing a policy of extensions in anticipation of the future, and while this naturally brings down the gross receipts per mile of track to a moderate figure—$16,800—even this compares favorably with other systems in the city, and its large increase in the future may be regarded as a certainty.

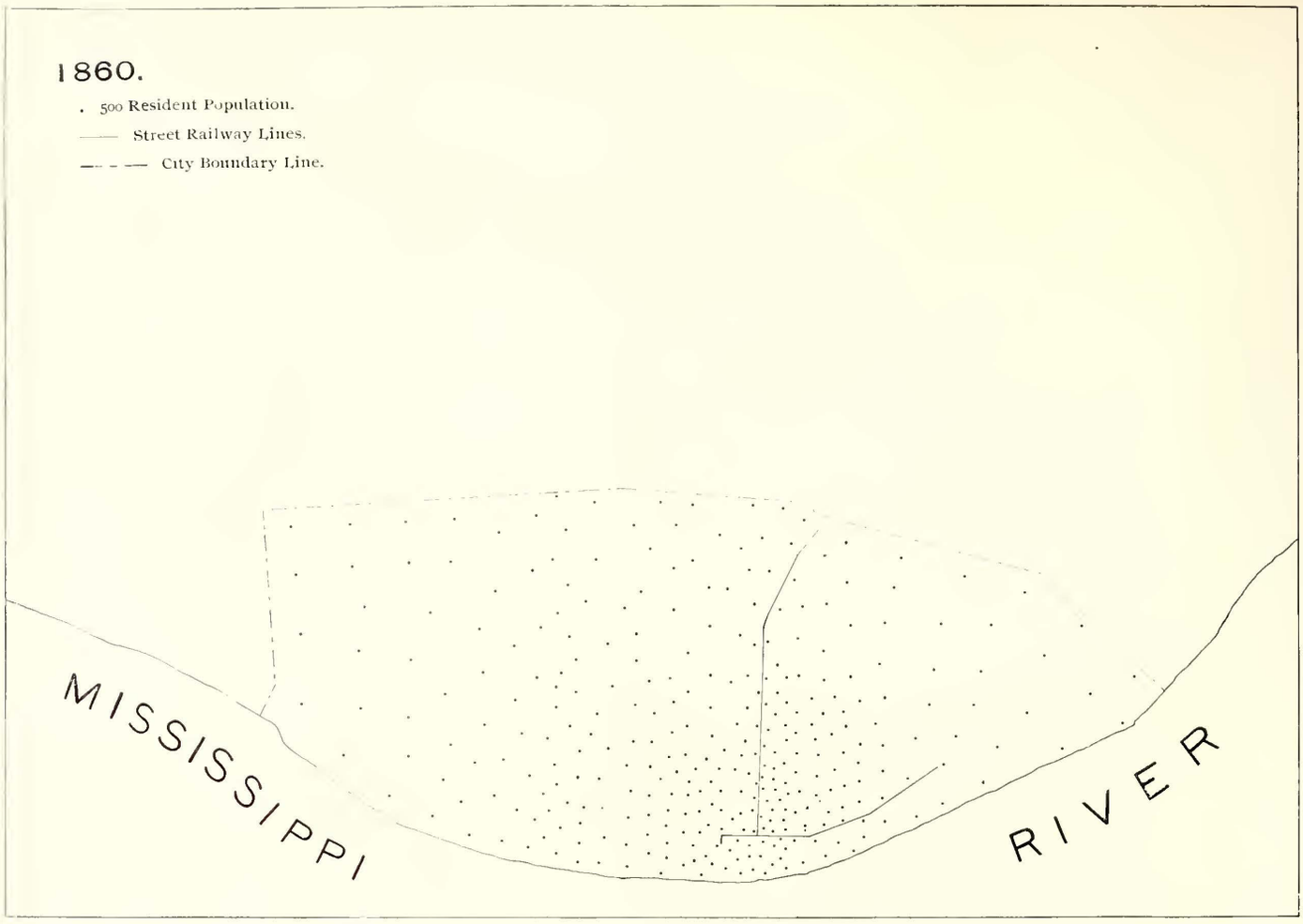
The company's total capitalization is the smallest of any of the large systems of St. Louis, being $89,800 per mile of track, of which $49,900 is in bonded debt. The percentage of interest charges to gross receipts is but 16.3, which is the smallest of any St. Louis system with one exception. Altogether the Lindell Railway appears to be in an exceedingly strong position among the St. Louis systems.

The Missouri Railroad.—This system, though not so extensive as some of the others, is one of the most valuable properties in the city. It extends from Fourth Street directly westward to Forest Park. Its cable line on Olive Street passes through the great retail shopping district downtown, and the fine residential district to the west, and it obtains an amount of short distance traffic second only

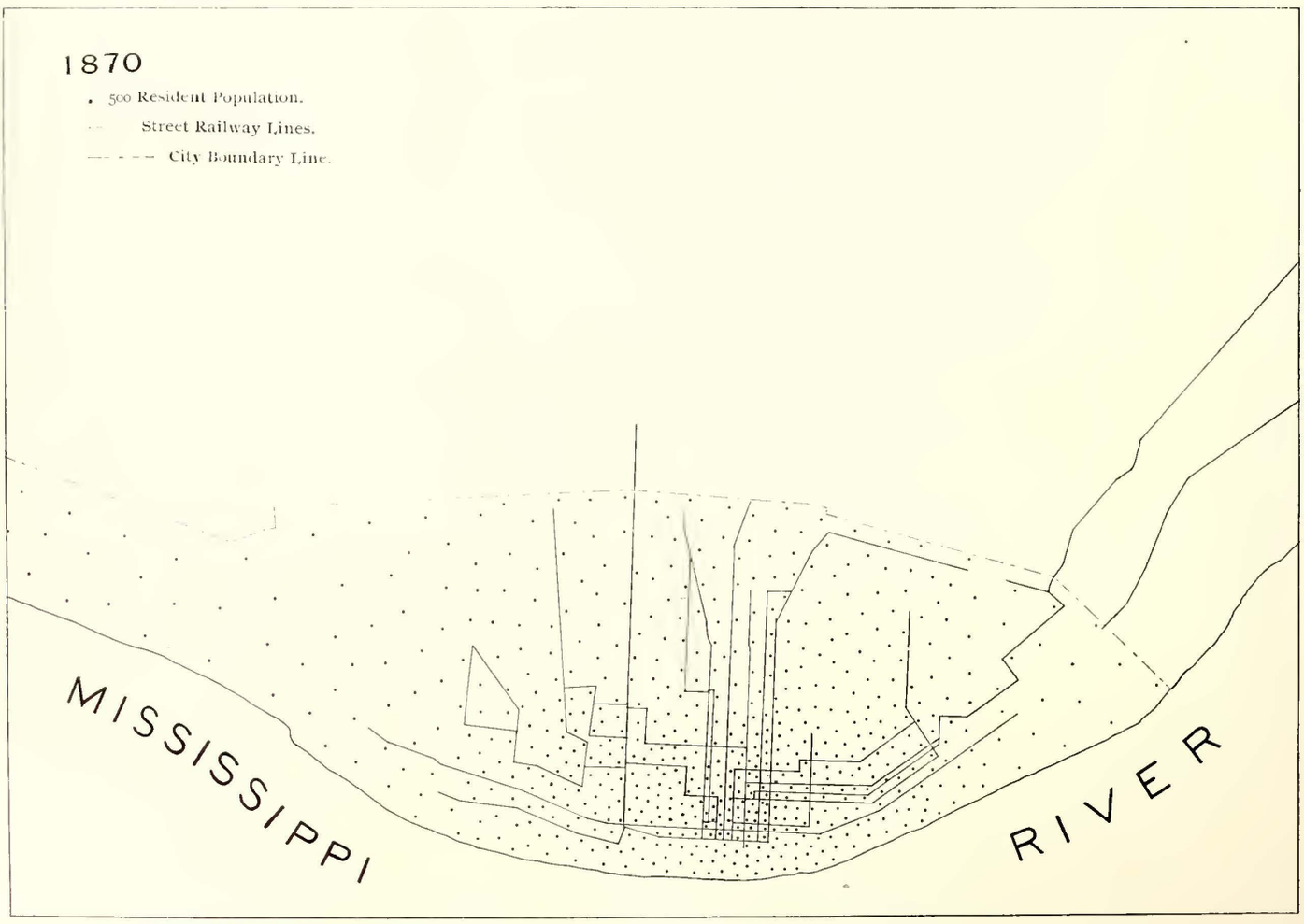
TERMINAL LOOP OF THE LINDELL RAILWAY.

to the Broadway line. The company's Market and Chestnut Street electric lines are also well patronized since they form one of the shortest and most direct routes between the hotel district and the new Union Station, while to the westward they also pass through valuable residential and manufacturing areas. The company's park connections are perhaps the most valuable in the city, and the competition for this class of travel between the Lindell Railway and itself sometimes becomes very keen.

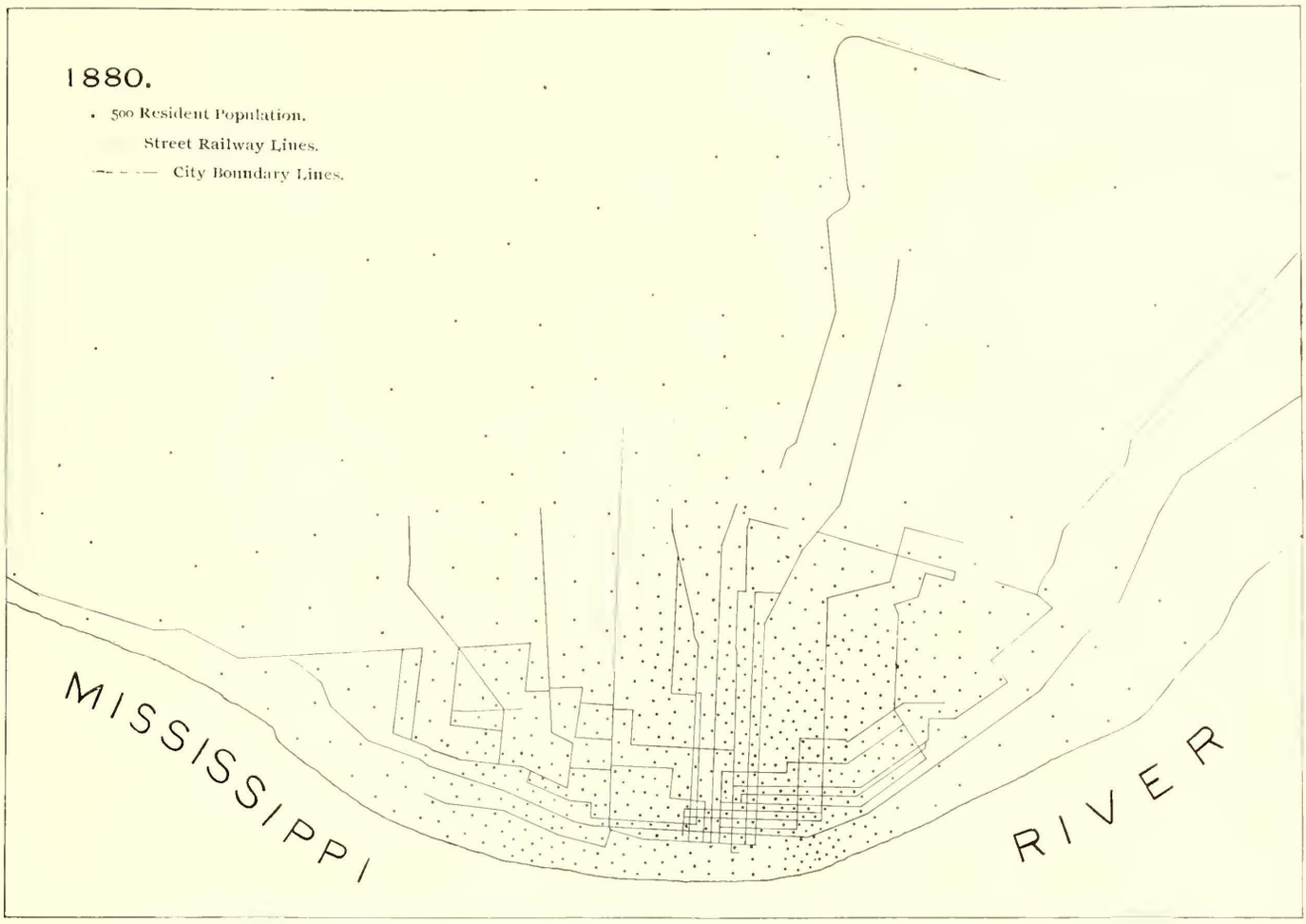
All these influences are reflected in the gross receipts



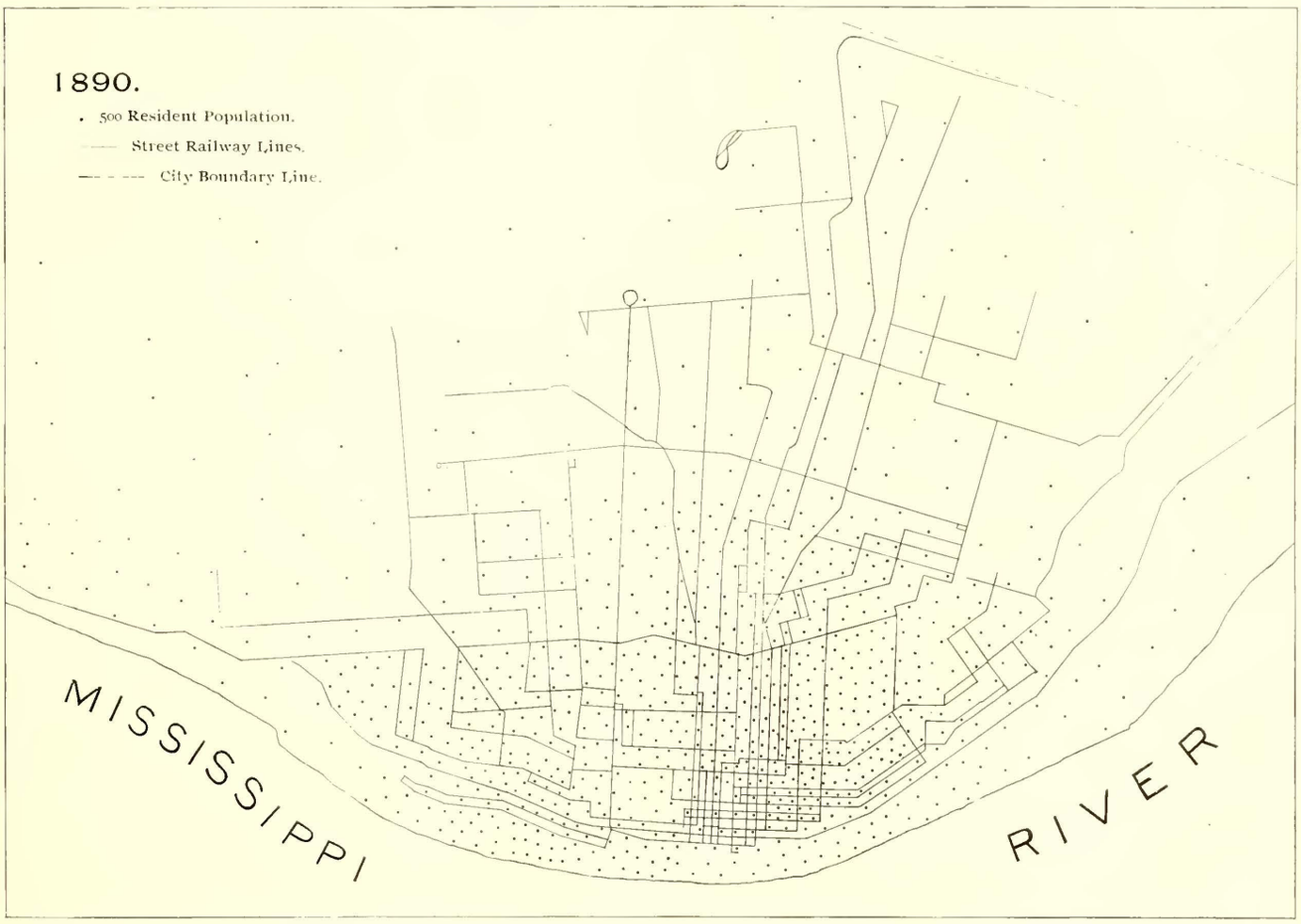
MAP SHOWING DISTRIBUTION OF POPULATION AND STREET RAILWAY SYSTEM OF ST. LOUIS IN 1860.



MAP SHOWING DISTRIBUTION OF POPULATION AND STREET RAILWAY SYSTEM OF ST. LOUIS IN 1870.



MAP SHOWING THE DISTRIBUTION OF POPULATION AND THE STREET RAILWAY SYSTEM OF ST. LOUIS IN 1880.



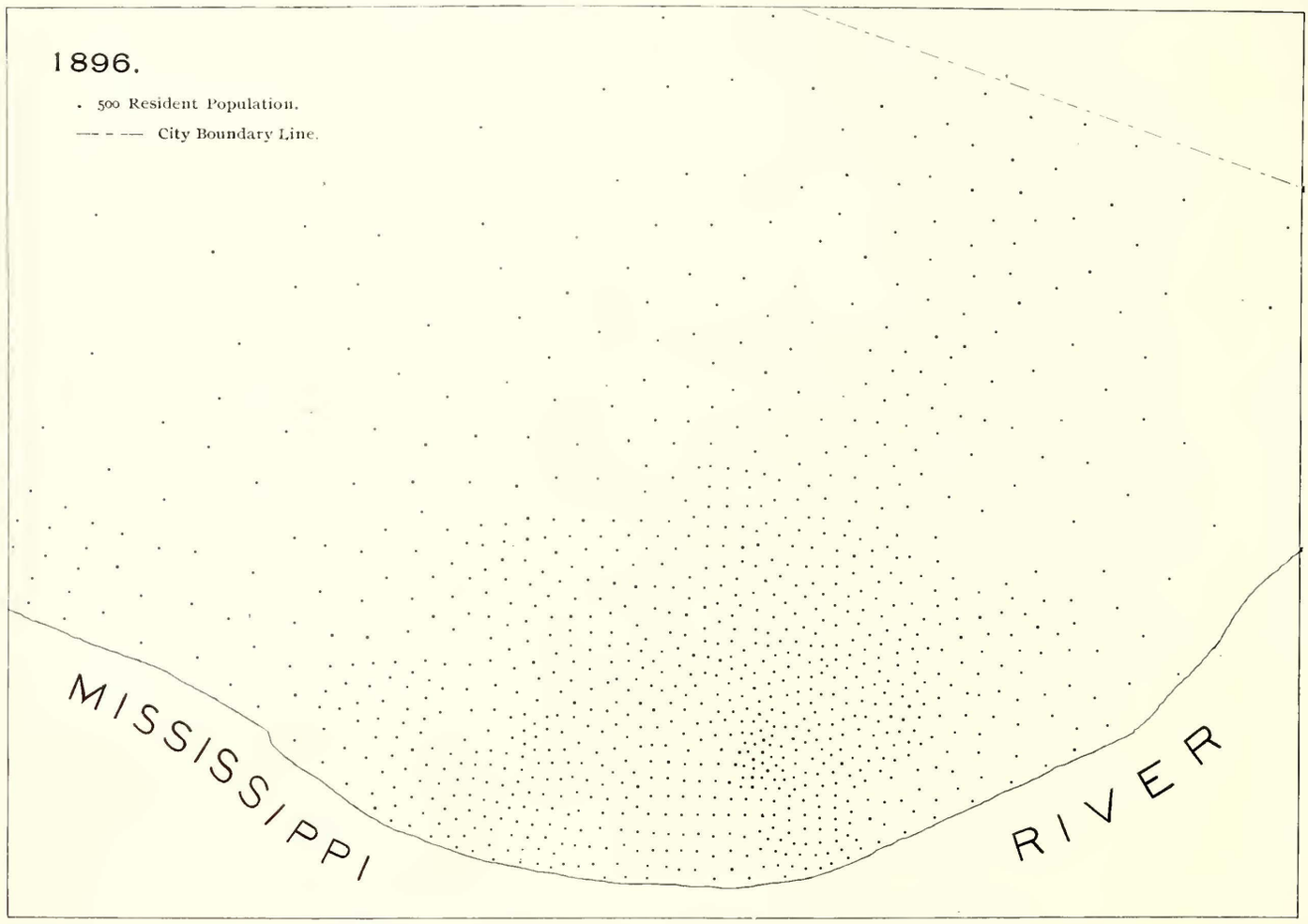
MAP SHOWING THE DISTRIBUTION OF POPULATION AND THE STREET RAILWAY SYSTEM OF ST. LOUIS IN 1890.

per mile of track which are $27,800, the largest in the city. The total capitalization is $112,400 per mile of track of which the bonded debt is but $28,800, the smallest in the city. The percentage of interest charges to gross receipts thus becomes exceedingly low, being but 5.2.

It is noteworthy, however, that the company's traffic has been fairly constant from year to year as is shown by the following table:

Year.	Number of trips.	Passengers carried.
1889	919,010	10,785,284
1890	979,633	12,315,566
1891	1,042,814	13,551,097
1892	966,190	14,706,156
1893	1,123,612	14,927,465
1894	1,162,158	14,480,126
1895	1,226,678	15,303,467

Street to Florissant, and the property is stronger to-day than ever before in spite of the piling up of liabilities due to the several reconstructions. The company owns its own right of way in fee over the line of the old steam railway, and this enables it to make good speed in the outlying sections of the city. When electricity was first introduced an attempt was made to give a frequent service to Florissant in the hope of inducing building along the line and of thus creating traffic. Unfortunately, however, the property owners in the country had exaggerated ideas of the value of their properties and they refused to sell for building purposes except at excessive prices. The electric service between the terminus of the city lines and Florissant is now reduced to six cars per day, although



MAP SHOWING THE DISTRIBUTION OF POPULATION IN ST. LOUIS IN 1896.

The company's power stations and general equipment (exclusive of cars) are not of the most modern types, and it is probable that the percentage of operating expenses to gross receipts cannot be kept down so low as would be the case with newer types of apparatus, but the property is handled with care and skill and is rightly considered one of the best in St. Louis.

St. Louis & Suburban Railway.—This system has passed through many vicissitudes, as has already been intimated. The nucleus was a narrow gauge steam line running from a point well out towards the then city limits to Florissant, some fifteen miles away. Its downtown line was built in 1885 and the cable system adopted. This proved a financial failure owing to imperfections of construction and overcapitalization, though the receipts were very large. Since 1890, the entire road has been rebuilt, the gauge broadened and electricity introduced from Sixth

twenty-one per day run as far as Ramona. On Sundays eleven cars run through to Florissant and nineteen to Ramona.

The company owns a large tract of land at Wellston, the terminus of its city lines, where an excellent beer garden has been established, through lessees, with a number of special attractions such as a scenic railway, theatre, etc. This has proved a profitable thing both for the lessees and the railway company, and the afternoon and evening summer traffic over "the Suburban" to this resort is very large. This means, of course, a "long haul" to the company, but the volume of business is sufficient to make it well worth while to cultivate it.

The company has also a branch line to Forest Park, which is well patronized in summer, and it has just built, by a separate organization, a crosstown line on Sarah Street turning westward to the south of Forest Park and running

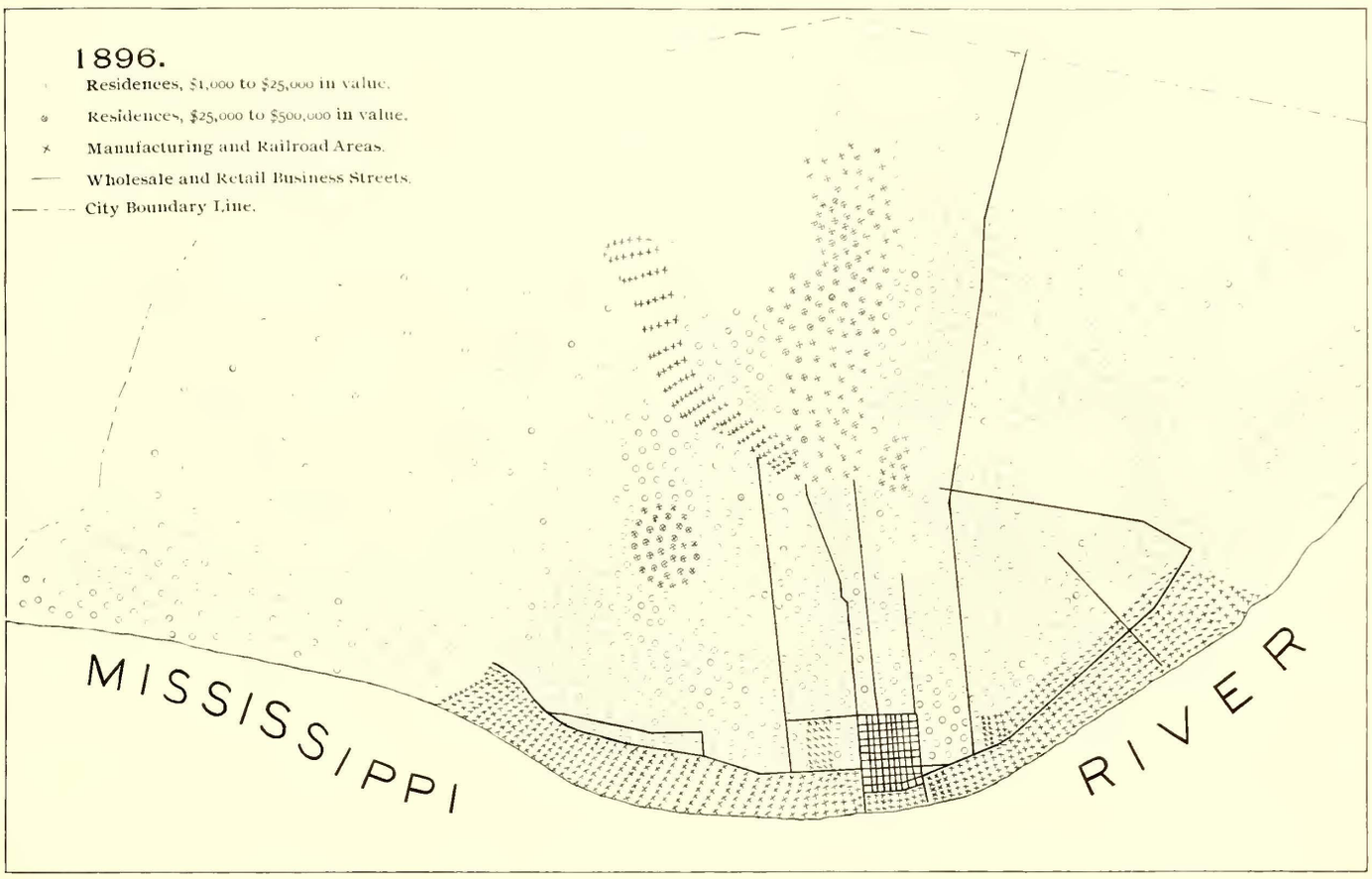
to Kirkwood, in the county of St. Louis, through a most beautiful country. It is intended to extend this line next year to Meremec Highlands. The line is well built, and has already obtained a large patronage.

The general course of the company's traffic is seen from the following table:

Year.	No. trips.	Passengers carried.
1889	111,629	4,680,335
1890	105,084	4,343,139
1891	102,160	4,027,888
1892	124,103	7,037,761
1893	255,996	8,030,182
1894	118,445	7,754,752
1895	105,806	7,803,746

The property is, of course, heavily capitalized, its bonded debt being $80,400 per mile, and its capital stock has thus obtained excellent connections which will doubtless give it a considerable increase of business. The company's bonded debt per mile of track is very small, though its capital stock is large. Its gross receipts amount to $13,400 per mile of track—a fair earning power considering the territory served and the competition of the Broadway cable line and others—and its interest charges are 12.9 per cent of the gross receipts.

The People's Railroad.—The cable lines of this company run from Washington Street south on Fourth Street, and westward past Lafayette Park. The territory around and near Lafayette Park has been until recent years one of the best resident sections in the city, while Fourth Street is the great banking and one of the great mercantile



MAP SHOWING THE LOCATION OF BUSINESS, MANUFACTURING AND RESIDENTIAL SECTIONS OF ST. LOUIS IN 1896.

$69,900. Its gross receipts amount to $13,600 per mile of track, which would be much larger were it not for the large proportion of suburban mileage. Its interest charges amount to 34.1 per cent of the gross receipts, which points to the necessity of rigid economy in management. The power station is now equipped with apparatus of modern types used in regular service—the older engines and generators being held in reserve—and can be operated with fairly high economy. The roadbed is not in the best condition, but is being improved considerably by the application of cast welded joints. The cars are good, and the electrical equipment in general is of apparatus which can be handled with fair economy.

The Southern Electric Railway.—The lines of this company are laid out in the southeastern portion of the city, and run in a direction generally parallel to the river. Until within a short time the company has had no good terminus in the heart of the city, but has recently acquired the right to run over tracks of other companies, and streets. More recently, however, the movement of population has been towards Forest Park, and this, together with the increasing competition of electric lines cutting into the territory just described, has seriously injured this property, so that its passenger traffic in 1895 was thirty per cent less than in 1890. Nevertheless, the company's gross receipts amount to $19,300 per mile of track, which is almost as large as the Broadway line with its electric extensions, though, of course, far less than the Broadway cable line alone. The interest charges call for 31.3 per cent of the gross receipts, as the funded debt amounts to $99,000 per mile of track, the largest in the city.

The Fourth Street & Arsenal Railway.—This is an electric line allied to the People's Railroad. Between 1884 and 1890 it carried from 800,000 to 1,100,000 passengers per annum with considerable variation from year to year. In 1891 it was unable to endure the competition of other lines in its territory operated by mechanical power, and its traffic was reduced to but 434,000 passengers, and in

1892 operation was suspended entirely. The road has now been equipped for electricity and was put in operation in the summer of 1896. Any intelligent comment upon its financial condition therefore becomes impossible.

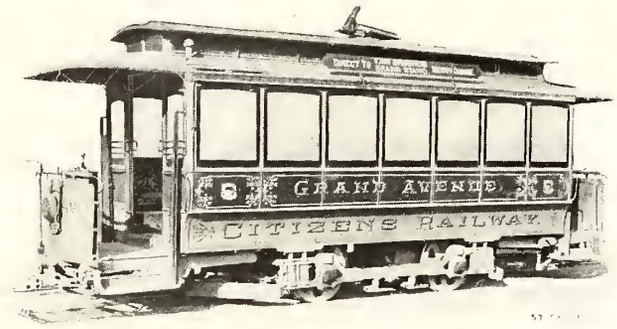


FIG. 1.

In general it may be said of the street railways of St. Louis that there are greater possibilities of future development of earning power than can be seen with present eyes in any city in the United States, with the possible exception of Buffalo. It is locally believed, and with reason, that St. Louis is destined to grow during the next ten years in a far more rapid ratio than ever before. This will mean little new mileage, but increasing patronage of present lines and correspondingly greater earnings per mile. In other great cities of the country the main arteries of travel are choked almost to suffocation at heavy hours of the day while the regular twenty hour traffic also fairly well fills the cars. This is not so in St. Louis. Sharp competition has brought about a mileage and car service which is really ahead of the times and is not warranted by the business offered, large as the latter has become. During too many hours of the day St. Louis street cars run comparatively empty while the periods of congestion are all too short. This will be changed when the city more completely realizes its metropolitan character and assumes metropolitan customs and business habits—a change which is now being brought about with great rapidity.

NAME OF COMPANY.	MILEAGE OF TRACK OWNED.	CAPITAL STOCK. Total.	CAPITAL STOCK. Per Mile Track.	MORTG'GE BONDS Total.	MORTG'GE BONDS Per Mile Track.	CAPITAL LIABILITIES. Total.	CAPITAL LIABILITIES. Per Mile Track.	GROSS RECEIPTS YEAR ENDING DEC. 31, 1895.b Total (Approximate).	GROSS RECEIPTS YEAR ENDING DEC. 31, 1895.b Per Mile Track.	INTEREST. CHARGES. Total.	INTEREST. CHARGES. Per cent. Gross Receipts.
Cass Avenue & Fair Grounds Ry Co	34.5	2,500,000	72,500	1,901,000	55,100	4,401,000	127,600	475,581	13,800	95,050	20.0
Citizens' Ry. Co.	16.4	1,000,000	61,000	1,500,000	91,500	2,500,000	152,500	368,540	22,400	90,000	24.4
Fourth St. & Arsenal Ry Co.	3.4	200,000	58,800	200,000	58,800	400,000	117,600			12,000	
Jefferson Avenue Ry. Co.	7.0	112,000	16,000	500,000	71,400	612,000	87,400	57,947	8,300	26,000	44.9
Lindell Ry. Co.	60.1	2,400,000	39,900	3,000,000	49,900	5,400,000	89,800	1,011,880	16,800	165,000	16.3
Missouri R. R. Co.	27.5	2,300,000	83,600	792,000	28,800	3,092,000	112,400	765,173	27,800	39,600	5.2
National Ry. Co.a	79.6	3,814,500c	48,700	5,651,000	71,000	9,525,500	119,700	1,403,957	17,600	297,550	21.2
People's R. R. Co.	10.1	300,000	29,700	1,000,000	99,000	1,300,000	128,700	195,168	19,300	60,750	31.3
St, Louis R. R. Co.	28.7	2,000,000	69,700	2,000,000	69,700	4,000,000	139,400	557,392	19,400	100,000	17.9
St. Louis & Suburban Ry. Co.	28.6	2,000,000	69,900	2,300,000	80,400	4,300,000	150,300	390,187	13,600	124,000	34.1
Southern Elec. Ry. Co	16.6	1,500,000	90,400	500,000	30,100	2,000,000	120,500	231,808	13,400	30,000	12.9
Union Depot R. R. Co.	74.6	4,000,000	53,600	3,250,000	43,600	7,250,000	97,200	1,096,213	14,700	195,000	17.8

TABLE SHOWING THE PRINCIPAL FINANCIAL CHARACTERISTICS OF THE ST. LOUIS STREET RAILWAY SYSTEMS.

a—In this report are combined several others, also given separately in table. See text.
b—Estimated on basis of $1.00 for each twenty passengers carried.
c—Including outstanding stock of controlled companies.

STREET RAILWAY CARS IN ST. LOUIS

BY RICHARD MC CULLOCH

The electric street car is now in that period of evolution through which all great improvements must pass. The first electric cars were horse cars with motors under them instead of in front of them. It was soon found that no part of the horse car was strong enough to endure the speed or carry the loads of electric cars, and changes were made in their construction to overcome these defects, still following, however, the general plan of the horse car. The present electric car has been developed in much the same manner as the steam railroad passenger car from the stage coach. There was exhibited at the World's Fair, the first train run between Albany and Schenectady. The cars resembled very strongly the stage coach in use at that time and could have been used as such if different wheels had been put under them. Although the steam railroads have required seventy years to bridge the distance between the Albany stage coach and the vestibuled sleeper, library and dining car, the street railroads, utilizing the results of steam railroad experience, have moved faster in departing from horse car practice. The present danger is that in the great desire for improvements and in the haste with which new cars are usually designed and built, some of the salient points may be overlooked and cars built, which, while containing new features, may be poorly adapted to the work to be done.

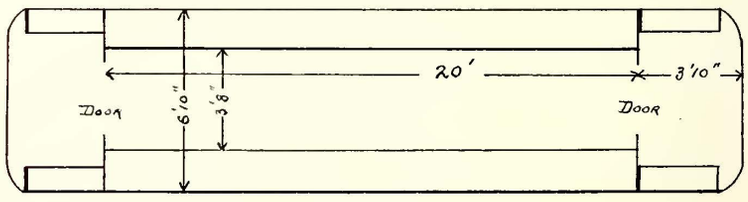
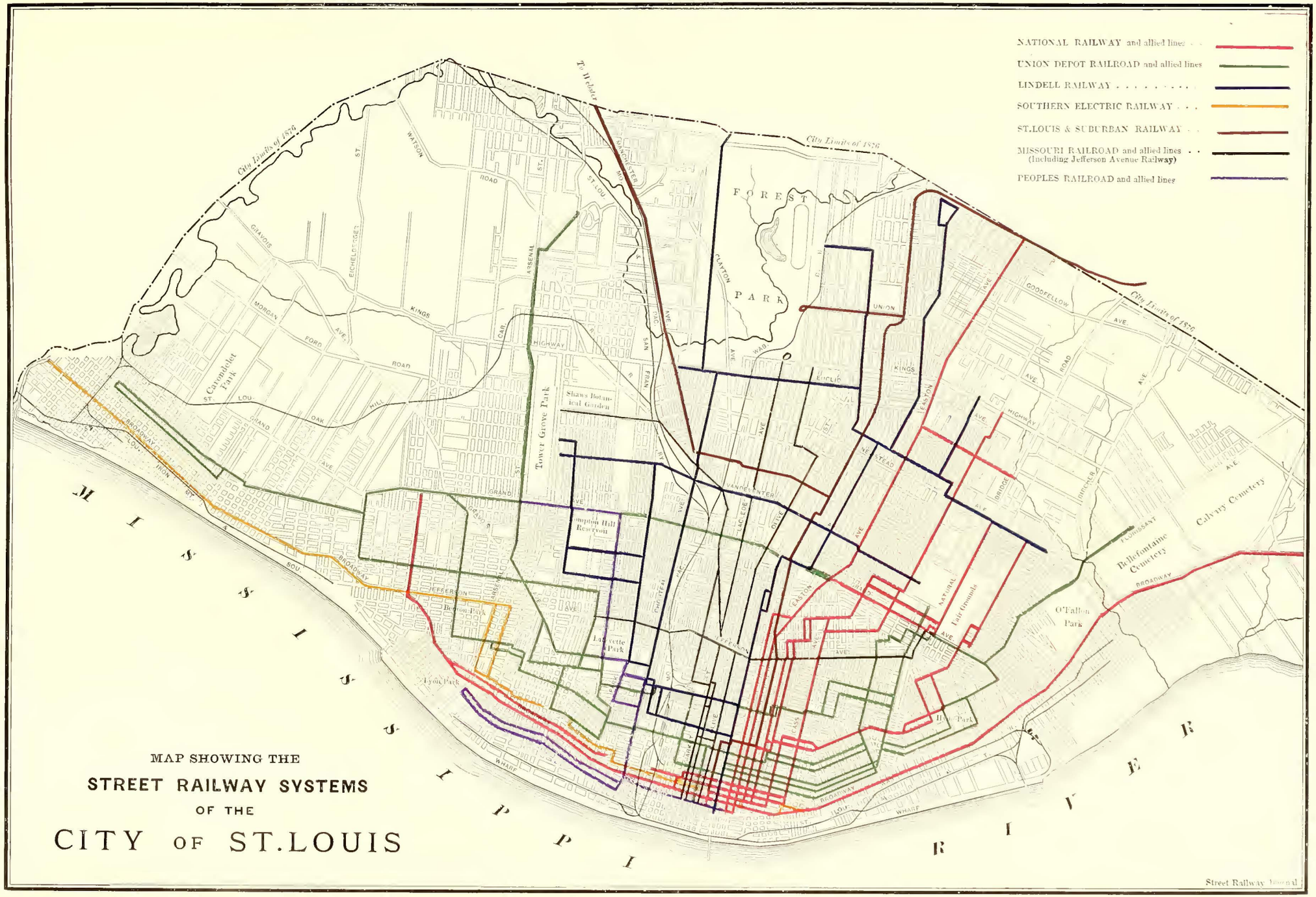


FIG. 1-A.

Conditions in St. Louis are perhaps such as to bring out more strongly than elsewhere the relative advantages of the different types of cars. A fierce, though entirely unnecessary competition has caused the companies in many cases to disregard the actual cost of taking care of travel and has forced them to seek for that style of car most preferred


NATIONAL RAILWAY and allied lines
UNION DEPOT RAILROAD and allied lines
LINDELL RAILWAY
SOUTHERN ELECTRIC RAILWAY
ST. LOUIS & SUBURBAN RAILWAY
MISSOURI RAILROAD and allied lines (including Jefferson Avenue Railway)
PEOPLES RAILROAD and allied lines
City Limits of 1876
FOREST PARK
Tower Grove Park
Shaws Botanical Garden
Lafayette Park
Benton Park
York Park
Hyde Park
Calvary Cemetery
Bellefontaine Cemetery
O'Fallon Park
Fair Grounds
MISSISSIPPI RIVER
MAP SHOWING THE
STREET RAILWAY SYSTEMS
OF THE
CITY OF ST. LOUIS
Street Railway Journal

by passengers. The question "Which is the best type of car" has here become a pre-eminent one, and the purpose of this article is to point out in a very general way the relative advantages and disadvantages of some of the different styles of cars in use in St. Louis.

The street railway business has assumed such proportions and advanced so far beyond its predecessor, the horse road, that we now have interurban roads, suburban roads, pleasure roads and express roads, all in addition to the old city street railroad running over streets which only a short time ago were echoing to the merry jingle of the mule bell. These different kinds of roads, hauling different classes and numbers of passengers, transporting them for different distances, stopping at different intervals, and running at different speeds, require for their use various sorts of cars, but this discussion will be confined chiefly to those types of cars in use in regular city traffic, having the characteristic heavy night and morning travel, the Sunday, the holiday, the park and the picnic travel, and the summer night travel to the parks and gardens.

The illustrations show types of the different sorts of cars in use in St. Louis.

Fig. 1. This is a motor car with a twenty foot body and longitudinal seats. Its seating capacity is twenty-eight in summer and twenty-seven in winter. Its total crowded capacity is eighty and its total standing capacity, including both platforms, is sixty-five square feet. The car is mounted on single trucks and weighs 16,000 lbs.

Fig. 2. This is the same kind of body as Fig. 1, but is equipped with fourteen cane cross seats, seven on each side. Its seating capacity is twenty-eight in summer and twenty-six in winter. Its total crowded capacity is sixty and the total standing space, including both platforms, is

FIG. 2.

sixty square feet. The car is mounted on single trucks and weighs 16,000 lbs.

Fig. 3. This is the same type of car as Fig. 1, but is drawing a trailer. An open seven seat trailer is used in summer and a closed trailer with longitudinal seats in winter. The weight of trailer is 5000 lbs. The seating capacity of the summer trailer is thirty-five and the total crowded capacity is sixty. The seating capacity of the winter trailer is nineteen and the total crowded capacity is forty-five. These trailers are operated night and morning during the heavy travel, usually four trips each day.

Fig. 4 is a type of what is known as the long car. This car has a body twenty-six feet long and is thirty-five feet over all. It has eighteen cane cross seats, nine on each side. The seating capacity is thirty-six in summer and thirty-four in winter on account of the space taken for the stove. The total crowded capacity of the car is 110. The standing room capacity, including both platforms, is ninety square feet. The total weight of car is 23,500 lbs. The car is mounted on double trucks of the maximum

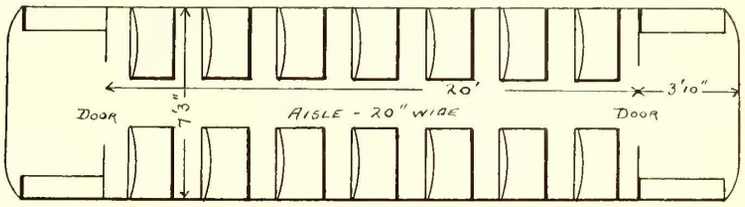


FIG. 2-A.

traction type with seventy per cent of the weight on the driving wheels.

Fig. 5. This is an interior view of the car shown in Fig. 4.

Fig. 6. This is a long car with longitudinal seats and is mounted on Robinson radial trucks.

Fig. 7. This is a vestibuled car made by splicing together two sixteen foot cars. There are longitudinal seats in each compartment and one longitudinal seat in the vestibule. The seating capacity is fifty-three and the total crowded capacity 140. The total standing room, including vestibule and both platforms, is ninety-five square feet. There is a door at each end of the car and another in the vestibule in the middle of the car. The car is mounted on double trucks of the maximum traction type.

Fig. 8. This is a long car with twenty-eight foot body, built for use as a summer car. There are eleven cane cross seats on one side and ten on the other, a door at each end and one in the middle. The car is mounted on double trucks of the maximum traction type. The seating capacity is forty-two and the total crowded capacity 120. The standing room space, including both platforms, is 110 sq. ft.

It will readily be seen that the main points in which these cars differ from each other are:

1. In the seating arrangement.
2. In the relative length, seating capacity and weight.
3. In the sort of trucks used, whether single or double trucks.
4. In the height of the car from the ground.
5. In the number and location of exits and entrances.
6. In respect to trailer service.

SEATING ARRANGEMENT

Most of the older cars are equipped with longitudinal seats. This was partly for the reason that the car with the longitudinal seat has the greater crowded capacity. If the plans of the different types of cars are consulted it will be seen that in the two twenty foot body motor cars, the standing room is almost the same in area. The crowded capacity of the car with longitudinal seats is the greater, however, because in the cross-seat car passengers lean their bodies and their knees out into the aisle taking up much of the standing room. To give the same seating capacity the cross-seat car must be made

wider and consequently heavier than the car with longitudinal seats. To provide for quick passage, the aisle must be made at least nineteen inches wide, and to insure comfort a seat for two persons should be thirty-three inches wide. This makes the minimum width of the inside of the car seven feet one inch or about eight feet over all. If the width of the seat is decreased in order to widen the aisle, the popularity of the road may be temporarily increased among the younger element of passengers, because a narrower seat forces two persons to sit very closely together and the back of the cross-seat offers a very convenient resting place for the arm of a young man; but this cannot last indefinitely, and the arrangement is apt to result in dissatisfaction among the more solidly constructed and less sentimental class of patrons. The cross-seat car is at a great disadvantage from the fact that when crowded, it requires a longer time to receive and discharge passengers. The narrow aisle and the protruding knees of the seated passengers make passage slow, and it is necessary for the passenger seated next to the aisle to rise to allow the one seated next to the window to leave his seat. However, all these arguments against cross-seated cars are upset by the very simple and very illogical fact that passengers prefer to ride in them. There is a certain element of privacy about the cross-seat, and passengers like to ride facing the direction in which they are traveling. It is probable that a great deal of pleasure riding is encouraged by the cross-seat and most of the modern cars are being built with this feature, the backs of the seats being made reversible, so that the passenger can face either way.

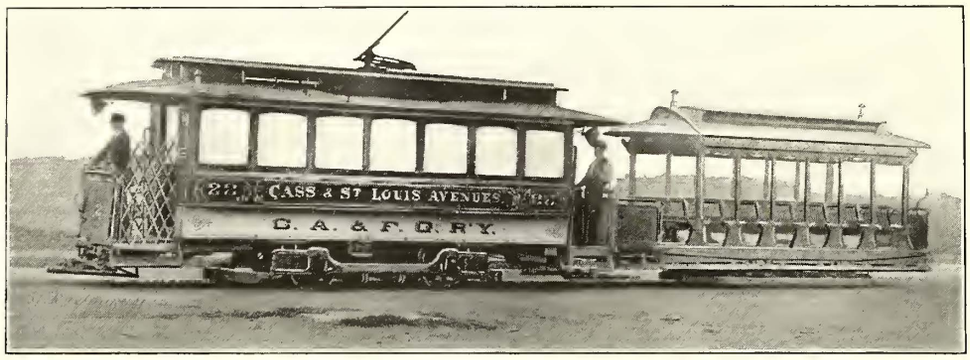


FIG. 3.

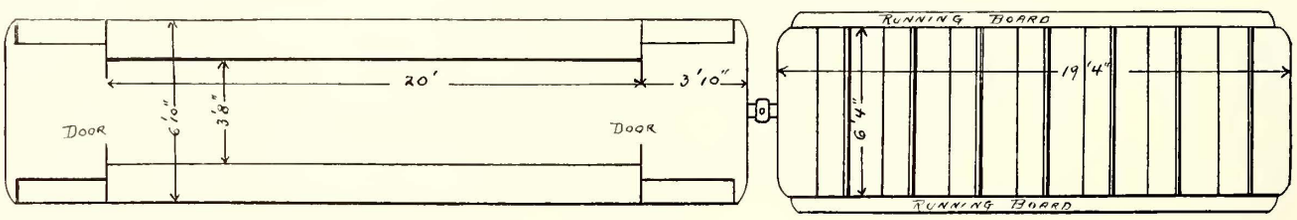


FIG. 3-A.

TRUCKS

The single truck is used under most cars less than twenty-two feet in length of body, and double trucks under cars whose length is greater. In a single truck the axles are connected so that they are rigidly parallel and the length of this truck is limited by the greatest allowable wheel base. This in turn is governed by the radius of the curves used. It is best not to have the wheel base greater than seven feet, where curves as sharp as thirty-five feet in radius must be used, as is the case in most city streets. With this wheel base, a body twenty-two feet in length is as long as practicable and even then "teetering" is difficult to avoid especially if the track is rough.

The advantages of the double truck are that it makes the car smooth riding, that it avoids teetering and that the car can turn sharp curves very easily on account of the short wheel base of each truck. The disadvantages of this form of truck are that it raises the height of the car floor; that it is more expensive to keep in order; that it requires more power to operate, and consequently induces more wear and tear on the motors, which thereupon require greater repairs; that it produces greater wear on the track; and that the traction is reduced on account of some of the weight being placed on wheels which are not drivers. In the first forms of double trucks, steam railroad practice was followed and the truck pivoted in the center, thus placing half the weight on the driving wheels and half on the following wheels. It was soon found that there was a great deal of trouble when the rail was at all slippery in starting the cars and in climbing grades, and that the strains on the motors at these times were very severe. The maximun traction truck remedies this defect by so hanging the car that the greater part of the weight is placed upon the driving wheels. It is not feasible to place too much of the weight on the driving wheels, however, because if the follower wheels are too scantily loaded, they leave the track very easily. This is especially true of the follower wheel of the rear truck, as there is a tendency of the armature pinion on that end to climb the gear wheel, thus elevating the front end of the rear truck. It has been found that it is necessary to leave about thirty per cent of the weight of the car on the follower wheels, thus utilizing seventy per cent for traction. Enthusiastic truck salesmen are apt to claim less, but the books of the unfortunate companies who have purchased double trucks in which the traction is ninety-five per cent of the weight will probably show a large account for having the hanging changed, while the books of the Recording Angel will show a similar account marked "Profanity" and credited to ninety-five per cent maximum traction trucks. With the comparatively light grades found in St. Louis, seventy per cent maximum traction trucks are found to have sufficient traction for all practical purposes, and they are used on most of the railway systems of the city.

Relative Heights of Car Floors

Where a single truck is used, the floor of the car is usually closer to the ground than is allowable with the double truck, because since, in the former case, the truck does not move laterally with respect to the body when rounding curves, boxes can be placed over the wheels and the floor of cars built at a less height above the ground than the diameter of the wheel. With the double truck pivoted in the center, the body must be high enough from the rails for the wheels to swing under it. This height of body requires several steep steps to enter the car, and these are especially obnoxious to ladies. With the modern forms of maximum traction trucks, the car body is pivoted directly over the axle of the driving wheels so that they have very little lateral motion, and the follower wheels are made small enough to swing under the car body. In the car shown in Fig, 4, the platform is lowered one step of 7½ ins. below the car floor so that it may be reached from the ground by a single step. In this case the height of the car floor above the rails is thirty-six inches, and the step from the ground to the platform step is fourteen inches, making the car very accessible. In the car shown in Fig. 1, the platform is five inches below the floor which is thirty-two inches above the rails, while the first step to the platform is fourteen inches.

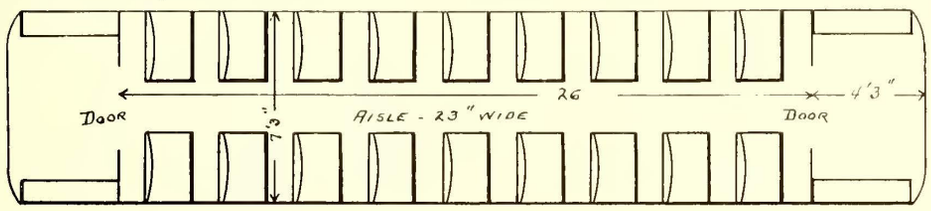


FIG. 4-A.

Number and Location of Exits

It will be noticed on consulting the illustrations of the cars shown in Figs. 7 and 8 that there is an exit at the side of the car in addition to the usual door at the end. This is so placed to facilitate loading and unloading. When a long car is crowded, the stops to discharge passengers become seriously long, especially when the car is equipped with cross-seats as has already been pointed out. There can be no question but that this arrangement shortens the stops, but it introduces the great disadvantage that two doors have been given the conductor to watch. It greatly increases the danger of missing fares and the liability of starting the car while passengers are alighting or getting on. These troubles are so serious that one road in St. Louis which operated cars with side entrances, closed them up and abandoned their use after a short time.

Car Trains vs Double Truck Cars

In all city street railroads there is one class of travel which is very difficult to provide for. This occurs when about one-half of the patrons of the road all desire to ride at once, and occurs regularly twice a day on week days and on pleasant Sunday afternoons and holidays on roads leading to the parks. How best to provide for this travel is still a question and it is done usually by one, or several of the following methods:

1. By running additional motor cars, thus increasing the capacity of the line.

2. By attaching trailers to the motor cars, thus increasing the capacity of each unit.

3. By the operation throughout the day of long cars, capable of carrying a large number of passengers.

It is usual to employ the first method in conjunction with either of the others. The great objection to the use of the first method alone of increasing the capacity of the road is its great expense, as each motor car put in service requires two men. However, it must be used to some extent to decrease the headway during the period of heavy travel.

At first thought there is no neater method of increasing the capacity of the line than through the use of the trail car. It practically amounts to increasing the seating capacity of the car, and doing so only when it is needed, so that it is not carried around the road empty throughout the day. It obviates the necessity of carrying a large number of tripper men, and it makes the loading and unloading of the train very rapid. In spite of these advantages, however, there are grave defects in the system, and in order to discuss the question thoroughly, a comparison will be made between a road operating long cars throughout the day and one operating short cars through the middle of the day and at night, but utilizing the trail car during the hours of heavy travel.

FIG. 4.

The long car used is of the type shown in Fig. 4. The body is twenty-six feet in length and contains eighteen

cross-seats, seating thirty-six passengers in summer and thirty-four in winter, as the stove occupies the space of one cross-seat. The weight of the car is 23,500 lbs., and

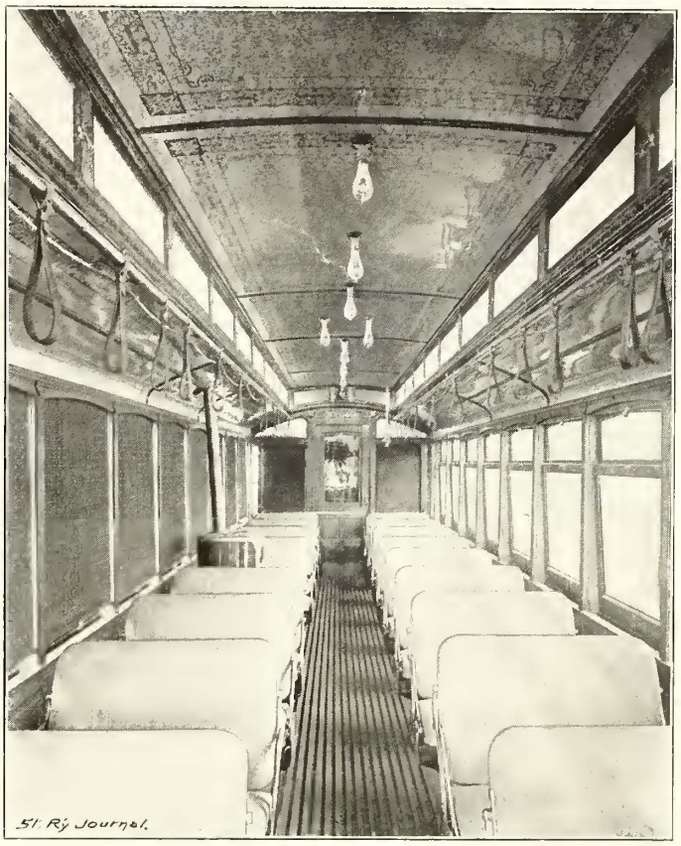


FIG. 5.

the average length of trip is thirteen miles. The number of cars in actual service is forty-four.

The short car is of the type shown in Figs. 1 and 3. The length of the motor body is twenty feet, and the weight of the car is 16,000 lbs. A closed motor car is operated throughout the year. The open trailers operated during the summer weigh 5000 lbs. and seat thirty-five persons. The closed trailers used during the winter weigh 5000 lbs. and seat nineteen persons. The motor car seats twenty-eight persons in summer and twenty-seven persons during the winter. Trailers are operated on 28.4 per cent of the trips, so that 7½ seats, or 28.4 per cent of the average seating capacity of the trailer, should be added to the average seating capacity of the motor car. This gives thirty-five seats as the average seating capacity of each unit operated in this manner. The average length of the trip is 11½ miles, and seventy-seven cars are in actual operation.

Both roads are under the same management and have the same general class of travel.

In making a comparison of these two systems, the relative advantages will first be stated. The advantages of the short car and trailer are (*a*) less repairs on trucks and motors, (*b*) less consumption of power, (*c*) less dead weight carried, (*d*) less wear on track and special work, and (*e*) less loss of time in starting and stopping for passengers. On the other hand, the advantages of the long car are: (*a*) the elimination of trail car wages, (*b*) the elimination of accidents due to persons falling under the trailer, (*c*) the fact that each car is an independent motor, and that there is no necessity of men and horses for switching, (*d*) the doing away with part of the car expenses, such as the cleaning, heating and licensing of trail cars, (*e*) the fact that passengers prefer to ride in long cars. Each of these features will be taken up in turn and discussed.

Repairs on Trucks and Motors.—Table 1 shows the relative cost of keeping in repair the trucks of the two roads. The trucks on the long car are maximum traction, and the motors G. E. 800. The short car has single trucks and W. P. 50 motors. It will be noted that the extra expense per day by reason of the use of long cars is $29.48.

Consumption of Power.—Table 2 shows the relative consumption of power by the two roads. It will be noted that the consumption of power by the road operating short cars is less by 291 watt hours per car mile, and is twenty-nine per cent greater in the case of the road operating long cars. This amounts to 1600 k. w. hours per day, and at $.01 per k. w. hour, $16 per day should be charged up against the long car.

Weight.—Table 3 gives a comparison of the different types of cars, with respect to their weight at different degrees of load, and also shows the proportion of the weight on the driving wheels. It will be noted that when the cars are empty the dead weight of the long car is much the highest, but as the cars become loaded, this proportion rapidly diminishes. The proportion of the weight available for traction is seventy per cent in the case of the long car. It is higher in all of the other cases when the cars are empty, but when trail cars are used the proportion of the weight available for traction falls as the car becomes more crowded, just when there is the greatest demand for it.

Wear on Track and Special Work. The hammer blow from the wheels in passing over joints and frogs is greater in the case of long cars. Exactly what is the money equivalent of this difference is difficult to estimate because the long double truck car has been in use such a short time that it is impossible to obtain figures covering a sufficient

FIG. 6.

lapse of time to make a fair comparison. It is probable that the actual wear on the rails themselves is proportional to the weights of the cars, the great difference being more perceptible at the joints and the openings in the special work. This difference in wear could largely be eliminated by the use of some form of welded joint or some joint

which would prevent motion of the rail ends, because as has been pointed out, the difference in wear would then be proportional only to the difference in weight of the two cars.

during these periods is one-half the final velocity, and in the stopping of a car 5¾ seconds will be lost at each stop and 3¾ seconds will be lost at each slow-up, in comparison with the short car. The average total number of stops

Type of Car.	No. of Cars.	Average number of seats in each train.	Motor Repairs.				Truck Repairs.				Total motor and truck repairs per car per day.	Percentage decreased cost of motor and truck repairs of short car over long car.	Increased expenses per day by reason of the use of long cars.
			Total for first six months of 1896.	Per car per year.	Per seat per year.	Per car per day.	Total for first six months of 1896.	Per car per year.	Per seat per year.	Per car per day.			
Fig. 4. Long Car	44	35	$6,681.43	$303.70	$8.66	$0.83	$5,328.58	$242.21	$6.93	$0.66	$1.49	45	$29.48
Figs 1 and 3. Short Car	77	35	7,304.04	189.74	5.42	0 52	4,274.59	111.02	3.18	0.30	0.82	.....	.....

TABLE 1.—COMPARISON OF MOTOR AND TRUCK REPAIRS ON LONG AND SHORT CARS.

Time Lost in Stopping and Starting.—A large number of observations were made to determine the relative time required for stopping and starting the two types of cars.

Type of Car.	Average watts per car.	Average speed per car miles per hour.	Average watt-hours per car mile.	Increased power required by long car. Watt-hours per car mile.	Percentage of increase.
Figs. 1 and 3. Short car	8,640	8.6	1,004		
Fig. 4. Long car	12,345	9.6	1,295	291	29

TABLE 2.—COMPARISON OF POWER REQUIRED BY LONG AND SHORT CARS.

The average of these observations is shown in table 4. Observations were made on the length of time required to stop the car, the duration of the stop and the length of time required to regain speed. These observations were made at different times of the day and with varying numbers of passengers in the car so as to obtain as fair an average as pos-

per day for passengers is 376, and 320 slow-ups are made for passengers. The long car thus consumes per day fifty-six minutes more time in making stops and slackening

Type of Car.	Time required to stop the car in seconds.	Duration of stop in seconds.	Time required to regain speed in seconds.
Figs, 1 and 3. Short car with trailer	7½	5	6
Fig. 4. Long Car	10	7	11
Difference in favor of short car in seconds.	2½	2	5
Percentage increased time required by long car.	33	40	83

TABLE 4.—COMPARISON OF TIME REQUIRED FOR STOPPING AND STARTING.

speed for passengers than would a short car operating in the same service. In order to maintain the same headway and give the same service as the short car, either the speed

Types of Car.	No. of seats.	Total crowded capacity	Weight empty.	Percentage of weight on driving wheels.			Pounds weight per seat.			Pounds weight per unit of total capacity.		
				Car empty	Seats full	Car crowded	Car empty	Seats full	Car crowded	Car empty	Seats full	Car crowded
Fig. 1. Short car	28	80	16000	100	100	100	572	702	943	200	246	330
Fig. 3. Short car with open trailer	63	140	21000	76	67	67	334	463	622	150	210	280
Fig. 3. Short car with closed trailer	48	125	21000	76	72	71	438	568	776	168	218	298
Fig. 2. Short car with cross seats	28	60	16000	100	100	100	572	702	850	267	328	396
Fig. 4. Long car	36	110	23500	70	70	70	653	782	1050	214	258	344

Note.—Each passenger is estimated at 130 lbs.

TABLE 3.—COMPARISON OF WEIGHTS CARRIED BY DIFFERENT CARS.

sible. It will be noted that the long car required the greater time at each observation. If we assume that during the time of stopping and starting the car, the velocity is uniformly retarded or uniformly accelerated, the average velocity

of the long cars must be increased between stops, or the number of cars on the road must be increased. If the speed between stops is increased, there will be a greater consumption of power and a greater liability to accidents;

if the other alternative of increasing the number of cars is adopted, there is a corresponding increase in the wages and the car maintenance.

Trailer Wages.—With some roads operating trailers, an extra conductor is put on the trail car and paid for each trip. In the case of the road under discussion, however, the conductor of the motor car takes care of the trailer when in service and both he and the motorman are paid ten cents per trip extra for each trip when there is a trailer on the motor car. The manifest advantage of the first method is that all the fares are collected, and the disadvantage is that it requires the employment of a large number of men who handle the money of the company and earn very little themselves. In the case cited, trailers are operated on 28.4 per cent of the trips and hence 28.4 per cent of twenty cents or 5.68 cents should be charged up per trip as the additional expense due to trailer wages. On the road operating long cars, 423 trips per day are made, so that the additional expense per day in case trailers were used would be $24.03.

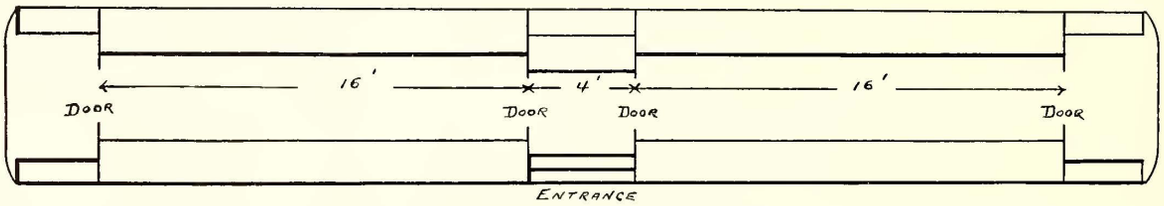


FIG. 7-A.

Accidents.—The question of accidents on mechanically propelled cars has of late become such a serious one that any feature liable to increase this account is regarded with horror. There can be no question but that the trailer increases the risk of accidents both on account of the fact that it is another car and on account of the open space between the motor and trailer. An attempt was made by going through the conductors' reports for a year, to ascertain what proportion of the total number of accidents was due to the use of trailers. The attempt was unsuccessful, partly from the fact that many of the cases have not been settled, and partly because it was difficult always to determine when an accident should be charged entirely to the trailer or what part of the cost should be charged to the trailer. For instance, a man attempts to get on a motor car and falls down. The trailer runs upon him and injures him. If no trailer had been operated he would have fallen and have been injured, though perhaps not so seriously. His imaginary internal injuries, however, might have been just as costly in the case of the simple fall as his visible external injuries in case the trailer had run over him. What proportion of the cost of the accident should be charged to the trailer is impossible to estimate. However, judging from the examination of the reports, the percentage of accidents is increased by the use of trailers though not in the proportion popularly supposed. A great part of the trailer accidents occur on account of persons attempting to get on or get off the cars while in motion, for which class of accidents the company is in no way responsible either in law or in equity. It is a well known fact, however, that in the trial of a damage suit against a corporation, neither law nor equity receives serious consideration.

Switching of Trailers.—In the large cities, loops and "Y" switches are difficult to obtain and in many cases motor cars must be switched back at the end of the road by the use of crossovers. If trailers are used on a road of this kind, men must be stationed at each end of the road to assist in switching the trailers, and a man and horse at the car house to pull them into the shed. A conservative estimate of what this cost would be in the case of the road operating long cars if trailers were used, is $4 per day. This would be charged against the trailer.

FIG. 7.

Car Expenses.—The fact that the trailer is a separate car produces a number of expenses such as car cleaning, car heating and car license. While these expenses are not serious, as the trailers are operated only a short part of the time, their cost should be charged against the use of the trailer.

Preferences of Passengers.—There can be no question but that passengers prefer cross-seats and the long double truck car, and manifest their preferences by patronizing roads which give them this form of car. The experience of roads in St. Louis which have changed their car equipment and adopted this type of car has been that their receipts are immediately increased. Part of this has been

taken from other roads on account of the preferences already mentioned, but part of it is travel which has actually been created. This created travel is pleasure riding and is very desirable to encourage, as it occurs at a time when the travel would otherwise be slack.

To sum up, the comparison which has been instituted, the amounts to be charged against the long car are repairs on trucks and motors, $29.48, and greater consumption of power, $16 per day. On the other hand we have the extra wages due to trail cars, $24.03, and the cost of switching, $4 per day, leaving a balance in favor of the trail car of $17.35 per day. We have neglected to value the wear on the track, the greater number of accidents due to trailers, the trail car maintenance expenses and the preferences of passengers. Taking these into consideration, however, it would be very safe to estimate that if the road gained $10 per day or 200 passengers due to increased travel, the long car would be the better investment.

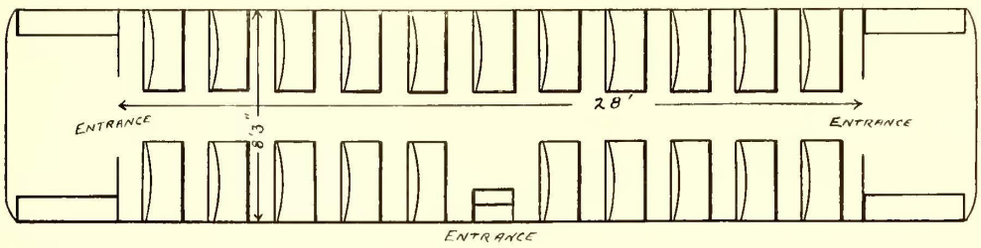


FIG. 8-A.

There are other considerations which have not entered into the comparison. For instance, many roads use old horse cars as trailers, not through choice, but because they have the horse cars, cannot sell them and cannot afford to buy other motor cars. The trail car system is a very flexible one. It increases the capacity of the cars just at a time when such an increase is needed, and is especially suitable for roads having very sudden and erratic calls for capacity.

It will be evident from what has been stated that no general rule can be laid down as to the best type of car, on account of the fact that no two roads are operated under precisely the same conditions. A great deal will depend upon the amount of travel to be gained by the use of the more expensive car. This will vary with the class of people served. In residence territory it will probably be very considerable and in factory districts correspondingly less. There is little question that double truck cross-seat cars on interurban lines are desirable not only from their popularity and the pleasure taken by passengers in riding through the country in an easy and comfortable position, but also because speeds can be greater and curves taken more easily with the same factor of safety than is the case with the shorter cars. All these special considerations must be carefully studied before deciding upon equipment in any particular case. It is hoped however that certain points have been brought out in this discussion which will be of value in the selection and design of cars.

STREET RAILWAY POWER STATIONS IN ST. LOUIS

BY WINTHROP BARTLETT

In view of the magical growth and development of mechanical devices since the introduction and application of mechanical power for street car populsion, it would scarcely be expected to find all the various types of improved machines in any one city. The visitor will find, however, that St. Louis, in her power station equipments, represents quite a major portion of the serviceable types of electrical machines which during the past eight years have been thrust at us in such rapid succession that we have hardly had time to repair one burnt out armature before the electrical agent was with us with a new type that "can't burn out."

Coincident with the wonderful production of electrical machines, have been the improvements in steam engines, boilers, and other adjuncts to power house equipments which have made it possible for street railway companies to handle immense volumes of business economically, and at a less cost than with animal power.

Probably never before in the history of mechanical engineering have so large a number of practical, serviceable, and almost perfect machines been put into successful financial operation, as in the past eight years. Mechanical and electrical engineers, during this time, have been exceedingly busy in collecting data, studying the various requirements and formulating results with a view to obtaining greater efficiency, economy, durability and security in all parts of the power station equipments. It will be observed from a study of the power station plans here presented that the labors of the engineer have resulted in many marked improvements which have already been financially successful, and that the tendencies of these improvements point to larger units and slower speed, resulting in the longer life of apparatus and reduced operating expenses.

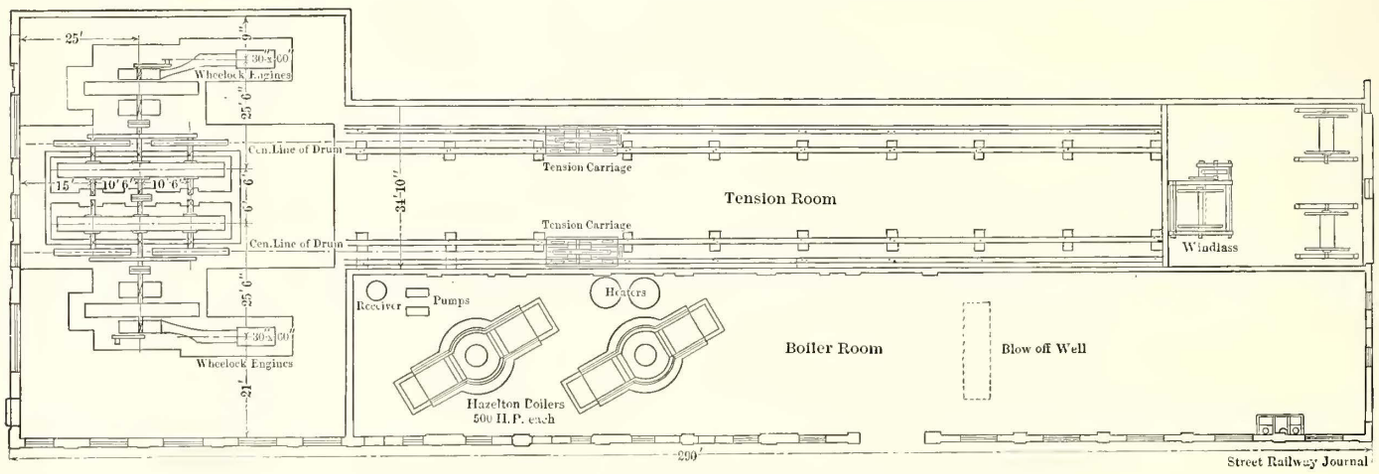
FIG. 8.

There are in St. Louis at present eight electrie and four cable power stations, and in St. Louis County two electric power stations, all used exclusively for street

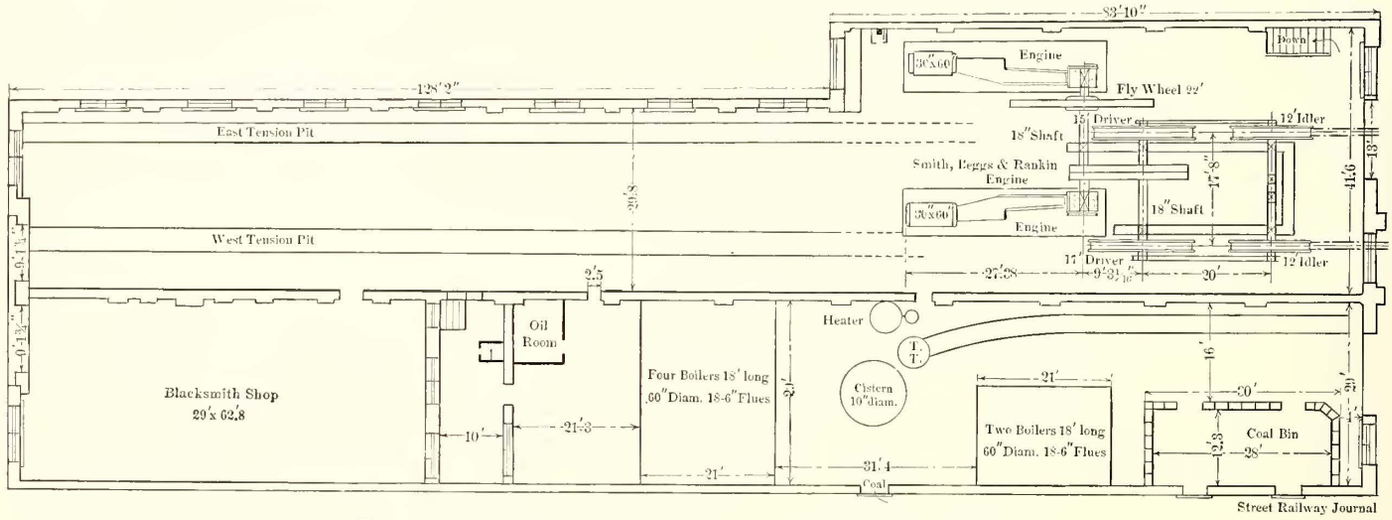
railway purposes. The pioneer power house in St. Louis was that of the St. Louis Cable & Western Railway Company (now the St. Louis & Suburban Railway Company), located at the north-east corner of Thirty-fourth Street and Franklin Avenue. This was operated from Apr. 15, 1886, to Oct. 27, 1891. The remarkable feature of this original plant was the single cable about 6¼ miles (in one piece) operated by very light winding machinery. The line was very crooked, having fourteen single track, right angle curves of short radii and twelve curves of longer radii. There was no end to the trouble and expense of operating this plant. The original plant lasted about three years when it was replaced with modern apparatus operating two cables and this new plant was abandoned Oct. 27, 1891, after the road had been converted into an electric line. The two 30 in. × 72 in. Hamilton-Corliss engines installed in this latter plant and practically new, were removed and placed in the electric power house at De Hodiamont and have since been running dynamos.

St. Louis Railroad Cable Stations

The St. Louis Railroad Company's two stations are alike, so that only one plan is presented. Each station has two 500 h. p. Hazelton boilers, and two 36 in. × 72 in. Wheelock engines, with the necessary pumps, heaters, etc. A very unfortunate feature in the design of the engines for this plant was the unsuitably large cylinders—these were determined upon arbitrarily by the former president of the company. The writer objected to the diameter, thirty-six inches, as too large—hence wasteful and troublesome in operation, considering the length of the cables and the possible maximum loads. Indicator cards, taken with the heaviest loads that it has been so far possible to get, give less than 600 h. p. as a maximum, the average load being about 400 h. p. or less.



PLAN OF CABLE POWER STATIONS OF THE ST. LOUIS RAILROAD.



PLAN OF CABLE POWER STATION OF THE MISSOURI RAILROAD.

The Citizens' Railway was operated by cable for about seven years, commencing September, 1887. The motive power was changed to electricity during 1894, and the cable power house was abandoned on the last day of that year. Electric power is now furnished from the Cass Avenue power house.

There are now only four cable power houses in the city, the Missouri Railroad Company's Olive Street power station, the St. Louis Railroad Company's two Broadway stations and the People's Railway station at Park Avenue and Eighteenth Street.

The engines run at fifty-six revolutions, with initial pressure of seventy pounds. Cutting off at the most economical point, this engine should have a load of 650 to 700 h. p. One of the engines in the north power house was bushed to twenty-eight inches diameter, resulting in a saving of eighty bushels of coal per day, the cost of which is nearly $3000 per year. If these engines had been properly designed the company would have saved much more.

As shown in the drawings, the winding machinery has the main shaft between the driving drums, and both drums are driven by a cast iron pinion on the engine

shaft, which meshes into a mortise spur wheel with hard maple teeth. The drums are provided with the Walker differential grooves.

The pea coal used in these power houses is carried by conveyors to the Roney stokers on the boilers. Rain water from the surrounding buildings is stored in large iron tanks under the floors and between the tension carriage pits. This water is used for boiler feed, and it is found that by alternating frequently with the river water the scale in the boilers is greatly reduced.

The power house, as well as the car houses and other buildings, are lighted by a small isolated electric plant located in the engine room.

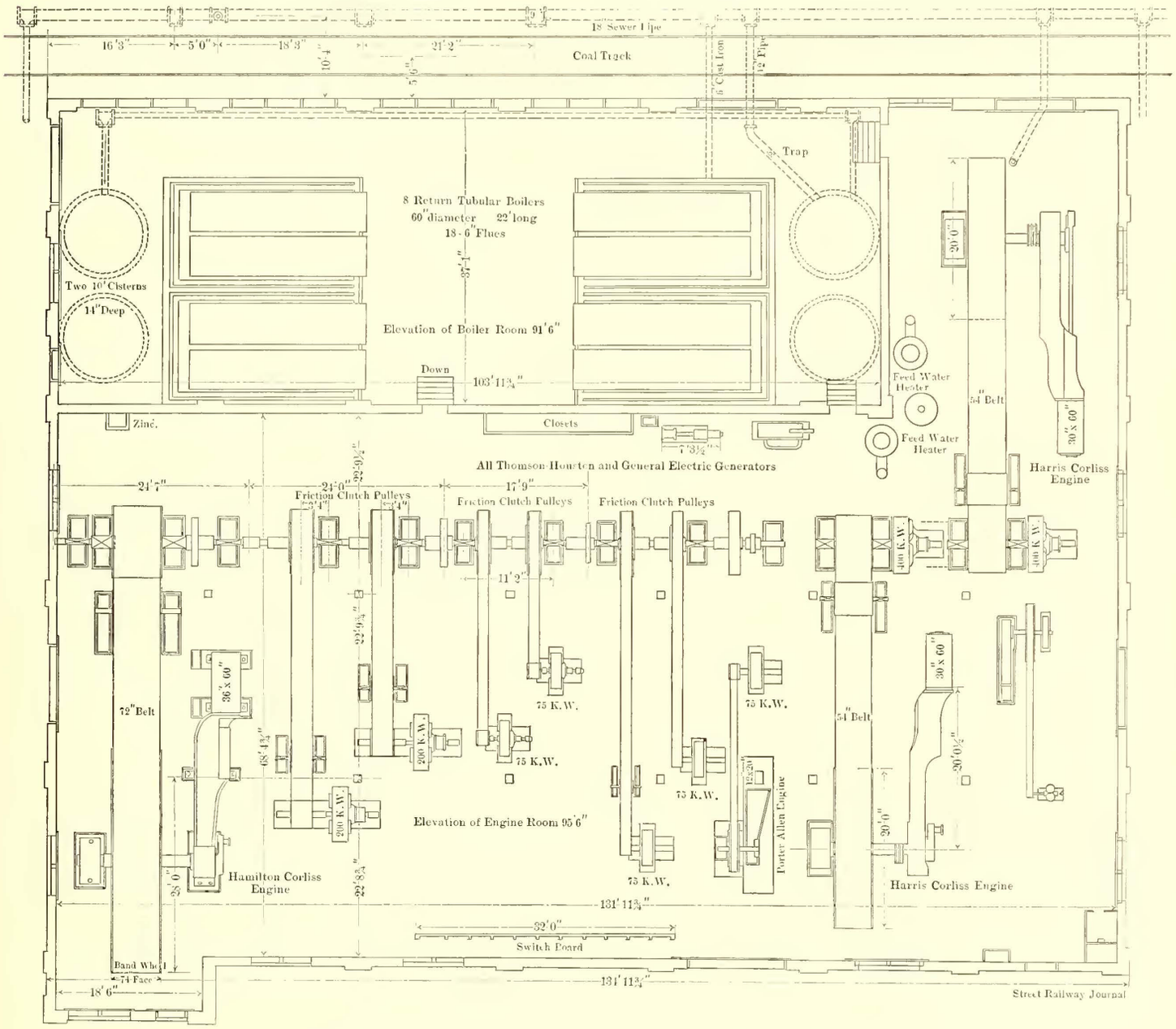
The following table concerning the cables of the St. Louis Railroad Company is self explanatory:

The first through trains were run on this line Jan. 19, 1891.

The cost of motive power on this line is close to $.016 per car mile, or $.032 per train mile.

MISSOURI RAILROAD CABLE STATION

The Olive Street cable power house of the Missouri Railroad Company is located at the corner of Thirty-third and Olive Streets. It was started Mar. 17, 1888. The original station equipment consisted of two 30 in. × 60 in. Corliss engines made by local manufacturers of St. Louis; winding machinery for two cables; two No. 9



PLAN OF ELECTRIC POWER STATION OF THE MISSOURI RAILROAD.

Cable.	Length in ft.	Average miles per mo.	Average life in mos.	REMARKS.
1	11,300	7,000	7 to 8	Operated by north station
2	28,300	6,000	7½	" " " "
3	19,860	6,000	8	" " south "
4	20,500	7,000	4	" " " "
	79,960			

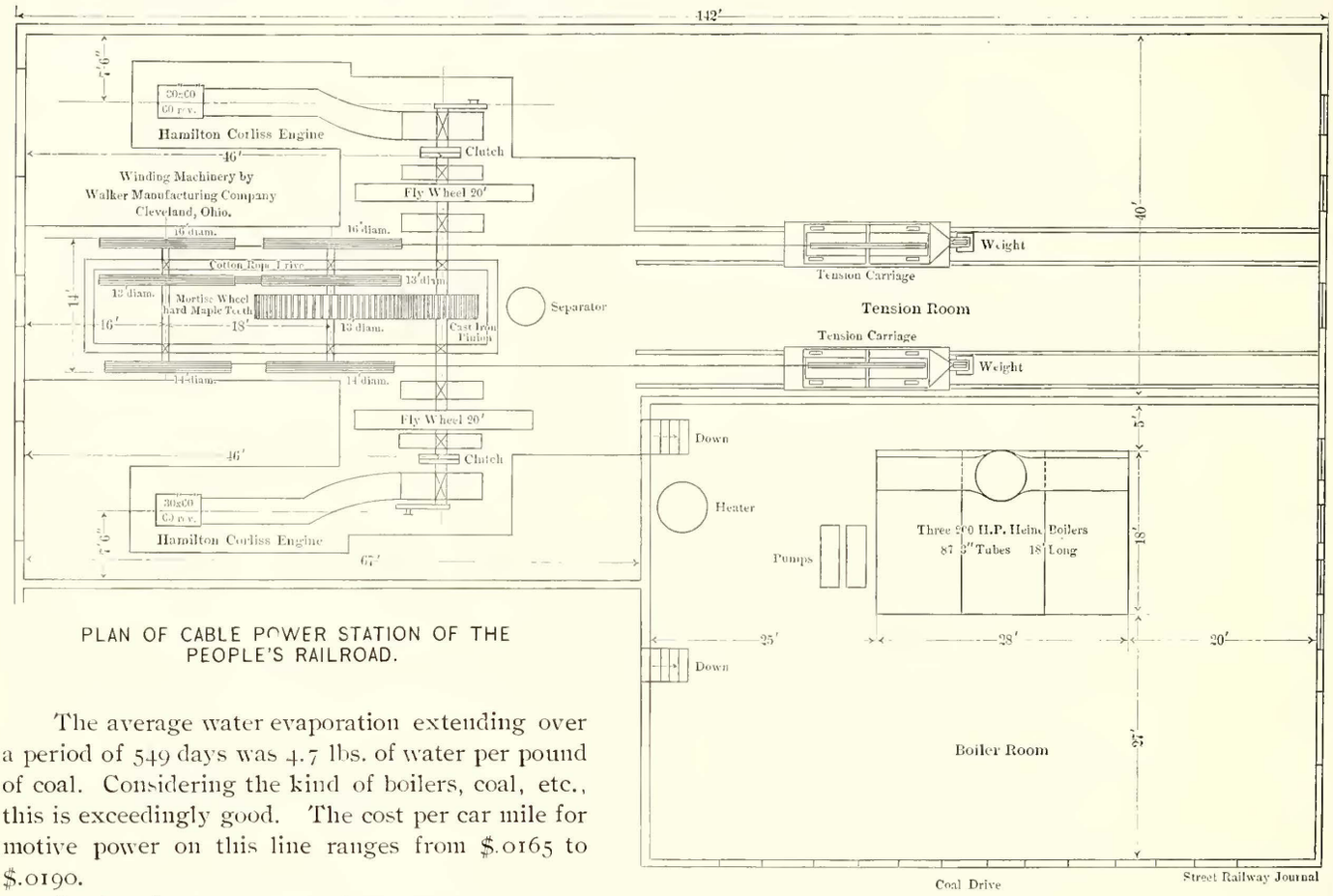
Hooker pumps, one 500 h. p. closed heater; one receiver; one small engine with reels and apparatus for taking out old cables; and the boiler plant, which consists of three batteries of horizontal tubular boilers. The boilers are set in batteries of two boilers each, the shells being 60 ins. diameter, 18 ft. long, with eighteen 6 in. flues. The furnaces are set with plain grates, and equipped with the "Hutchinson smoke consumer," a steam jet device. This device, while very efficient in preventing smoke, gave in

one test a slight loss, and in another a slight gain in coal consumption, and as there was no appreciable increase in the coal bills after its introduction it has been allowed to remain.

On the two cables operated by this station the downtown, or east one, is 23,700 ft. long, and the west one 25,700 ft. long. The power required to move the cables without cars is distributed as follows:

Engine and winding machine	29.15 h. p.
East cable	43.00 "
West cable	67.20 "
Total power to move machinery and cables	139.35 "

The life of the east cable is from nine to fifteen months, and of the west cable from five to eight months.



PLAN OF CABLE POWER STATION OF THE PEOPLE'S RAILROAD.

The average water evaporation extending over a period of 549 days was 4.7 lbs. of water per pound of coal. Considering the kind of boilers, coal, etc., this is exceedingly good. The cost per car mile for motive power on this line ranges from $.0165 to $.0190.

During the present year the company put on an entirely new equipment of rolling stock, somewhat heavier than the old, and entirely different in design. The grip was also changed from the Root to the Johnson or New York grip, the latter being operated from either end of the car by means of a "pilot wheel" and woven gear. The old 30 in. × 60 in. cylinders were replaced by new ones.

PEOPLES RAILROAD CABLE STATION

On Apr. 20, 1890, the People's Railway cable power house was put into operation, and from that day until the day of the great tornado, May 27, 1896, a period of over six years, it ran without interruption, the occasional stoppages being attributable to strands, blockades, etc.—causes outside of the power house.

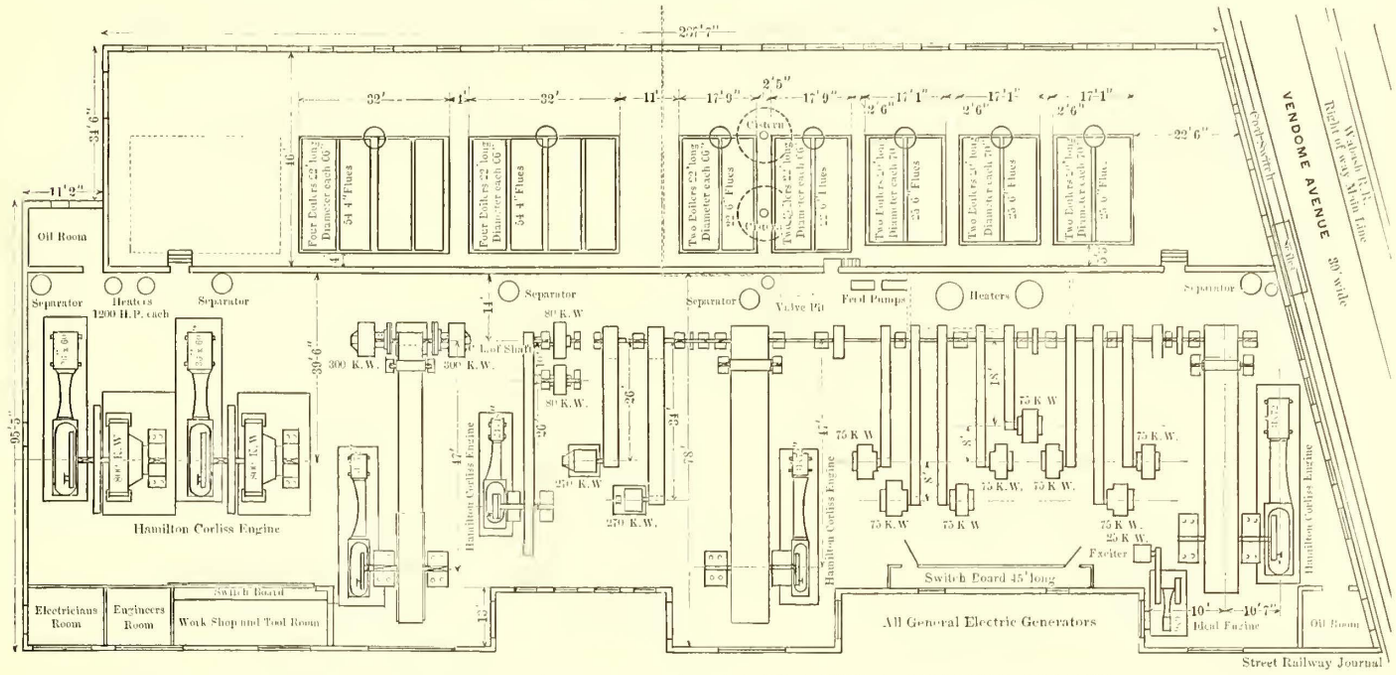
Three Heine water tube boilers, 200 h. p. each, furnish steam to the two 30 in. × 60 in. Hamilton-Corliss engines. The winding machinery, as shown on the plan, is driven from the main engine shaft by gearing, the spur being a mortise wheel with hard maple teeth, and the pinion of cast iron. The idle drums are driven from the main drum shaft by cotton ropes. About a year ago the drums in this plant were changed from "solid" grooves to the "Walker differential." The superintendent reported to the writer that there was no measurable difference in the life of the cables since the change. The downtown or east cable is 25,600 ft. long and the west cable 28,750 ft. There are eight single track curves in the former and ten in the latter cable. The average life of these cables ranges from six to eight months.

A very serious and expensive delay in operating was recently caused by the peculiar design of this winding machine. It will be observed on the plan presented, that the clutches which disconnect the engines are located between the flywheels and the main bearings, so that when either engine is out of service it cannot be run. During the tornado of May 27, one of the engines had its valve gear carried away and was otherwise badly damaged. In order to break the engine in after being rebuilt it was necessary to run it without a load. This could be done only by throwing off both cables and running the entire winding machinery, causing great delay and expense.

ST. LOUIS AND SUBURBAN RAILWAY ELECTRIC POWER STATION

In selecting the site for the power house for this road, a large tract of ground was necessary, and as the old cable station was found too small, it was entirely abandoned. This was not done, however, until the company had decided and built upon a tract of ground at De Hodiamont. This place was found favorable for power house construction,

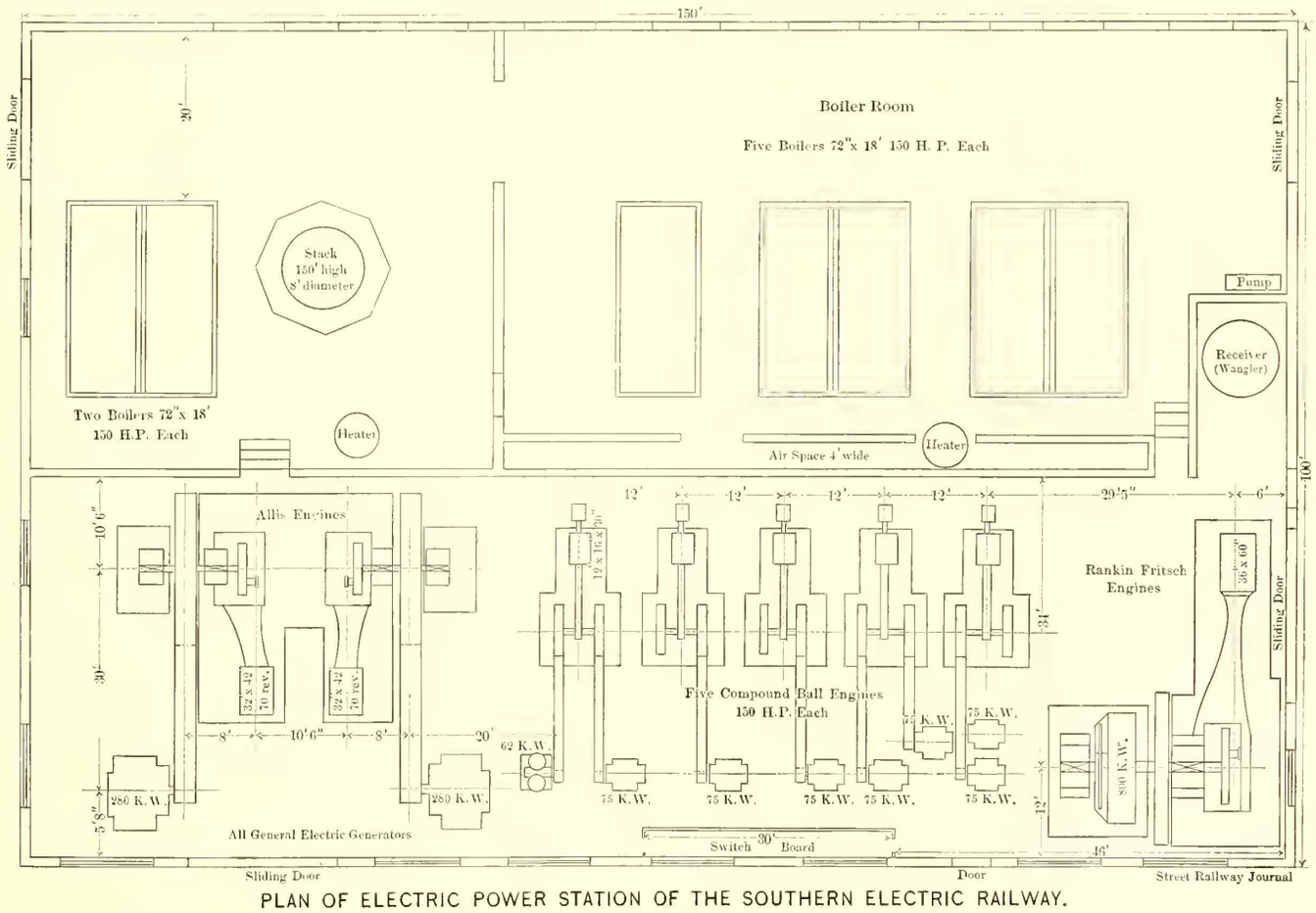
it being a level piece of ground, within a stone's throw of the main line of the Wabash Railroad, and also, from the nature of the soil, well adapted for engine and dynamo foundations. The first portion of the new large power house was completed September, 1891. This part was nearest the railroad tracks and was built with a view of future extensions.



PLAN OF ELECTRIC POWER STATION OF THE ST. LOUIS & SUBURBAN RAILWAY.

Eight Thomson-Houston M.P. 75 and two M.P. 80 generators were operated from a countershaft belted to a 31 in. × 72 in. Hamilton-Corliss engines. Three batteries of two boilers each, two batteries furnishing steam for the engine, made up the power house equipment. The boilers were of the horizontal tubular type and were built in St. Louis. They were seventy inches in diameter and 20 ft. and 22 ft. long, with twenty-five six-inch flues.

During the next month after starting up (October), the cable plant was abandoned and the engines used in running the same were moved to De Hodiamont, placed in position as twin engines and belted to the line shaft.



PLAN OF ELECTRIC POWER STATION OF THE SOUTHERN ELECTRIC RAILWAY.

In 1893 an extension was built to the engine room and a Hamilton-Corliss engine 24 ins. × 48 ins. belted tandem to two Thomson-Houston M.P. 80 generators was

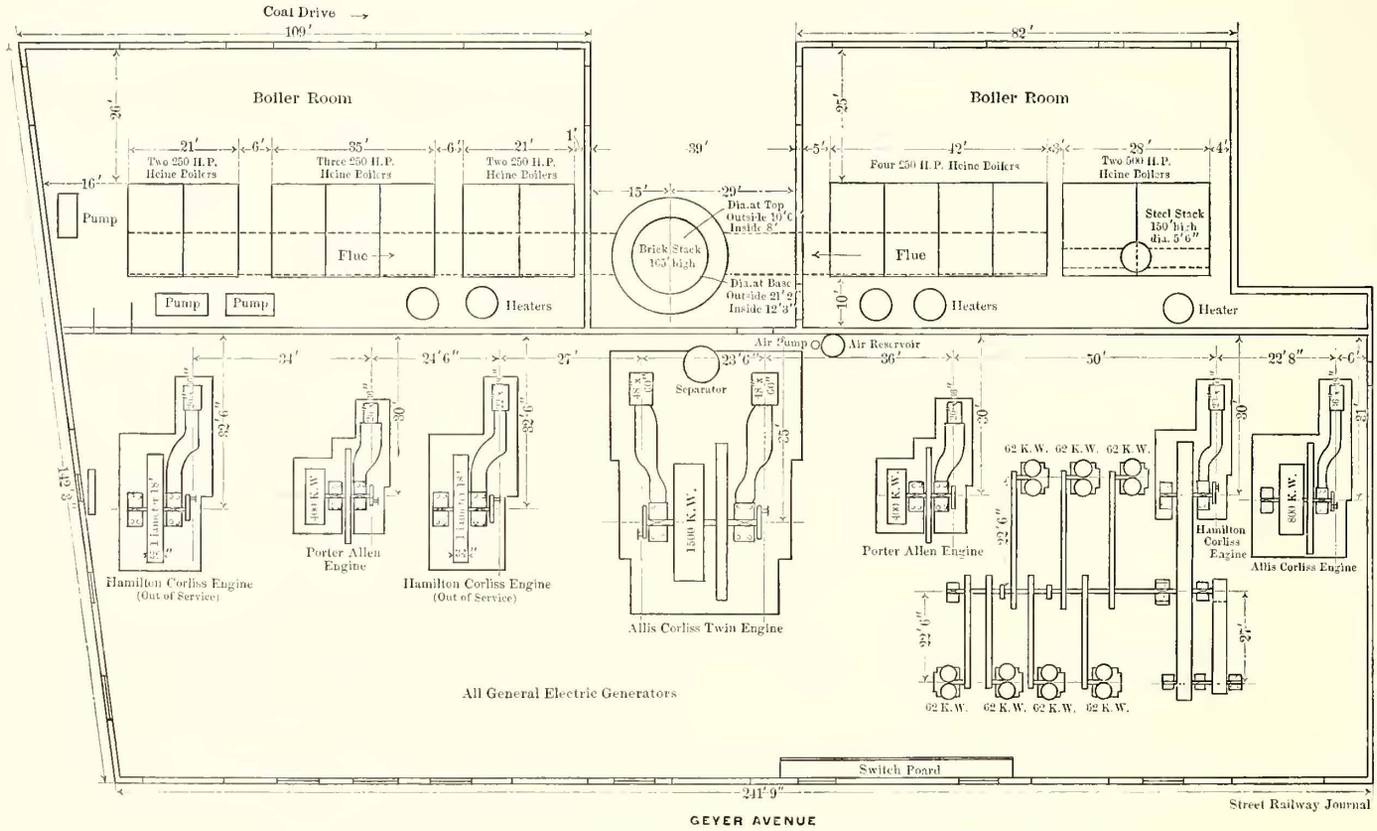
taken from the old portion of the house. At the same time the east 31 in. × 72 in. twin engine was moved to the east end of the extension and belted to two Thomson-Houston M.P. 300 dynamos. The line shaft was also extended to the east and two Thomson-Houston M.P. 270 generators were belted to it.

It took four more boilers to furnish the steam for this new addition and two were put in in 1892, each having a shell 60 ins. × 22 ft., with twenty six-inch flues. The other two were 66 ins. × 22 ft., with twenty-two six-inch flues. This addition was made on account of an increased business.

The power house now remained as it was for three years. Then the St. Louis & Meremec River Railroad was chartered and built. This company rented power from the Suburban, and it was found necessary to build an extension in order to accommodate the new road. In January, 1896, this extension was begun, sixty feet was added to the engine room and 118 ft. to the boiler room. Two 36 in. × 60 in. Hamilton-Corliss engines direct coupled to two G. E. 800 k. w. generators were installed, and two batteries of four boilers each were added. These boilers are twenty-two feet long and have fifty-four four-inch flues.

All the boilers are now provided with the Hawley down draft furnace, and each battery has a steel stack 150 ft. high. The station is provided with an improved switchboard manufactured by the General Electric Company, also a full set of feeder panels. Rooms and a work shop for the electrician and the engineer are provided in this extension.

Special attention was paid to the steam piping in this house which has just been renewed throughout. Scott valves were used. This work of piping is considered one of the best jobs in the city. Water for this entire plant is supplied by a six inch city water main. It can be fed direct to the pumps, to the boilers, to the heaters, or to the two cisterns, or hot wells located in the boiler room. These cisterns, or hot wells, are connected with each other by a twelve inch cast iron pipe, two feet from the bottom. All water of condensation from exhaust pipes, traps, etc., is discharged into the south well. The scum and dirt rising to the top is run off into the sewer; thus the north one contains good water, which is pumped into the boilers. As a rule the water from the main is run through the heaters to the pumps, thence to boilers. There are four closed heaters, one O'Brien, one Baragwanath and two Goubert. The pumps are Hooker packed, plunger, duplex, 12 ins. × 7 ins. × 12 ins.



PLAN OF ELECTRIC POWER STATION NO. 1 OF THE UNION DEPOT RAILROAD.

SOUTHERN ELECTRIC RAILWAY STATION

Competition and increasing business necessitated a change in the motive power of the South St. Louis Street Railway Company. In 1890, electricity was adopted and the name changed to the Southern Electric Railroad Company. The horses were retired on Nov. 24 of that year, and twenty-six single truck cars equipped with two F. 40 motors each were put into commission.

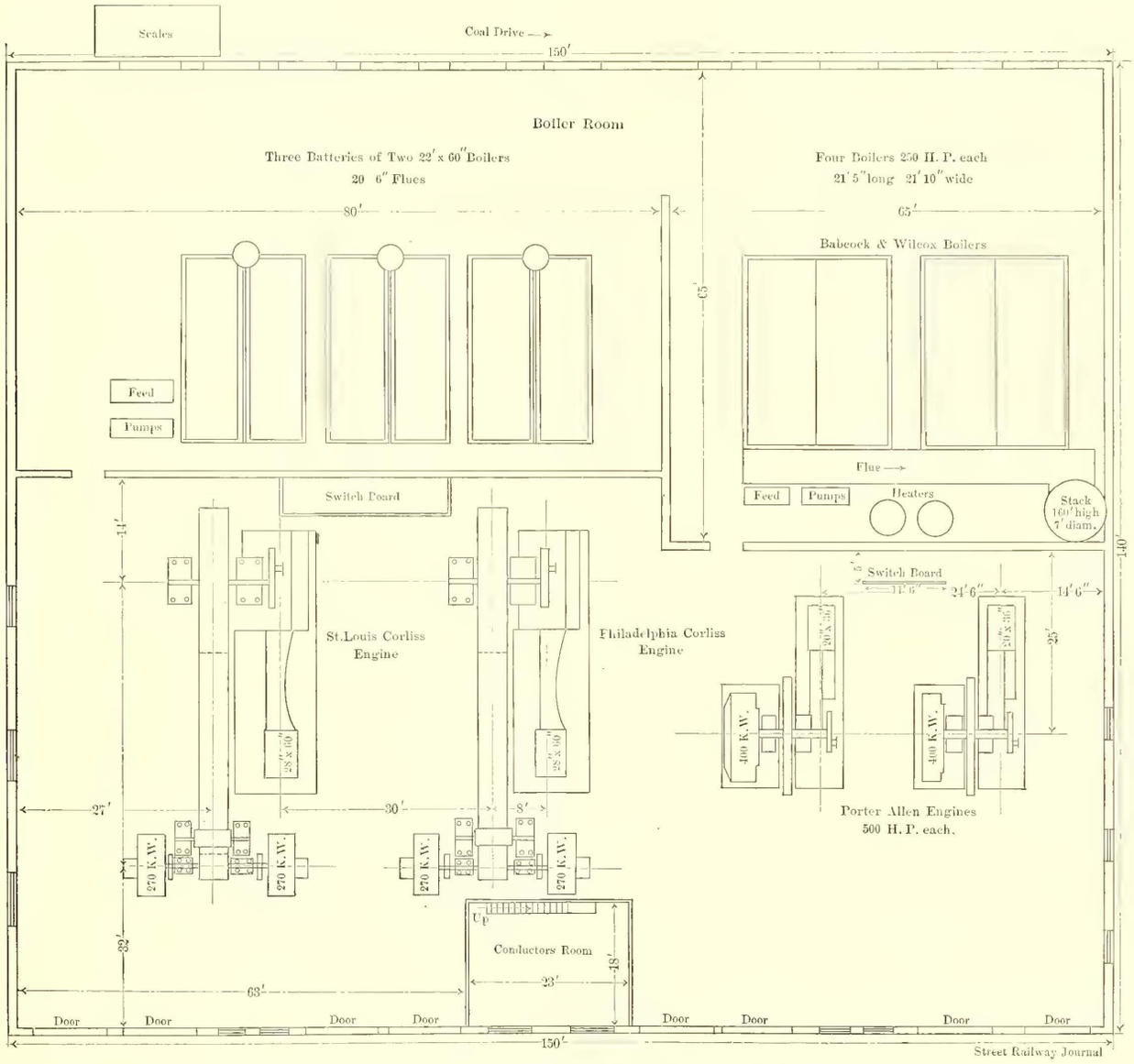
Power was supplied from a station built between Osage and Gasconade Streets on South Broadway. This house was equipped with five General Electric M. P. 75 generators belted to five compound Ball engines 12 ins. × 16 ins. × 30 ins. of 100 h. p. each, steam being supplied from four 150 h. p. tubular boilers, 18 ft. × 72 ins. diameter. The next year (1891) it was found necessary to increase the motive power, and two more Ball engines and two General Electric M. P. 75 generators were added, the additional steam required being furnished by another boiler of the same size as the others.

In 1893, the engine and boiler room were found to be too small and they were enlarged by an addition, into which were placed two Allis engines 32 ins. × 42 ins., making seventy revolutions. These were each belted to one General Electric M. P. 280 generator. The source of steam for these engines consisted of two boilers 72 ins. × 18 ft., 150 h. p. each. A brick stack 150 ft. high having an inside diameter of eight feet was also built at this time. The power house was now found to be amply equipped to handle all the business, but in the latter part of 1895 and beginning of 1896 the road was extended, and two of the Ball engines were taken out to make room in the power house for a 36 in. × 60 in. engine direct coupled to a General Electric 800 k. w. generator.

One more point which should not be overlooked is the introduction of the M. P. 280 generator; then came one large unit, the 800 k. w., direct coupled. This generator can alone take care of all the business on the road. The small machines are used only as reserve.

UNION DEPOT RAILROAD ELECTRIC STATIONS

In selecting the location for power station No. 1, a central one was decided upon, and the block bounded by Geyer, Missouri, Allen and Jefferson Avenues was taken. The first portion of the plant was erected at the corner of Missouri and Geyer Avenues and started during the early part of 1890. The boiler room was 54 ft. × 109 ft., and the engine room 85 ft. × 129 ft.



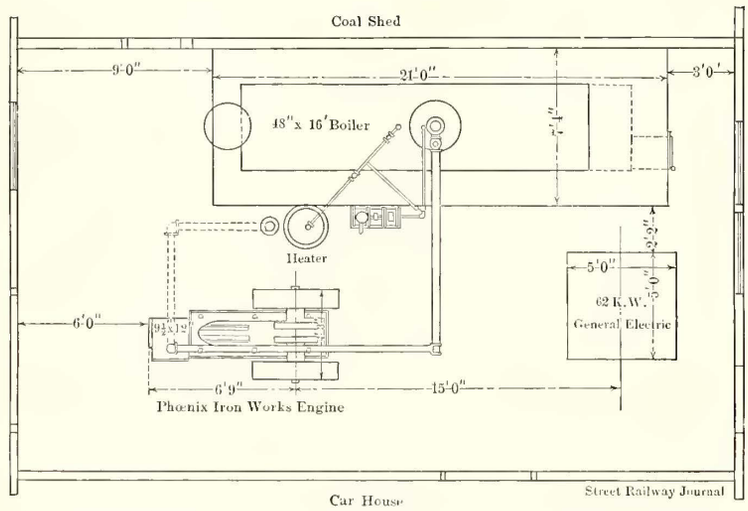
PLAN OF ELECTRIC POWER STATION NO. 2 OF THE UNION DEPOT RAILROAD.

that of the natural sewage system of this power house, viz., a cave which extends from the power house to the river, through which a wagon can be driven with ease.

On reading a description and history of this power house, it would be supposed that some mistakes were made in the selection of the machinery; but, on second thought, it will be noticed that the changes were made as the larger machines were put on the market, and as the tendencies have been toward larger units and slower speed they were adopted. The first step in this direction was

Three boilers, of 250 h. p. each, were placed in position in the latter portion of 1889. Each of these boilers, which were made by the Heine Boiler Company, has 113 tubes, 3½ ins. diameter and sixteen feet long. The first engine room equipment consisted of two Hamilton-Corliss engines, one 24 ins. × 48 ins., the other 20 ins. × 48 ins., together with fourteen Thomson-Houston D 62 dynamos. The engines were belted to an eight inch jackshaft, from which the power was transmitted to a six inch countershaft by a one inch rope drive, and this drive was provided

with an automatic tension carriage. The dynamos were driven from the countershaft by ¾ in. rope transmission. In a very short time the rope transmission proved to be entirely unsuitable and unreliable, and was replaced by belts. During the next year a small addition was made to the building, the countershaft extended and another engine put in, and the number of D 62 dynamos increased to twenty-two.



PLAN OF ELECTRIC POWER STATION OF THE MIDLAND STREET RAILWAY.

Shortly after this the building was increased to its present dimensions, and in the spring of 1895 the equipment consisted of eight 250 h. p. Heine boilers, two Porter-Allen 20 in. × 36 in. engines direct coupled to two General Electric M. P. 400 generators, and seven D 62 generators run from jack and countershafts, belted to a 28 in. × 54 in. Hamilton-Corliss engine, together with the engines, countershaft and dynamos of the original equipment, which had been thrown out of service. These last named dynamos and countershafting were removed about May, 1896.

In August, 1895, a General Electric M. P. 1500 k. w. dynamo direct coupled to two 48 in. × 60 in. Allis engines, together with two 500 h. p. Heine boilers, were installed in this house. This is the largest dynamo in the city and the only one of its size.

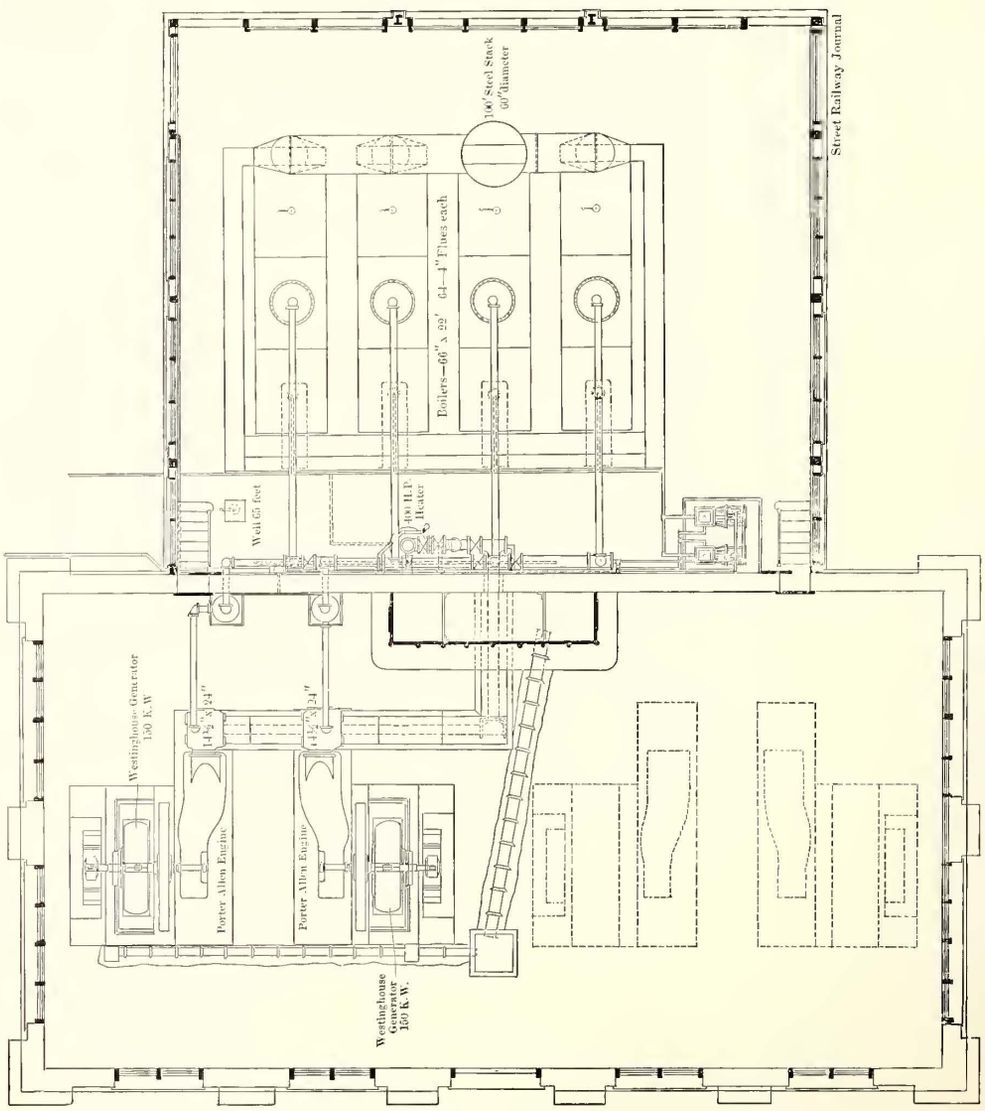
On May 27, when the disastrous cyclone visited the city, the whole plant was almost destroyed, the two brick stacks which fell upon the engine house, crushing it in completely. Most of the machinery was saved and repaired, but the two engines which comprised the first part of the plant have since been out of service.

The water is supplied from the city mains. The company dug a well, but struck only sulphur water which they could not use. Excelsior heaters are used throughout.

Coal is hauled in wagons. The beds of these wagons are so arranged that by means of an electric hoist they can be lifted and automatically dumped into the boiler room.

This station represents, better than any in the city, a wide range in improved street railway apparatus. It shows how rapidly the changes have been made from the smallest to the largest electrical units. Designed originally on the idea that the greatest economy could be attained only by a combination of small electrical and steam units and high speeds, it has been forced, through a series of expansion experiences, to remodel and reconstruct its design on the later ideas of large units and slow speeds, and as the expense accounts testify, the management has not been disappointed in the results.

The Benton-Bellefontaine station, otherwise called the Union Depot Railroad power house No. 2 is a smaller power station than No. 1 and is located at Twentieth and Ferry Streets in North St. Louis. The buildings of this power station were at one time the stables of the Ninth Street line, and were remodeled in 1892 and used as the power house when the road was changed to an electric line.

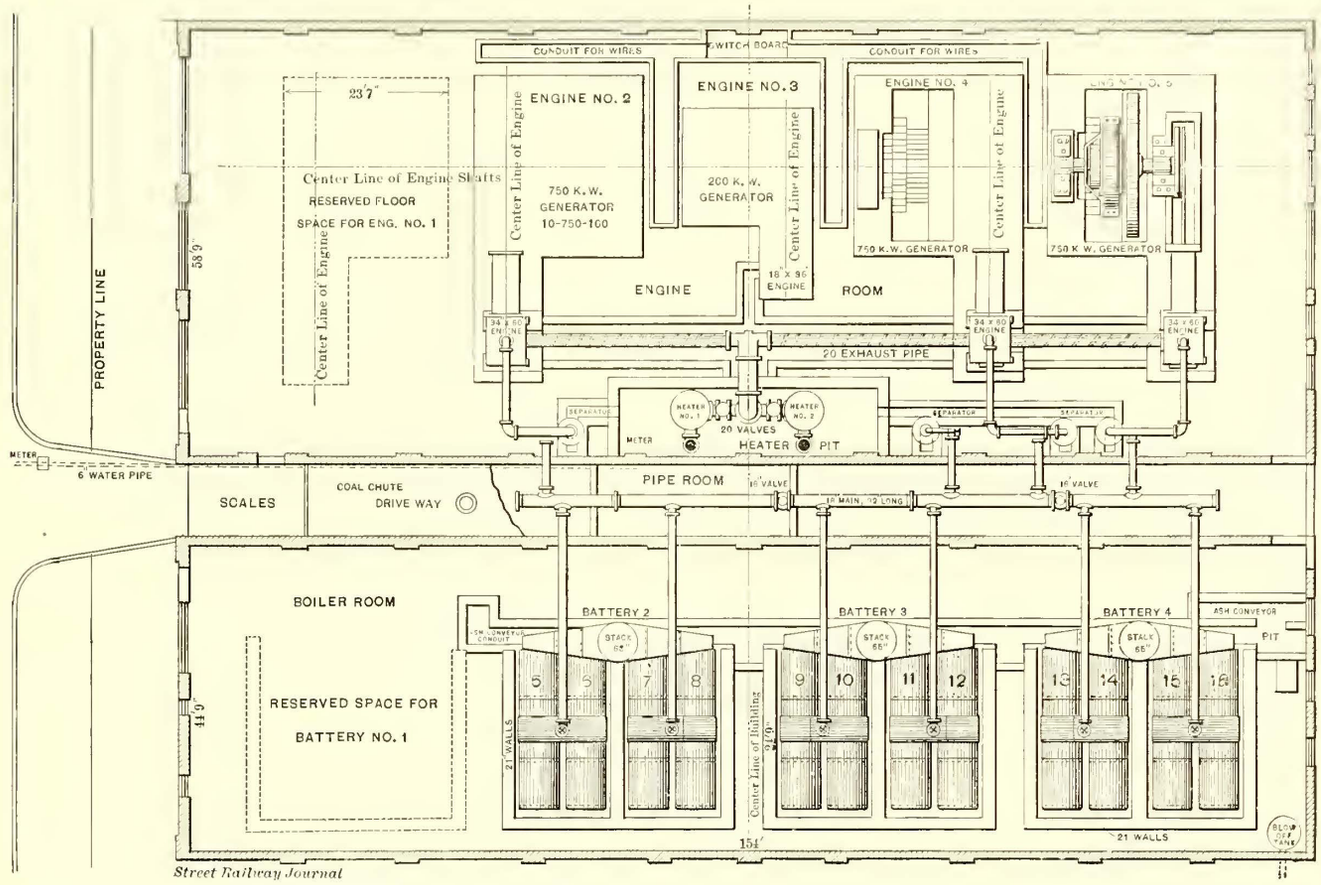


PLAN OF ELECTRIC POWER STATION OF THE ST. LOUIS & KIRKWOOD RAILROAD.

The original equipment consisted of four Thomson-

Houston M. P. 270 generators belted in couples to two Philadelphia-Corliss engines, together with six return tubular boilers. These boilers have a shell sixty-six inches in diameter and twenty-two feet long and have twenty six-inch flues. Later one Philadelphia-Corliss engine was replaced with a the St. Louis Corliss engine.

In April, 1894, two Porter-Allen engines, 20 ins. × 36 ins., direct coupled to two General Electric M. P. 400 generators, were installed. Four Babcock & Wilcox boilers twenty-one feet five inches long furnished the steam. These four boilers have a stack 160 ft. high, 7 ft. diameter. The other boilers are divided into three batteries each, each battery having a stack 100 ft. high. Coal is hauled in wagons as at power house, No. 1, but there is no apparatus for dumping it. The Heine boilers are constantly used, the others being held only as reserve.



ELECTRIC POWER STATION OF THE CASS AVENUE & FAIR GROUNDS RAILWAY CO.

ST. LOUIS AND KIRKWOOD RAILROAD ELECTRIC STATION

The St. Louis & Kirkwood Railroad Company's power house is located at Brentwood, about three miles west of the city limits on the line of its road. This is a suburban road and is entirely in St. Louis County. It connects Meremec Highlands, Kirkwood, Webster and intermediate points, with the city at its main junction with the Lindell Railway Company's lines at the southwest corner of Forest Park. The line is ten miles long and is single track with turnouts. The first equipment consisted of five large double truck cars with two fifty horse power motors each. Five more cars have been added this summer. The road was opened for business about Feb. 15, 1896.

The power house is a substantial brick structure and is practically fireproof. The floors are of concrete, with exhaust pipe pits of brick, all laid in Portland cement. The wire conduits are of vitrified sewer pipes with joints of Portland cement. These pipes are filled with wooden tubes four inches square with two inch holes in them for wires. The foundations for the machinery are of concrete in Portland cement.

There is an 8 in. well, 650 ft. deep, flowing about 60,000 gals. in twenty-four hours, which was sunk for a water supply, but the water contained a large amount of sulphur and could not be used for steam. The present water supply is taken from a small stream near by and it is pumped into a wooden tank 16 ft. × 20 ft., elevated on a 30 ft. tower, from which it goes by gravity into the heaters or pumps.

There are two Porter-Allen engines, 14½ ins. × 24 in. cylinders, coupled direct to Westinghouse 150 k. w. dynamos. The speed is 200 r. p. m. There is a 400 h. p. Excelsior heater, two 6 in. × 4 in. × 6 in. Duplex boiler feed pumps, four horizontal tubular boilers 66 ins. diameter, 20 ft. long with sixty-four four-inch flues. The furnaces have plain grates. The stack is of steel 100 ft. high above the grate bars, and sixty inches in diameter.

[Owing to Mr. Bartlett's illness during the latter part of September, it was impossible for him to fully complete this article, and his descriptions of three of the stations in the city—those of the Cass Avenue & Fair Grounds Railway Company, the Missouri Railroad Company (electric) and the Lindell Railway Company—are therefore omitted from this article. Considerable information about these stations will be found, however, in the STREET RAILWAY JOURNAL for June, 1895, pages 353 to 358, and a diagram of the Cass Avenue station is given on this page. A diagram of the Midland Street Railway Company's station is also found on page 594.—EDITORS.]

Street Railway Roadbed in St. Louis

The roadbed in St. Louis, like the power station and car equipment, is decidedly miscellaneous in character, although most of the principal systems are steadily working towards a somewhat uniform construction consisting of sixty foot deep girder rails with cast welded joints spiked directly to the ties.

The standard construction of the National Railway Company's lines, which were the first in the country to obtain and use sixty foot rail, is as follows: the ties are 6 ins. × 8 ins. × 7 ft. in length, are of white oak and are laid two feet apart from center to center in a trench eighteen inches deep. Tie plates are used and the rail joints shown in Figs. 17 and 19 are what the company is purchasing of the Johnson Company. The joints are cast welded and no special bonds are considered necessary, the company's experiments having satisfied its officers that the joint itself has a conductivity as great as the rails. In doing this cast welding the ends of the rails are brought to a high polish with an emery grinder operated by an electric motor with current from the trolley wire. The union between the molten metal and the rail is thus rendered exceedingly good and very few joints have parted in practice. On this line are also found about six miles of electric welded rail of a six inch, seventy-eight pound section. Figs. 9, 11 and 12 represent sections still in service on the National Railway lines. The tracks are laid in 7 miles of granite pavement, 3½ miles of wooden block pavement, 3½ miles of asphalt, and the remainder in macadam. Practically all the special work was made by the Johnson Company.

The sections shown in Figs. 10 and 13 are found on the lines of the Union Depot Railroad system. Fig. 13 is a 6 in., 73 lb. rail of the Wharton Company, and Fig. 10 is the 86 lb., 6 in. rail used on all curves. The company has also about seven miles of 6 in., 78 lb. Johnson rail. The rails are laid on mountain white oak hewn ties, 6 ins. × 6 ins. × 8 ft. placed at two foot centers on an eight inch foundation of macadam. The joint ties are 9½ ins. wide. Brace and tie plates are placed on the alternate ties. The joints are mostly six bolt, thirty-six inch channel iron fishplates and have stood up very well in service, but the company is commencing to cast weld the joints in all its renewal construction and will also use sixty foot rails. Special copper bonds will be riveted to the rails before the molten metal is applied, as in Mr. Scullin's opinion it is not safe to trust to the conductivity of the joints alone. Wharton integral special work was used originally, but latterly both new work and renewals have been of Wharton manganese steel. All crossovers and emergency curves are provided with Wharton unbroken main line switches.

The standard track of the Lindell Railway Company is a seventy-eight pound, sixty foot rail rolled by the Johnson Company and illustrated in Fig. 12. One thousand tons of this sixty foot rail are now being put in on the principal streets. For macadamized streets a six inch rail is used spiked to the ties, while in paved streets a seven inch rail is preferred (Fig. 17). In recent construction the surface is excavated and rolled, after which a layer of from four to six inches of broken stone is provided on which the ties are placed. Mr. Baumhoff has tried a large number of methods of joint construction with more or less satisfactory results. A part of his mileage is laid with cast welded joints. In another part what is called a bridge joint is used, consisting of a piece 4 ins. × 6 ins. × 48 ins. of oak timber laid on the ties under the joint, the joint ties being let down for the purpose. On this timber is spiked a 4 in. × 6 in. × ⅜ in. steel plate with six holes on the side, the holes punched so that the head of the spike presses the base of the rail. The outside fishplate consists of a six bolt steel casting weighing from twelve to thirteen pounds. Other types of joint are being experimented with, notably the Weber rail joint. The Lindell Railway Company is now manufacturing its own special work in yards and shops laid out expressly for the purpose. Nearly all the present special work on the system, however, is of Johnson and Wharton manufacture, and a number of Wharton unbroken main line curves and crossovers are used.

On the electric lines of the Missouri Railroad, the Wharton six inch, seventy-eight pound rail is used, together with a small amount of Wharton fifty-seven pound chair rails still in place. Brace tie plates are used on the six inch rails. The joints on these lines have given a good deal of trouble, which was first developed when the double truck cars were put on. The company has begun to re-

Company.	Boiler H. P. Gross.	Engine H. P. Gross.	Gross H. P.	Elec. P. K. W.	Tons Annual Coal consump.	Remarks.
St. Louis R. R. Co.	1,000	2,500	.....	.....	8,000	North P. H. Cable.
" " "	1,000	2,500	.....	.....	8,000	South " "
Mo. R. R. Co.	1,000	900	.....	.....	6,125	Cable.
People's Railway Co.	1,000	600	.....	.....	7,000	Cable.
Lindell Railway Co.	2,500	3,250	2,747	2,050	21,750	No. 1, or old house.
" " "	4,000	2,256	2,212	1,650	34,800	" 2, or new "
Cass Av. and F. G. Ry.	2,400	3'250	3,284	2,450	26,300	Electric.
Mo. R. R. Co.	1,600	2,125	2,300	1,115	13,850	"
St. L. & Sub. Ry.	4,150	6,250	4,692	3,300	24,000	Includes Meramec River El.
Southern Elec. R. R.	1,400	2,814	2,610	1,947	11,535	Electric.
Union Depot Ry. Co.	3,750	*5,800	4,731	3,534	36,650	U. D. El. P. H.
" " " "	2,200	2,000	2,507	1,880	11,670	Benton-Bellefontaine P. H.
St. Louis & Kirkwood.	600	400	402	300	2,500	Entirely in St. Louis Co.
Midland Str. Ry. Co.	60	60	60	45	.....	" " "
Totals	26,660	30,705	25,545	18,471		

*2 engines about 1,000 H. P. out of service.

CAPACITIES OF STREET RAILWAY STATIONS OF ST. LOUIS, MO., SEPTEMBER, 1895.

place defective joints with cast welded joints, and a considerable number of these were put in in the summer of 1896. On the Olive Street cable line the Johnson rail, shown in Fig. 9, has been used. The curves on the electric line are of Wharton eighty-six pound rail, and the special work is both integral and manganese steel.

The city end of the Southern Electric Railway, which was originally built in 1885 with a fifty-two pound Johnson girder rail, was relaid in 1895 with a seven inch, seventy-eight pound girder rail, which was the same as that laid on the southern end of the line in 1890. The rails are spiked directly to the ties, and six-bolt fishplates are used, with three ties at each joint. Some Wharton seventy-five pound, seven inch rail, shown in Fig. 16, is also found on this line.

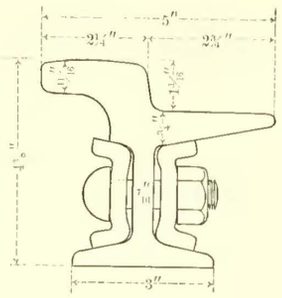


FIG. 9.

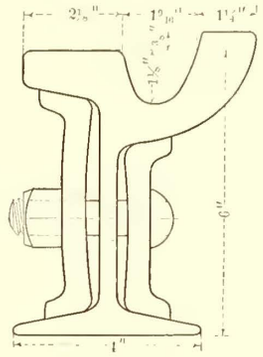


FIG. 10.

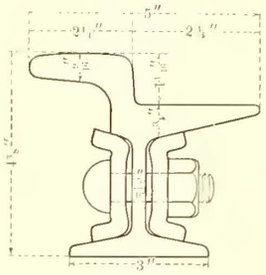


FIG. 11.

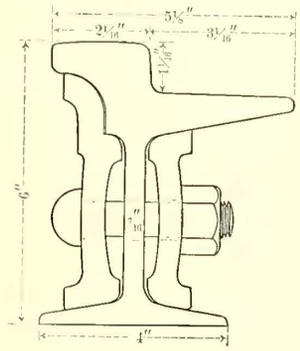


FIG. 12.

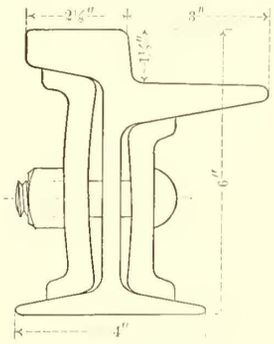


FIG. 13.

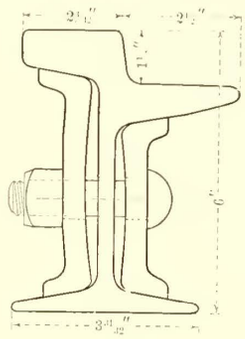


FIG. 14.

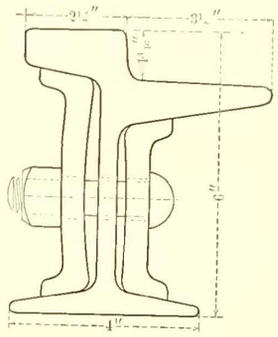


FIG. 15.

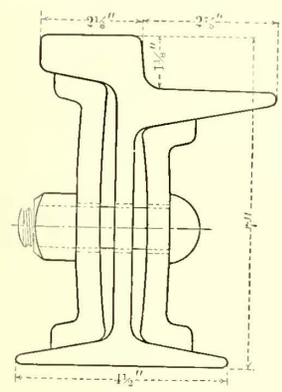


FIG. 16.

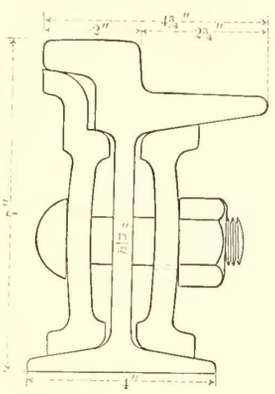


FIG. 17.

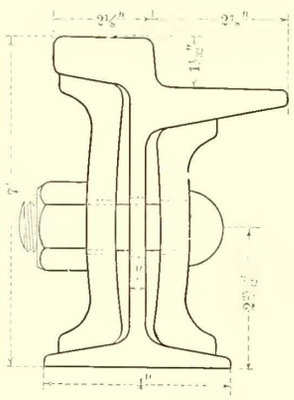


FIG. 18.

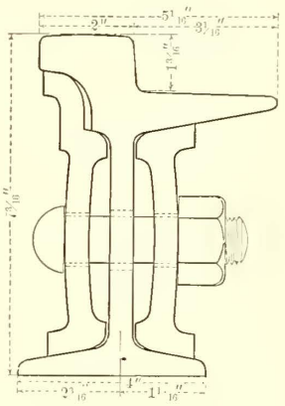


FIG. 19.

SOME OF THE RAIL SECTIONS IN ST. LOUIS

The city terminal of the St. Louis & Suburban Railway Company is laid with a five inch, seventy pound girder rail on ties which rest on concrete of the old cable foundation. Some cast welded joint work has recently been done on this end of the line from Thirty-ninth Street to the Wellston terminus. The track is a forty pound T rail, and from Wellston to Florissant a somewhat lighter T rail is used.

The Grand Avenue line is built of Wharton seventy-three pound girder rail (Fig. 13) laid on heavy oak ties spaced two feet from center to center. Wharton brace plates and plain plates are used on alternate ties. The special work is Wharton integral throughout, and all crossovers have Wharton unbroken main line switches.

The Jefferson Avenue line is built of Wharton 77½ lb., seven inch girder rail, shown in Fig 16, on heavy oak ties, two feet centers, with brace and plain tie plates alternately. Wharton manganese steel special work is used, together with unbroken main line switches.

The St. Louis & Meremec River Railroad was built of Wharton six inch, seventy-three pound girder rail (Fig. 13) within the city limits, and six inch, sixty-eight pound girder (Fig. 14) in the country. The construction is similar to that of the Grand Avenue and Jefferson Avenue lines.

The Fourth Street & Arsenal Railway is laid with Pennsylvania Steel Company's seven inch, eighty pound rail, shown in Fig. 18. Brace tie plates are used, and the rails are spiked directly to the ties.

The track and special work in the business section of the city is subjected to excessive wear and pounding of joints from the constant passing of the heavy, double truck cars common in St. Louis, and a life for this part of the system exceeding four or five years can hardly be expected. In other parts of the city a life for the best construction of eight or nine years may be hoped for with considerable confidence.

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Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

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THE transportation system of a great city is so closely interwoven with the life of its people that we make no apology for giving up a large portion of our space this month to a description of what is, considered as a whole, one of the most highly developed street railway systems in this country, and to a discussion of the way in which one of our great cities has been broadened out and its people benefited by the operation of many forces, all having their origin in the power of the individual to pass quickly from point to point within the city's area. We who are accustomed to the rapid growth of American, and particularly of Western cities, do not often pause to think about the wonder of their increase in population and wealth, from the petty beginnings of but a few years ago. We do not often remember—and the daily press of the country is especially derelict in this respect—how financially courageous have been the men who have built up our street railway systems in the different cities, in furnishing transportation facilities in advance of possible patronage, and in adopting new and almost untried improvements in motive power and methods of taking care of and attracting the public. Street railway managers and stockholders are not often, perhaps, philanthropists. They are doubtless actuated by motives of profit in most things which they undertake. But it is nevertheless true that in many cases they not only look far beyond present gains to the permanent good of their properties, but they often deliberately accept burdens which might be evaded, in order to promote the common good, and therefore—if this be selfishness, make the most of it—to bring about the joint prosperity of the city and their own street railway properties.

* * * *

Competition among street railway companies has held full sway in St. Louis. In no other American city are there now so many independent companies working in one field. They parallel each other's lines; they cross and recross other tracks; they are able, by a curious and unusual provision in the city charter, to use each other's lines to an almost unlimited extent upon the payment of sums as compensation which the courts have pronounced to be sufficient, but which common sense, educated in the technicalities of street railroading, pronounces totally inadequate; and they are keenly active in diverting traffic from each other's lines in every legitimate way. And yet cordial and friendly personal relationships are the rule among the managements of the different properties. In no department of operation are the results of this competition so clearly seen as in car equipment and car service. Only a few years ago the street cars of St. Louis were not remarkable in any way for comfort or cleanliness. One day, a moderately long, double truck car with cross seats appeared on one of the lines, and at once became the most popular car in the city. Others were purchased, with the result that the earnings of this line were largely increased at the expense of its competitors so that the latter were forced to take steps to recoup their losses of business. Then followed a period of rapid changes in equipment all over the city. Street railway managers vied with each other in designing most beautiful and attractive cars. The problem of turning these out rapidly enough to suit the different companies became a serious one in the sections, common in St. Louis, where a citizen going to business had a choice of two or three routes within approximately equal distances, and at a time when the putting into service of a dozen new cars meant a gain to one company, and a loss to another of several hundred dollars a day. It is not to be supposed that these changes were made without misgivings on the part of many managers They naturally feared track difficulties because of the heavier cars, slower schedule speeds because of delays in getting in and out of long cars, increased coal bills because of greater power consumption, and an increased proportion of dead weight to living weight, especially during the light traffic hours of the day. All these disadvantages have come to pass, but against them are set, of course, advantages—the doing away with trailers and the accidents resulting from their use, some reduction in car labor, and comparative ease in taking the many sharp curves found on most of the lines. But beyond all these advantages, looms up the one great fact that the pub-

lic likes these cars and will have them, and their most pronounced opponent is forced to recognize the power of this argument. It is in the matter of time intervals between cars that competition has been especially working in the interests of the public. Every important line in the city reaches the business section through a series of parallel streets, and their cars disgorge the greater part of their passengers within a very small area. It follows, therefore, that where there is choice of routes, a line must gain a reputation for having a car always ready for passengers if it is to get its due share of the traffic, and the result is that one minute and two minute intervals, even in the light traffic hours of the day, are the rule rather than the exception, while a four or five minute line would be almost forced out of business. Another consequence is that, except during the downtown hour in the morning and the uptown hour at night, the long cars on most of the roads are comparatively empty, frequently carrying barely half a dozen passengers. All these competitive conditions doubtless mean for the system as a whole, large gross receipts, large percentages of operating expenses and small receipts per car mile. If a consolidation of St. Louis companies, many times attempted, ever comes about, it is probable that large economies can by introduced through rearrangement of schedules, and this without substantial injury to the public—though the St. Louis public has come to be exceedingly finical in the matter of street railway transportation.

* * * * *

In the court decisions just referred to bearing on the right of one company to use the tracks of another is found a serious element of danger to St. Louis properties in independent operation. Nothing but the general forbearance exercised by the large companies in the matter of their neighbors' moral rights has prevented a merry war of encroachment and retaliation which might easily lead to serious consequences. This forbearance has not always been shown, however. In one case the project of a belt line around the city and the impossibility of coming to an agreement about compensation for the use of certain short stretches of "foreign track" encountered on the way, brought about an appeal to the courts in which the rule was laid down that the owners of street railway track in St. Louis are entitled to reeeive for their use a compensation not exceeding six per cent per annum of the cost of the track, without allowance for depreciation, and without the consent of property owners along the way (which had hitherto been considered a necessity). By virtue of this decision, the belt line was built and a company which had been for some time trying to reach the heart of the city over the lines of another was successful in doing so. There appears to be nothing in the provision of the city charter bearing on this matter to prevent a new company, which may be able to secure a franchise for a short stretch of way anywhere within the city limits, from running its cars over any or all of the other lines of the city. This has been several times attempted, but, fortunately, the city authorities have recognized the injustice to the other companies of allowing such a competition, as well as the impossibility of putting further burdens upon the heavily worked track in the heart of the city, and a number of franchises have been refused.

The physical condition of the St. Louis properties is fairly good and has very much improved within the last three or four years. There is still considerable light rail with a good many defective joints in various parts of the system, particularly in the business section, in which the traffic of the entire city is condensed. But heavier rails and better joints are replacing these as rapidly as the work can be properly done, and the roadbed is even now in pretty good condition. A great deal of cast-welded joint work, and some electric welding has been done and sixty foot rails are now the standard in St. Louis. The power stations, with one or two exceptions, are a mixture of the old and new, generator sizes, for example, ranging from sixty kilowatts to fifteen hundred kilowatts, and engines of all kinds being found, from the small high speed types to the immense direct connected units. The larger units are, of course, used for regular work and the smaller ones are held in reserve, so that the general economy of most of the power stations is excellent. The street railway companies, however, labor under the disadvantage of being unable to get water for condensing purposes, so that the cost of operation is therefore slightly in excess of that found in the best compound condensing steam plants. The high character of the cars in St. Louis has already been mentioned. The motor equipment of the electric cars is also something of a mixture, but considerably more than half of the total equipment is with the latest types of motors and controllers. The overhead construction gives little trouble and is not unsightly, considering the large amount of special curve work which is found in the city. Altogether the physical improvements needed in the system can undoubtedly be undertaken from time to time out of earnings, rather than by additions to capital.

* * * *

In the matter of litigation on account of accidents, St. Louis street railway companies are well treated by the courts and the public, and it has been possible to avoid a great deal of the trouble with "shyster lawyers" which is so common in other cities. There is a law in the state of Missouri which puts it within the power of street railway companies and other litigants to secure, upon payment of a moderate fee, a special panel of business men for jury duty. This takes the appraisal of damages—an exceptionally difficult problem and one which should never be governed by prejudice or undue sympathy—out of the hands of "professional jurymen," or those who are against corporations "from principle," and allows them to be determined fairly and honestly by men whose intelligence is of a high grade and who are likely to be guided by principles of right and justice rather than by passions. The result of the operation of this law has been the award of damages which are considered fair by street railway companies and the public in general, and appeals from the jury decisions, either by street railway companies or the injured parties, are comparatively rare. It is a question, of course, as to how far a principle of this kind can and should be carried. The theory of American democracy is that all men are equal in all the attributes of citizenship. That the application of this theory often leads to grave injustice in individual cases is a mere truism, and all the latitude possible should be given the judiciary in order to secure justice—the highest inherent right of every citizen.

The American Street Railway Association.

At the close of the St. Louis convention this month, the American Street Railway Association will have been in existence for fourteen years. The list of its accomplishments is a long one and has been often rehearsed. The papers read before the members from year to year have been fully equal in merit, and in internal evidence of careful research, to those of most of the great engineering societies of America, though dealing less with theory and the mathematics in which theory is oftentimes expressed, than with practical everyday engineering problems. It is an association of *companies*, not of individuals, but the individual representatives of these companies are strong, forceful, educated men of a high order of intelligence—men who combine organizing and managing ability with technical and engineering skill. A combination of intellectual characteristics of this kind produces men who are an honor to any profession, and to the *men* of the street railway industry, and not to circumstances or conditions, is due the position of the municipal transportation industry to-day among the world's great business and financial achievements.

The principal function of the American Street Railway Association has always been the holding of its great annual convention with the accompanying exhibition of new and improved apparatus embodying the changes and developments of the previous year. The St. Louis convention bids fair to be more largely attended, more interesting in the size of the exhibit, more attractive in the papers and discussions, and more successful from every point of view than any convention in recent years, and perhaps in the Association's history. From all parts of the country special trains are being made up for the accommodation of delegates, and from all manufacturing sections cars will be loaded with apparatus and material for the exhibition. Nothing, apparently, has been forgotten by the able and experienced committee in charge of another great convention in the great convention city of the year—nothing will be omitted to contribute to the pleasure of its guests. Captain McCulloch and the local committee have done, and are doing magnificent work in this direction, and we are making no mistake in predicting that they will receive the heartiest thanks of every visitor to St. Louis for the time and care and worry and labor which they have so cheerfully given to the Association.

It is only to be hoped that too much time will not be taken up with receptions, banquets and excursions of various kinds, for there is a growing feeling among the members of the Association that *business* and not pleasure should be the main object of attendance.

There has been no friction in the wheels of management during the year just past. The President and Executive Committee have held two meetings, one in St. Louis and the other in New York, and have given careful attention to the loose threads of the past and the problems of the future. Thanks to the efforts of Mr. Hurt and last year's Executive Committee in securing subscriptions to cancel the Association's debt, and to the good management and financial skill displayed by the present administration, the latter will turn over to the next Executive Committee receipted bills for all past indebtedness, a substantial surplus after paying all expenses at St. Louis, and an assured income for the coming year considerably more than sufficient to meet all the expenses hitherto undertaken by the Association.

The work of placing the Association on a sound financial basis has made it inexpedient for the Secretary to undertake in this past year any expensive work such as is involved in the collection and distribution of information to the members. It is probable, however, that the Executive Committee will make at St. Louis some recommendations upon the subject of increasing the responsibilities of the Secretary in future, so as to fully carry out the purposes for which the Association was formed. The general feeling among street railway managers, so far as we have been able to judge, is against making any important changes in the system of obtaining revenue such as are involved in the recommendations of the Executive Committee last year. Several of the member companies whose gross receipts are large are those also whose staff of engineers and heads of departments is sufficiently large to make it possible for them to work out their special problems themselves without calling upon the Association, while the smaller companies, including many who regard the annual convention as the chief *raison d'être* for the Association, are not convinced that any large statistical, or other work can be undertaken by the Association of sufficient value, measured by results, to warrant the extra burden of membership fees. Nevertheless, the amendments proposed last year, will, of course, be taken up, debated and passed upon at St. Louis, all the causes for and against presented, and a final decision reached.

But even if the Association decides not to increase its revenue for the purposes suggested, it is still possible with a surplus in the treasury and an income larger than can be spent on merely current expenses, to make an effort in the direction of a larger work—to authorize the Secretary, for example, to enter upon a special line of investigation and bring the results to the attention of the members, either at the next convention or from time to time through the year. There are far too many problems upon which street railway managers want light, to allow an Association in which there are such possibilities of organized effort, to stand aside during all but four days of the year and treat these problems with indifference. Standards in all departments of street railway practice may, perhaps, never be reached because of fundamental difficulties, but it certainly is possible for a larger number of systems to come closer and closer to desirable standards as the years go on, and through no machinery can this be brought about more easily and economically than by such an organization as the American Street Railway Association.

We confidently hope for *results* at St. Louis—results that will be the moving causes for other results to be gathered in larger and larger measure as the years go on. With so much to be done, so many decisions to make, so many interesting papers to hear, and so much valuable discussion for which ample time should be provided, we trust that there will be appointed a "steering committee" to look after the main features of the convention for the purpose of facilitating business. We hope that the President will, in the discussions, call from the chair for the experience of individuals present whom he may know to have experience to offer. And with all influences in the Association as harmonious as is the case to-day, we confidently look for a steady increase in its power and influence through the coming years.

PRENTISS CUMMINGS,

JOEL HURT.

WM. H. JACKSON,
SECOND VICE-PRESIDENT,

G. C CUNINGHAM,
FIRST VICE-PRESIDENT.

H. M. LITTELL,
PRESIDENT.

THOMAS C. PENINGTON,
SECRETARY.

C. G. GOODRICH.

A. MARKLE.

J. WILLARD MORGAN,
THIRD VICE-PRESIDENT.

W. F. KELLY.

OFFICERS and EXECUTIVE COMMITTEE

FOR

1895-6.

of the AMERICAN STREET RAILWAY ASSOCIATION.

The St. Louis Convention.

The Executive Committee of the American Street Railway Association held a meeting at the office of the Metropolitan Street Railway Company, in New York City, early in September, and took into consideration all the details remaining to be passed upon before the convention.

The secretary reported to the committee that practically all the papers to be read at the convention had been received and approved by him. The titles of these papers were announced last month.

The programme of the social events and excursions at the convention is not fully made up as yet, and no official circular has as yet been issued. There will be, however, a number of most interesting and enjoyable events which, together with the convention business, will keep the delegates busy from the time they reach St. Louis until their departure.

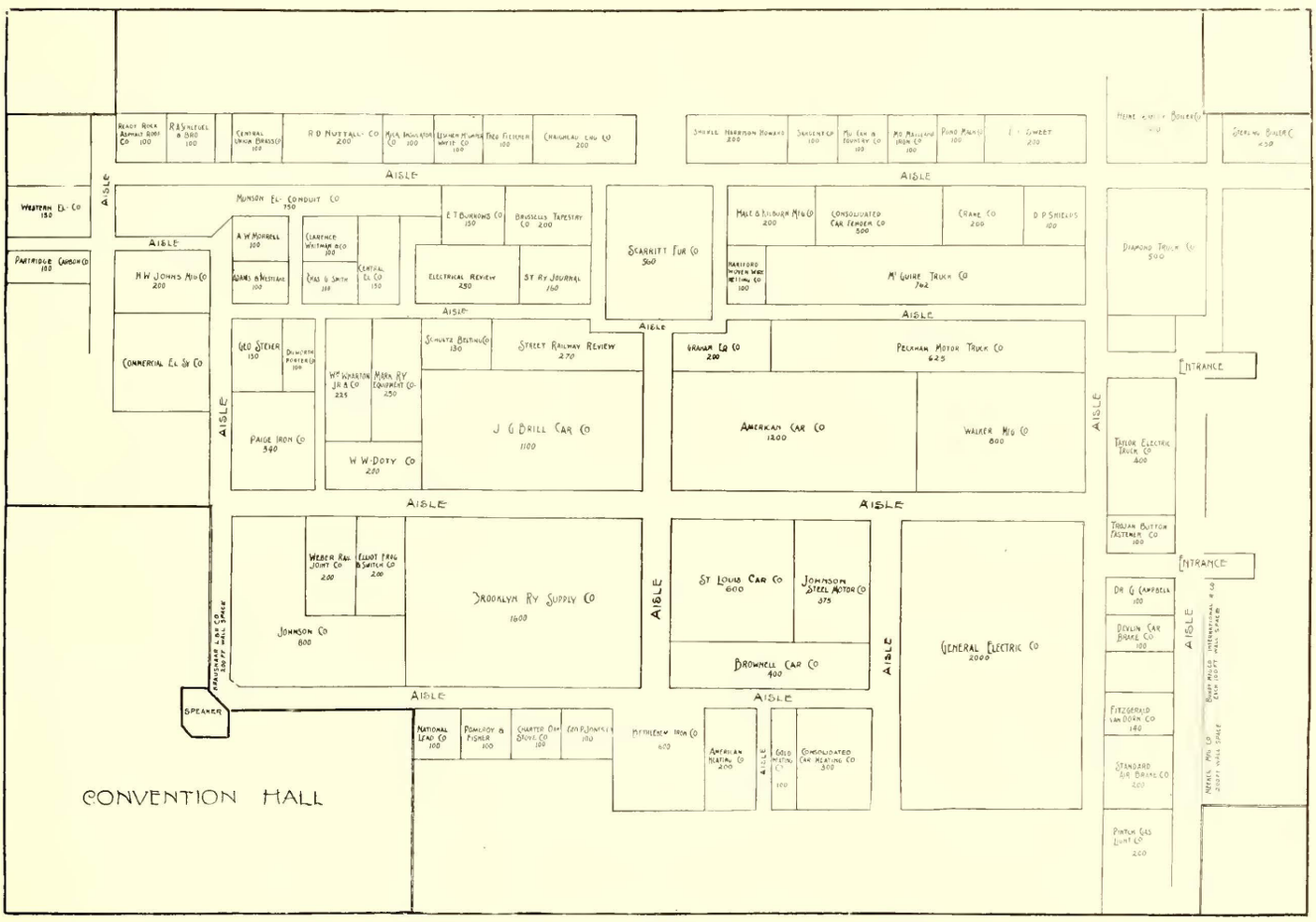


DIAGRAM OF THE EXHIBITION HALL AT ST. LOUIS.

In the accompanying diagram are shown the assignments of space to the different manufacturers. The largest single exhibitor is the General Electric Company, with 2000 sq. ft. of space. Next to this comes the Brooklyn & New York Railway Supply Company, with 1600 sq. ft.; the American Car Company, with 1200 sq. ft.; the J. G. Brill Company, with 1100 sq. ft.; the Johnson Company and the Walker Company, with 800 sq. ft., and the McGuire Manufacturing Company, the Peckham Motor Truck & Wheel Company, the Heine Safety Boiler Company, the St. Louis Car Company and the Bethlehem Iron Company, with from 600 to 800 sq. ft. The committee has made a more or less successful attempt to classify the exhibits and to remove all those which are likely to be noisy to the entrance doors, and as far away from the meeting hall as possible. There will doubtless be a good deal of disappointment with the spaces assigned in individual cases, together with some criticism of the committee, perhaps, but it should be remembered that the task was an exceedingly difficult one, and that any attempt to satisfy all parties must necessarily be unsuccessful.

Arrangements have been made for a special train via the New York Central & Hudson River Railroad and connections, for the accommodation of delegates and others attending the St. Louis convention. The special train will leave the Grand Central Station, Forty-Second Street, New York, Saturday, Oct. 17, at 1 P. M., arriving in St. Louis, Sunday, Oct. 18, at 6:56 P. M. Delegates from all points East can connect with the special at Albany, N. Y. The following shows the time schedule and one way fares.

Stations.	One Fare.	Berth.	Room.	Schedule.
Boston	$26.25	$6.50	$24.00	10:30 A. M.
Worcester	25.25	"	"	11:42 "
Springfield	24.25	6.00	22.00	1:14 P. M.
Pittsfield	23.90	"	"	2:52 "
New York	24.25	"	"	1:00 "
Poughkeepsie	23.25	"	"	2:43 "
Albany	22.75	5.50	20.00	4:20 "
Troy	22.75	"	"	
Utica	21.75	5.00	18.00	6:34 "
Syracuse	23.25	"	"	8:00 "
Rochester	20.25	4.00	14.00	9:50 "
Buffalo	19.25	"	"	10:50 "
Erie	17.10	"	"	
Cleveland	15.00	3.00	10.00	3:30 A. M.
Indianapolis				11:28 "

THE GREAT STREET RAILWAY PROPERTIES OF AMERICA

There are twenty-nine surface and elevated railway systems in the United States whose gross earnings amount to $1,000,000 or more, and whose operations are therefore on a scale which entitles them to special consideration from investors. One of these properties is now being formed through a consolidation of several smaller ones, and as it has not settled down into its final condition, no discussion of its financial features will here be made.

Only two of these properties have ever been in the hands of a receiver or passed through financial difficulties of any nature approaching insolvency, in spite of the fact that the average capitalization of twenty-eight of the properties is about $177,800 per mile of track, of which $77,300 is in funded debt. The earning power per mile of road is very large, in only six cases falling below $20,000, while in six cases earnings are shown exceeding $50,000 per mile of road.

The principal financial characteristics of these twenty-eight systems are given in the accompanying table, and in the following discussion an attempt will be made to point out the elements of strength and weakness in each property and to throw some light upon the probabilities of the future.

MANHATTAN RAILWAY COMPANY, OF NEW YORK.

This system has long been considered the most valuable municipal transportation property in the world. It occupies four main north and south arteries of travel on Manhattan Island, and its lines are so situated as to make the building of any competitive rapid transit system, whether above ground or below, exceedingly difficult, as the so far abortive efforts of the various Boards of Rapid Transit Commissioners appointed by the city during the last few years have proven. At the south end of the city all these four lines come together in one common terminal, and the system is more or less choked at this point so that it is difficult to operate trains rapidly enough in the busiest hours of the day to properly accommodate the public. The company's franchises are practically perpetual.

The total capital liabilities amount to $683,800 per mile of track, of which $385,600 is in funded debt. This capitalization is, without doubt, largely in excess of the actual cost of construction. The road was built at a time when downtown real estate was, of course, much cheaper than at present, while the uptown territory through which its lines were pushed was then a "howling wilderness," which owes its present high real estate values largely to the building of these elevated lines. In spite of the "water" in its securities, it is probable that the Manhattan system could not be duplicated to-day, and all damages for rights of way paid, for much less than the existing capitalization.

The earning power of this property is equivalent to $269,600 per mile of road and $96,700 per mile of track—figures which are enormous as compared with those found in steam railroad practice (compare New York Central & Hudson River Railroad, earning about $19,000 per mile of road and about $8500 per mile of track) and by far the largest of any similar property in the world. Nevertheless, passengers on this system obtain a good deal for their money, for their five cent fare will, if desired, take them for a distance of twelve miles, while the average distance traveled is probably not less than five miles.

Nineteen and one-tenth per cent of the gross receipts is consumed in paying interest on the funded debt, and as this property is being operated at less than sixty per cent of the gross receipts, it will be seen that any serious financial difficulties are a long way off; nevertheless, the business of the company has been seriously cut down during the last three or four years by the competition of cable surface lines below its tracks. These lines get a large proportion of the profitable short distance riding, and leave the less profitable longer hauls to the Manhattan Company, in consequence of which their percentage of operating expenses to gross receipts has somewhat increased.

It has become fashionable among financial writers to gravely shake their heads over Manhattan prospects and gloomily predict reductions in dividends and a permanent injury through this surface competition. Reductions in dividends, may, it is true, take place. The Manhattan Company will doubtless pass through a period of lower gross and net earnings. But the tremendous underlying strength of all New York properties, and especially of the Manhattan system, lies in the fact that the population density of Manhattan Island is steadily increasing, and within a few years every transportation system that can possibly be laid out above or below ground will be taxed to the utmost to carry the people who wish to ride. Moreover, the Manhattan Company could to-day, if it chose to do so, become more popular and more heavily patronized than ever before. All that is needed is the adoption of electricity as a motive power, the use of clean and brilliantly lighted cars built with a larger proportion of cross seats, open cars in summer, and broader principles of management, together with more regard for public comfort. The cost of these improvements would be hardly ten per cent of the present capitalization of the Manhattan Company and the influence on earnings would be immediate and pronounced.

METROPOLITAN STREET RAILWAY COMPANY OF NEW YORK.

Here is another system whose possibilities of development can hardly now be gauged. It operates 189 miles of track, of which improved motive powers are used on less than twenty per cent of the mileage. Its lines are a network covering the entire lower end of the city, while it controls or holds the key to eight out of a possible eleven north and south avenues running lengthwise of the island. Its cable and electric lines, which form seventeen per cent of the entire mileage, are earning thirty-nine per cent of the gross revenue.

NAME OF COMPANY.	MILEAGE.		CAPITAL STOCK.[e]		MORTGAGE BONDS.		CAPITAL LIABILITIES.		GROSS RECEIPTS.				INTEREST CHARGES.[g]	
	Track Owned.	Road Operated.	Total.	Per Mile Track.	Total.	Per Mile Track.	Total.	Per Mile Track.	For Year Ending.	Total.	Per Mile Track.	Per Mile Road.	Total.	Per cent. Gross Receipts.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Union Traction Co., Philadelphia	420.0	380.0	69,197,700[d]	164,800	41,198,210	98,100	110,395,910	262,900	June 30, 1896	10,210,026	24,300	26,900	5,532,961[i]	54.2
Manhattan Ry. Co., New York	100.6	36.1	30,000,000	298,200	38,791,000	385,600	68,791,000	683,800	Dec. 31, 1895	9,731,213	96,700	269,600	1,858,000	19.1
Metropolitan St. Ry. Co., New York	189.3	94.6[b]	27,948,000	147,600	26,936,000	142,300	54,884,000	280,900	June 30, 1896	9,131,000[j]	48,200	96,400	2,702,800[h]	29.6
West End St. Ry. Co., Boston	263.2	149.7	15,485,000	58,800	8,220,000	31,200	23,705,000	90,000	Sept. 30, 1895	7,746,171	29,400	51,800	409,000	5.3
Brooklyn Rapid Transit Co.	250.4	121.1	32,000,000	127,800	18,290,000	73,100	50,290,000	200,900	June 30, 1896	5,207,956	20,800	43,000	2,121,750[k]	40.7
Chicago City Ry. Co.	162.4	92.3	12,000,000	73,900	4,619,500	28,500	16,619,500	102,400	Dec. 31, 1895	4,476,824	27,500	48,500	207,878	4.6
West Chicago St. R. R. Co	201.5	96.1	14,083,900[a]	69,900	14,670,000	72,800	28,753,900	142,700	Dec. 31, 1895	4,201,477	20,900	43,700	763,300	18.2
Market St. Ry. Co., San Francisco	189.6	109.8	18,617,000	98,200	10,793,000	56,900	29,410,000	155,100	June 30, 1896	3,225,471	17,000	29,400	609,150	18.9
North Chicago St. R. R. Co.	100.0	48.4	5,749,400	57,500	5,813,000	58,100	11,562,400	115,600	Dec. 31, 1895	2,780,487	27,805	57,500	293,900	10.6
Third Ave. R. R. Co., New York	28.4	14.0	9,000,000	316,900	5,000,000	176,100	14,000,000	493,000	June 30, 1896	2,669,619	94,000	190,700	250,000	9.4
Consolidated Traction Co., Jersey City and Newark	175.0	87.5	21,500,000	122,900	19,927,000	113,900	41,427,000	236,800	Dec. 31, 1895	2,507,557	14,300	28,600	1,019,510[b]	40.7
Twin City Rapid Transit Co., Minneapolis	221.9	118.0	20,000,000	90,100	11,798,000	53,200	31,798,000	143,300	Dec. 31, 1895	1,988,804	9,000	16,900	634,700	31.9
Brooklyn Elevated R. R. Co	34.7	20.1	13,283,600	382,800	14,333,000	413,100	27,616,600	795,900	June 30, 1896	1,872,841	54,000	93,200	813,150	43.4
Metropolitan St. Ry. Co., Kansas City	136.0	70.0	5,586,800	41,100	9,856,000	72,500	15,442,800	113,600	May 31, 1896	1,780,940	13,100	25,400	481,800	27.1
United Traction & Elec. Co., Providence	129.7	108.5	8,000,000	61,700	8,247,000	63,600	16,247,000	125,300	June 30, 1896	1,720,784	13,300	15,900	412,350	23.9
Cleveland Elec. Ry. Co.	120.0	60.0	12,000,000	100,000	3,500,000	29,200	15,500,000	129,200	Dec. 31, 1895	1,503,620	12,500	25,000	184,000	12.2
National Ry. Co., Chicago, (St. Louis properties)	79.6	47.0	3,814,500[c]	48,700	5,651,000	71,000	9,465,500	119,700	Dec. 31, 1895	1,403,957	17,600	29,900	297,550	21.2
Buffalo Ry. Co.	142.9	84.3	5,370,500	37,600	7,136,500	47,100	12,507,000	84,700	June 30, 1896	1,394,986	9,800	16,600	378,510	27.2
North Shore Traction Co., Boston	122.2	120.2	6,000,000	49,100	5,379,000	44,000	11,379,000	93,100	Sept. 30, 1895	1,381,389	11,300	11,500	270,290	19.6
New Orleans Traction Co.	112.6	75.6	8,758,200	77,800	7,134,400	63,400	15,892,600	141,200	Nov. 30, 1895	1,327,756	11,800	17,600	362,069	27.3
Louisville Ry. Co	150.0	85.0	6,000,000	40,000	6,000,000	40,000	12,000,000	80,000	Dec. 31, 1895	1,288,172	8,600	15,200	312,630	24.3
Baltimore Traction Co	98.5		5,750,000	58,400	6,050,000	61,400	11,800,000	119,800	Dec. 31, 1895	1,179,191	12,000		315,000	26.7
Montreal St. Ry. Co.	75.2	39.5	4,000,000	53,200	1,000,000	13,300	5,000,000	66,500	Sept. 30, 1895	1,102,778	14,600	27,900	46,500	4.3
Union Depot R. R. Co., St. Louis	74.6	43.0	4,000,000	53,600	3,250,000	43,600	7,250,000	97,200	Dec. 31, 1895	1,096,213[b]	14,700	25,500	195,000	17.8
Capital Traction Co., Washington	36.0	18.0	12,000,000	333,300	None	None	12,000,000	333,300	Dec. 31, 1895	1,063,767	29,600	59,200	None	—
Kings Co. Traction Co., Brooklyn	58.7	28.4	4,500,000	76,700	5,500,000	93,700	10,000,000	170,400	June 30, 1895	1,073,157	18,300	37,800	279,000	26.0
Lindell Ry. Co., St. Louis	60.1	31.0	2,400,000	39,900	3,000,000	49,900	5,400,000	89,800	Dec. 31, 1895	1,011,880[b]	16,800	32,600	165,000	16.3
Toronto Ry. Co., Toronto, Ont	80.5	41.0	6,000,000	74,500	2,800,000	34,800	8,800,000	109,300	Dec. 31, 1895	992,801	12,300	24,200	126,000	12.7

[a] Not including outstanding stock of three companies controlled or operated under lease.
[b] Approximate.
[c] Including outstanding stock of constituent or controlled properties.
[d] $36,821,557 "paid in."
[e] Including all outstanding stock of controlled companies issued against mileage in column 1.
[f] Including all outstanding bonds of controlled companies issued against mileage in column 1.
[g] Covering interest on bonds in column 5 only except as specially noted.
[h] Including $1,308,140 rentals and guaranteed dividends on stocks of companies controlled.
[i] Of which $1,750,038 is interest on outstanding bonds, and $3,782,923 is guaranteed dividends.
[k] Including $1,200,000 guaranteed dividends on stocks of companies controlled.
[j] Partly estimated.

The total outstanding capitalization of this system amounts to $289,900 per mile of track, of which $142,300 is in funded debt. The company's connection with another organization, the Metropolitan Traction Company, makes it difficult to state just what proportion of the entire capital stock of the Metropolitan Street Railway Company and its leased properties is actually in the hands of the public, since the Metropolitan Traction Company owns a certain proportion of the guaranteed stocks of several of these companies. The Metropolitan Street Railway Company is, however, obliged to pay over to the Traction Company the guaranteed dividends on all these stocks, and it therefore seems fair to disregard the Traction Company entirely and to assume as the capital stock of the system that of the Street Railway Company and all the allied corporations.

During the year ending June 30, 1896, the Metropolitan Street Railway Company showed gross earnings of nearly $8,000,000, including six months earnings of the Eighth Avenue Railroad Company, leased late in 1895. If we add to these earnings, those of the other six months (partly estimated) together with the gross earnings of the Fourth Avenue line (which has formed, since July, 1896, a part of the Metropolitan system) for the entire year, we have a gross earning power for the complete system, as it is now constituted, of about $9,131,000 equivalent to $96,400 per mile of road and $48,200 per mile of track. This earning power per mile is exceeded by only three properties, two of them elevated and one the Third Avenue Railroad, of New York City, whose traffic is greater than the *average* of the combined horse and mechanical systems of the Metropolitan Company, but less than some of the latter's individual lines, such as the Broadway cable line.

The entire interest and guaranteed dividend obligations of the company call for 29.6 per cent of its gross receipts. The company is now operating its entire system at fifty-four per cent of the gross receipts and it is expected that with further extensions of the mechanical and electrical motive power this percentage will diminish rather than increase. It would seem that this company is in excellent financial condition, particularly when it is remembered that a part of the guaranteed dividends paid by the Metropolitan Street Railway Company are practically returned to the owners of its stock—the Metropolitan Traction Company.

This property is already the great surface carrying system of New York City and is destined to an even larger growth, since by its power to give extensive transfer privileges on all its lines it is placed in a particularly strong position with reference to competing corporations. Its management is exceptionally able and far seeing.

THIRD AVENUE RAILROAD COMPANY OF NEW YORK.

This is a strong competitor of the Metropolitan Street Railway Company for New York City traffic, but is, of course, a much smaller system, having only fourteen miles of road exclusive of the lines of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway which has recently been leased. Its main line is from City Hall Square to 129th Street and a branch line is operated across 125th Street, from river to river and up Amsterdam Avenue to Washington Bridge. All of this system is now operated by cable, but the adoption of the underground conduit is contemplated for the 125th Street and Amsterdam Avenue lines on which the cable sytem is old and defective.

The total capitalization of this system is very heavy, being $493,000 per mile of track, and the bonded debt is also heavy at $176,100 per mile. Nevertheless, the territory through which it runs is magnificent, as is shown from the fact that the system is earning $94,000 per mile of track and $190,700 per mile of road, so that the percentage of interest charges to gross receipts is but 9.4. The company is operating at about fifty-five per cent of the gross receipts and has paid eight per cent dividends for the last two years, while earning considerably more. The power stations, are not first class in design and the 125th Street cable line needs a thorough overhauling, so that the conditions of operation are not such as bring about the highest economy. Moreover, the system is paralleled on the west by the newly built Lexington Avenue cable line of the Metropolitan Street Railway Company; above it run the Third Avenue elevated lines of the Manhattan Company; and one block to the east are the horse railway lines of the Second Avenue Railroad Company. If the latter should adopt an improved motive power and the Manhattan Company electricity, it is probable that the company's business would fall off to some extent, though it can never be other than a successful and prosperous property if handled as conservatively as is the case at present.

UNION TRACTION COMPANY OF PHILADELPHIA.

Through a virtual consolidation of three out of the four principal systems of Philadelphia, this company now operates nearly ninety per cent of the entire street railway mileage of Philadelphia. Its lines are laid out peculiarly as will be seen from the table, the idea in Philadelphia having been from the earliest days of street railroading, to pre-empt all the principal streets (which are, moreover, rather too narrow for double track) with single track roadbed, so that cars go out on one street and return on the next.

The capitalization of this system amounts to $262,900 per mile of track, of which $98,100 is in mortgage bonds. This heavy capitalization has been brought about partly through inflation, in the various consolidations which have taken place in times past, and partly by reason of very heavy paving burdens placed by the city upon the constituent companies at the time of granting electric franchises. The gross receipts are fairly large ($24,300 per mile of track), and on the basis of these receipts the interest on the funded debt can probably be taken care of without much difficulty. Unfortunately, however, a large proportion of the capitalization of the leased and allied corporations is in the form of stocks on which large dividends are guaranteed by the Union Traction Company, dividends ranging from eight to thirty-eight per cent on par values even in cases where par values are largely in excess of "paid in" values. The result is, therefore, that the guaranteed dividends amount to more than twice the interest on bonds, so that the obligatory charges, exclusive of taxes and maintenance of pavements, amount to 54.2 per cent of the gross receipts. It is difficult to see how this property can long be successfully financed.

CHICAGO CITY RAILWAY COMPANY.

The city of Chicago spreads over three-quarters of a

circular area whose center is the business heart of the city, this business heart covering an exceedingly small territory and being therefore highly congested. The Chicago River runs in such a way as to divide the city into three sections, locally known as the North Side, the West Side and the South Side. The surface traffic of each of these sections is practically controlled by a single company.

On the South Side the Chicago City Railway Company operates by cable several main north and south arteries of traffic, and by electricity a large number of branches or feeders. The traffic is so heavy at certain hours of the day that its cable trains are usually made up of three or four cars, and even then it is difficult to secure standing room.

The funded debt of this system is only $28,500 per mile, calling for but 4.6 of the gross receipts. The capital stock is, however, $73,900 per mile of track which includes a recent increase for electric equipment. There is undoubtedly very little "water" in this capitalization. The gross receipts amount to $27,500 per mile of track and the company pays regular dividends of twelve per cent, while in 1893, the World's Fair year, twenty-four per cent in cash was divided and a distribution of stock of another Chicago railway company held in the treasury was also made among the stockholders.

The company's cable equipment gives little trouble, but is not as economical in operation nor as satisfactory to the company and the public as would be the case were it installed according to more modern methods. The electric lines, however, are all modern, were built at low prices for apparatus and material, and are showing excellent results. It is not improbable that the cable lines will be converted to electric in the near future.

WEST CHICAGO STREET RAILWAY COMPANY.

This company occupies the western section of the city and gains access to the business part through a tunnel under the Chicago River which makes it possible to prevent the through competition of other surface lines on the West Side, all of which are, moreover, either dependent upon the company or are comparatively insignificant. The electric lines of this system, in common with others in Chicago, have been transformed so recently that nearly the full benefit of low prices and modern methods has been realized.

The company's capitalization is considerably larger than the other two principal Chicago systems, being $142,700 per mile of track of which $72,800 is in funded debt. The gross receipts per mile of track are less than on the other two systems and the interest on mortgage indebtedness calls for 18.2 per cent of the gross receipts. The company is being operated at between fifty-five and sixty per cent of the receipts, but, for the causes stated, is unable to pay as large dividends as the other two systems, the dividends for 1892 being 8¾ per cent, for 1893, nine per cent, for 1894, nine per cent (not earned) and for 1895, six per cent.

NORTH CHICAGO STREET RAILWAY COMPANY.

This system is closely allied to the West Chicago system. It also reaches the business centre of the city through a tunnel under the Chicago River and has nearly a monopoly of its own territory. Its principal lines are operated by the cable system and its feeders by electricity as is the case with the other two principal Chicago systems. Its capitalization amounts to $115,600 per mile of track of which $58,100 is in funded debt calling for 10.6 per cent of the gross receipts. The company pays dividends of about twelve per cent and earns much more, so that in 1895, an extra dividend of twenty per cent was declared. Its operating expenses in 1895 were 47.2 of the gross receipts and in 1894, 52.5 per cent.

All of these Chicago properties have evidently been financed conservatively and their future is hardly in doubt. In fact, it is difficult to see how they can properly take care of all the traffic that is sure to be offered to them during the period of Chicago's growth which is confidently expected to be at an even more rapid ratio in the future than has been the case in the past.

BROOKLYN ELEVATED RAILROAD COMPANY.

Following the great success of the Manhattan Elevated Railway in New York, the experiment of building elevated lines in Brooklyn was made, with results more or less disastrous to security holders. The city is not well adapted to an elevated railroad service, because it spreads out over too large an area, so that the lines of traffic are not condensed as in New York City, but are free to take whatever course the freaks of residence building and business locations may determine.

When the surface lines of Brooklyn adopted electricity, the elevated systems found their traffic drawn away to an alarming extent, and the number of accidents occurring on the trolley surface lines was made the excuse for the passage of ordinances limiting the rates of speed of surface lines to eight miles per hour. This action, in connection with the great surface railroad strike in 1895, brought about a better state of affairs on the elevated lines, and the Brooklyn Elevated Railroad Company was, in 1895, able to show some surplus over fixed charges, though in 1893 and 1894 there were large deficits.

The system is enormously overcapitalized. Both the stock and funded debt per mile of track are largely in excess of corresponding items on the Manhattan system, while the earning power per mile of track is little more than half that of the Manhattan Company. The interest charges call for 43.4 per cent of the gross receipts, and as the percentage of operating expenses to total receipts has varied in the last four years between 55.6 and 50.1, it will be seen upon what a narrow margin the company is working in attempting to maintain solvency.

BROOKLYN RAPID TRANSIT COMPANY.

The system of this company serves a large portion of the city of Brooklyn, including Coney Island which has just been brought within the city limits. Brooklyn is the dormitory of New York and nearly all the male element of the former's citizens uses the surface and elevated railways daily as may be inferred from the fact that the latter carry the population of Brooklyn 235 times per annum. Some mistakes have been made in equipment, but on the whole the property is in fairly good operating condition and is well laid out to obtain the largest possible amount of traffic.

In this property, however, is found an example of excessive overcapitalization of costs and a decidedly heavy capitalization of earning power. The funded debt could

be easily taken care of, as it is but $73,100 per mile of track, but a larger charge on earnings is found in guaranteed dividends of $1,200,000 per annum, interest and dividends together calling for 40.7 per cent of the gross receipts. The latter amount to $20,800 per mile of track which is moderately, but not especially good for a city of this size. It is probable that the company has been building for the future and that the gross receipts show a steady increase from year to year.

WEST END STREET RAILWAY COMPANY OF BOSTON.

This property is conservatively financed and is managed with skill and economy. Together with the North Shore Traction system, presently to be mentioned, it serves a population of nearly 1,000,000 people in one of the richest street railway territories in the world. This territory is one, however, in which the proportion of "long hauls" to the total traffic is large, and this is one reason why it is impossible to obtain low percentages of operating expenses to gross receipts. The population in and around Boston is rapidly increasing, and the future of this company is bright. Its franchises are sometimes spoken of as defective, in that, according to the laws of Massachusetts, the company's tenure of streets is subject to the power of the Legislature and the municipal authorities to a greater extent than is usually the case with street railway companies in American cities. Practically, however, the danger of these laws is not that the company will be dispossessed of its territory, but that the ultimate power to do this will be used as a means of imposing additional burdens upon the property in the way of improvements in motive power, burial of wires, assessments for general city improvements, etc.

The company suffers from the effects of a serious congestion of traffic in the heart of the city proper, through which a large proportion of the cars from all the outlying suburbs are forced to pass, and in consequence of this, the cars are run on slower schedule speeds than in most cities, averaging hardly six miles per hour. This increases, of course, the operating expenses per car mile and the percentage of operating expenses to gross receipts.

The total capitalization of the West End Company is moderate as compared with other large cities, being but $90,000 per mile of track, while the funded debt calls for but 5.3 per cent of the gross receipts. The company is thus strongly intrenched against financial disaster, and is locally considered an investment property of high character.

THE NORTH SHORE TRACTION COMPANY OF BOSTON.

This company owns the capital stock of the Lynn & Boston Railroad Company which operates an extensive suburban and interurban system in territory tributary to Boston and containing a population of about 250,000 people. It has excellent Boston terminal facilities and its regular all the year round business is good, in addition to which it derives a large income from pleasure riding in summer between the various cities in its territory and the beaches of the famous Massachusetts North Shore. The capital stock of the Lynn & Boston Railroad Company is only $1,100,000, but this has been expanded by the operations of the Traction Company to $6,000,000, of which $2,000,000 is preferred stock and $4,000,000 is common stock. This makes a total capitalization of $93,100 per mile of track, of which $44,000 is in bonds calling for 19.6 per cent of the gross receipts. This fixed charge is not excessive and the property has an excellent net earning power, but net income spread over too large a mass of capital stock makes dividends small to insignificance, particularly if a floating debt is created or if repairs, improvements or contingencies impose added burdens on the property.

THE NATIONAL RAILWAY COMPANY OF CHICAGO.

This company controls six street railway properties in St. Louis operating about eighty miles of track. The physical and financial characteristics of this system have been fully described elsewhere in this paper (see pages 574 *et al.*), but it is interesting to note how it compares with the other large properties of its class. It will be seen that its capitalization per mile of track amounts to $119,700, of which $71,000 is in mortgage bonds calling for 21.2 per cent of the gross receipts, which amount to $17,600 per mile of track.

THE BUFFALO RAILWAY COMPANY OF BUFFALO, N. Y.

This is an exceedingly valuable property not so much because of its present earning power, as because of its possibilities of development in the near future. Buffalo is a city of long distances from residential to business areas. Within the last two or three years its street railway system gave a service totally inadequate to the needs of the people and the result was shown in a patronage amounting to less than sixty rides per capita per annum. The introduction of electricity has increased the patronage to 104 rides per capita (based on the population of 1890), but even this is a far smaller number than is found in other cities of its size. Moreover Buffalo is rapidly growing and is surely destined to be a great city, so that there is little doubt that this property has a most promising future.

It is capitalized at $84,700 per mile of track of which $47,100 is in bonds calling for 27.2 per cent of the gross receipts, which are but $9800 per mile of track. The company is now paying dividends of one per cent quarterly, the first having been paid in September, 1895.

CLEVELAND ELECTRIC RAILWAY COMPANY, OF CLEVELAND.

This is a consolidation, effected in 1893, of three large Cleveland properties, all of which were previously in successful operation and whose lines covered very thoroughly a large portion of this important city. There is, however, a strong competitor in this territory, so that it has no monopoly of traffic. The total capitalization is large, being $129,200 per mile of track, of which, however, but $29,200 is in funded debt, calling for only 12.2 per cent of the gross receipts. The latter are rather small for a city of this size, the reason being that the company has considerable suburban and semi-suburban mileage, the earning part of which is not yet fully developed.

Small dividends have been paid upon the stock, but not regularly, and in January and July last no dividends were paid, though a three-fourths per cent dividend was paid in April. One of the strong investment features for the bonds of this and other Ohio properties is found in the fact that under the laws of Ohio, the stockholders of all corporations in the state, including the street railway companies, are individually and collectively liable for the debts

of the company to an amount equal to the par value of the stock in addition to their original payments.

CONSOLIDATED TRACTION COMPANY OF NEW JERSEY.

This is a combined suburban and interurban system serving territory partially tributary to New York City, though the main portion of its business is acquired in and between the cities of Newark, Hoboken and Jersey City. The three cities have a population of nearly 400,000. Other smaller towns such as the Oranges are reached by the lines of this system and it is a large and valuable property. The roadbed and equipment are fairly good, considering the time of purchase.

For a city serving territory of this nature, the capitalization is large, being $236,800 per mile of track of which nearly one-half is in mortgage bonds, the interest on which requires 40.7 per cent of the gross receipts. The latter amount to $14,300 per mile of track, a sum so small as to indicate a large proportion of long distance riding.

UNITED TRACTION & ELECTRIC COMPANY OF PROVIDENCE.

This company owns the capital stocks and nearly all the (insignificant) mortgage bond issues of four operating companies in the city and suburbs of Providence, R. I. The total capitalization is large for a territory containing but 250,000 population; but the funded debt can be taken care of without much difficulty, the interest amounting to 23.9 per cent of the gross receipts, which are $13,300 per mile of track. The electrical equipment of the system was made at a time when prices for apparatus and material were not excessive, though more than at present. The property was in 1895 operated at 54.9 per cent of the gross receipts, as shown by the books, but no dividends have as yet been paid.

TWIN CITY RAPID TRANSIT COMPANY OF MINNEAPOLIS.

This company owns the capital stocks of three companies which operate the entire street railway systems of the two cities named, together with an interurban line between. The combined system is the largest in the West and was one of the first in the country to adopt electricity on a large scale. Its equipment is therefore not of the most modern types, but the property is apparently being handled with skill and economy, as may be inferred from the fact that its books show operating expenses of but fifty per cent of the gross receipts. The system is earning only $9000 per mile of track, which is the smallest earning power of any of the twenty-eight properties with one exception. The reason for this is probably that instead of one united city of 300,000 population there are, in fact as well as in name, two cities which are separated not only by distance, but by mutual jealousies and rivalries which prevent close intimacies in business life. The distances between the residential and business sections of each city are naturally smaller than would be found in a single city of the same total population, so that there is less inducement for traffic. The total capitalization is pretty large for a system of this kind, the bonds alone, issued at a rate of $53,200 per mile of track calling for 31.9 per cent of the gross receipts. No dividends have ever been paid on the common stock of the Twin City Rapid Transit Company, although its books show for the two systems a combined surplus equivalent to about five per cent on the entire outstanding stock, preferred as well as common.

THE METROPOLITAN STREET RAILWAY COMPANY OF KANSAS CITY.

This is a consolidation (effected in 1895) of a number of more or less important cable, electric, elevated and horse railway properties in Kansas City. The cable lines in Kansas City were formerly among the best in the country and are to-day in fairly good operating condition, but the general troubles through which Kansas City itself has been passing within the last ten years have had, of course, their effect upon the street railway system in many ways.

The capitalization is large for a city of but $175,000 population, being $113,600 per mile of track, of which nearly two-thirds is in mortgage bonds, the interest on which requires 27.1 per cent of the gross receipts. The latter amount to $13,100 per mile of track—a good average figure for a city of this size.

THE MARKET STREET RAILWAY COMPANY OF SAN FRANCISCO.

This is a property little known in the East, but is by far the most important on the Pacific Coast. Its capitalization is $155,100 per mile of track, of which a little more than one-third is in funded debt, calling for 18.9 per cent of the gross receipts for interest charges. The latter amount to $17,000 per mile of track, which is less than that of other large cities just investigated. Street railway patronage in San Francisco is evidently large, when the principal (but not the only) system in the city is able to carry the population 249 times per annum. Of the total track mileage, about one-third is operated by the cable system (which is not built according to latest modern practice), about forty per cent by electricity (built within the last two or three years), and the remainder by horses and steam.

NEW ORLEANS TRACTION COMPANY.

This is another example of heavy overcapitalization, the total capital liabilities being $141,200 per mile of track. The interest charges call for 27.3 per cent of the gross receipts, and these are but moderate at $11,800 per mile.

OTHER PROPERTIES.

The principal financial characteristics of the eight smaller properties are shown in the table and do not require extended comment. Louisville carries its population only about eighty times per annum, partly because its service is poor compared with that found in other cities. It is a dividend earner, however, as far as its preferred stock is concerned, although only one dividend, of 1¼ per cent, has so far been paid upon its common stock.

The Baltimore Traction Company is heavily capitalized, and has but moderate earning power. It has paid only two dividends since its organization, one in October, 1891, and the other in January, 1892.

The Montreal Street Railway system is moderately capitalized, particularly in respect to its bonded debt, which requires but 4.3 per cent of the gross receipts—the smallest in the list. It is worthy of note that this is one of the few street railway properties which have been able to borrow money at 4½ per cent interest. This is especially remarkable because its 4½ per cent bonds are second mortgage. It has paid regular dividends for some years, and these have been latterly at the rate of eight per cent per annum.

The Union Depot Railroad and the Lindell Railway Company of St. Louis, have been described elsewhere (pages 574 *et al.*) and it will be seen that they make a very favorable showing in comparison with other great American properties, particularly in the matter of funded debt, which, though large according to old standards, is not so according to the new, calling for but 17.8 per cent and 16.3 per cent of the gross receipts respectively.

The Capital Traction Company of Washington, has no funded debt, but this is more than made up by the enormous amount of its capital stock, $333,300 per mile of track. Its earning power per mile of track is good, but it is difficult to say how there can be any expectation of large dividends with this heavy inflation of capital.

The Kings County Traction Company of Brooklyn, is brought into this table only to show its earning power in the past. Its operating properties, consisting of the Atlantic Avenue Railroad and the Brooklyn, Bath & West End Railroad, both in the city of Brooklyn, are now leased to the Nassau Electric Railroad Company.

The Toronto Railway Company while not as conservatively capitalized as the Montreal system still makes an excellent financial showing, its bonded debt calling for but 12.7 per cent of the gross receipts, which are fairly good at $12,300 per mile of track.

GENERAL CONCLUSIONS.

It will be seen from the above discussion that of these twenty-eight American street railway properties, the largest in the country, two are capitalized at over $500,000 per mile of track, four between $250,000 and $500,000, fifteen between $100,000 and $250,000 and only seven at less than $100,000. In the matter of bonded indebtedness, two have more than $250,000 per mile of track, three between $100,000 and $250,000, twelve between $50,000 and $100,000, ten less than $50,000, while one has no funded debt whatever.

In the matter of gross receipts, two companies are earning between $90,000 and $100,000 per mile of track, one $54,000, one $48,200, seven between $20,000 and $30,000, fourteen between $10,000 and $20,000 and three less than $10,000.

The funded debt of one road calls for 54.2 per cent of the gross receipts, of three between forty and forty-four per cent, of one road thirty-two per cent, of nine between twenty and thirty per cent, of nine between ten and twenty cent, of four less than ten per cent and of one road nothing.

All these figures and summaries clearly lead us to certain conclusions. In the first place, it is undoubtedly true that the tangible assets of nearly, or quite all of these companies could be duplicated at the prices of to-day for sums less than those represented by their capitalization. This, however, is, of course, to be expected. Present prices in every department of street railway construction and equipment are much below those of even three or four years ago. Moreover, the old horse railway roadbed, rolling stock and horse equipment cost money, and a good deal of it, and when improvements came along in the form of electrical apparatus, nothing more conservative could be done in practice but to add the net cost of these improvements to the old capitalization.

In most cases, however, nothing half so conservative as this was thought of for a moment. In not a few instances the old properties passed into the hands of syndicates at high valuations, based on earning power, and were equipped by these syndicates, oftentimes through "construction companies," for bonds and stock. If the par of these securities had represented the cost to the syndicate of the old properties plus the actual cash cost of equipment, the capitalization might even then be called moderate; but instead of this there was inflation of values everywhere so that the capitalizations finally arrived at bear in many cases little relation to costs, but are based, purely and simply, on estimates of earning power, which estimates have sometimes been realized and sometimes not. There are, of course, honorable exceptions to this method of procedure but only three or four can be found among these twenty-eight large properties in which there is not some inflation of values.

But financiers do not, and need not trouble themselves to any great extent about the basis of capitalization, nor has the public in general much reason to grumble at high street railway capitalization, since, in the effort to make returns upon these securities, street railway managers usually seek public favor and patronage by every method which wit and ingenuity can devise. The real question is, "Is the *earning power* of these properties sufficient to permanently carry their bonded debt and to pay dividends upon their stocks?"

It is clear that three companies at least out of these twenty-eight are in serious financial straits and can hardly be expected to much longer avoid default in interest charges. One other road will have to exercise great economy to keep its percentage of operating expenses well below the danger point. Four of the nine companies whose interest charges call for between twenty and thirty per cent of their gross receipts are in "easy circumstances," so to speak, and need fear no trouble, since their future development is assured; while the thirteen properties whose interest charges call for less than twenty per cent of the gross receipts are, with one exception, thoroughly safe for investment purposes.

All these companies must look to the future, however, for any large returns on their stock, for the impetus given by the general adoption of electricity as a motive power has caused a sudden expansion in mileage and in service given, to which the public has not yet fully responded. With the increase of population this response will surely come and it will be found that the street railway companies' gross receipts per car mile will increase, together with, it is to be hoped, their net earnings, but the latter will be governed to a larger extent than is now realized by the layman in street railway matters, by the part which repairs and general depreciation are going to play in increasing operating expenses.

STREET RAILWAY CARS IN THE UNITED STATES

In no one department of street railway operation have more changes been made during the past five years than in the style of cars used. As in the case of the track, motors and generators the constant tendency has been toward heavier and more substantial construction. The strains incident to street railway service have shown that true economy lies in the direction of carefully and strongly built cars which shall be amply sufficient to sustain the shocks and wear inseparable from electric railway service.

A number of car builders have followed, in the construction of their cars, the well known lines employed by the builders of steam railway cars. Others believe that strains to which street railway cars are subjected are different from those in steam railway practice, being more transverse and not longitudinal. In consequence they have followed more the pattern of the old sixteen foot horse car, which was itself similar in general design to the stage coach. Nearly all have, however, freely introduced iron or steel as a substitute for wood where a gain of strength would follow its employment, and have added other changes which experience has suggested during the employment of electric motors as a means of propulsion.

A glance into the interior of a modern electric car reveals as many changes from the former horse car as does a study of the car skeleton. The first difference which would immediately strike an ordinary observer is that of increased beauty. Car decoration has received a great deal of study during the past few years, and the result of this has been a great increase in tasteful work. These striking effects in interior decoration which although attractive at first sight become tiresome, have given place largely to more subdued though as rich decoration, while as much or more money is spent on the interior ornamentation of the cars. While to some this expenditure in the line of what may be regarded purely a luxury may appear extravagance, experience has shown that it is an important factor as a traffic producer and the yield is a large percentage on the money invested. Outside of decoration pure and simple, the tendency during the past year has been constantly toward added comfort and luxury. Spring car seats and backs are becoming more common. Tasteful electroliers and car fittings are being more generally used, and a larger number than ever before of the electric cars being built are now designed to use ten lamps instead of five.

The proper length of a car for different conditions of traffic and service is still an open question, although a car body of less than twenty feet is less popular than formerly.

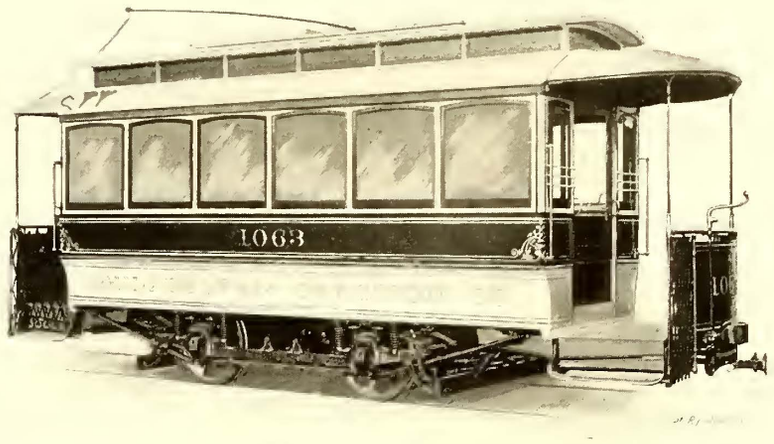


FIG. 1.

For interurban service the long center aisle, double truck car, similar in general design to those used in steam railroad service, is generally regarded as the proper design. Double decked cars, although in use on a few roads, have never reached the popularity in this country that they have abroad and it is doubtful whether they will ever come into general use here.

FIG. 2.

A large proportion of the roads now employ one or more special cars for different services, mail, express and for parlor use. The construction of the latter type of car has received a wonderful impetus from the general popularity of trolley parties, and most of the roads in large cities which afford opportunities to cater to a traffic of this

kind, now own one or more parlor cars. This branch of the business promises to form a considerable source of income in the future, and railways are beginning to learn that there is considerable profit in providing accommodations for pleasure riders.

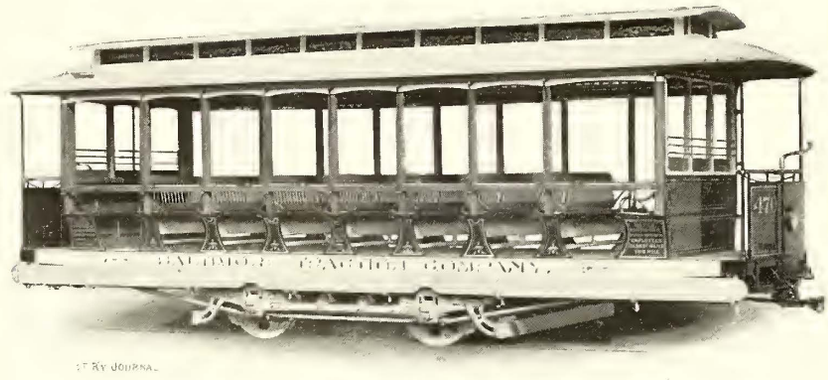


FIG. 3.

In the accompanying pages no attempt is made to illustrate all or even a large proportion of the large number of the different types of cars in use in this country. A few, however, have been selected to show some of the standards which are being followed and these, it is thought, will give a general idea of the practice in this country.

Fig. 1 illustrates one of the standard closed cars of the Philadelphia Traction division of the Union Traction Company, of Philadelphia, built by the Laclede Car Company. These cars have proved very popular in Philadelphia, and the Laclede Company has supplied 550 of these cars to this company.

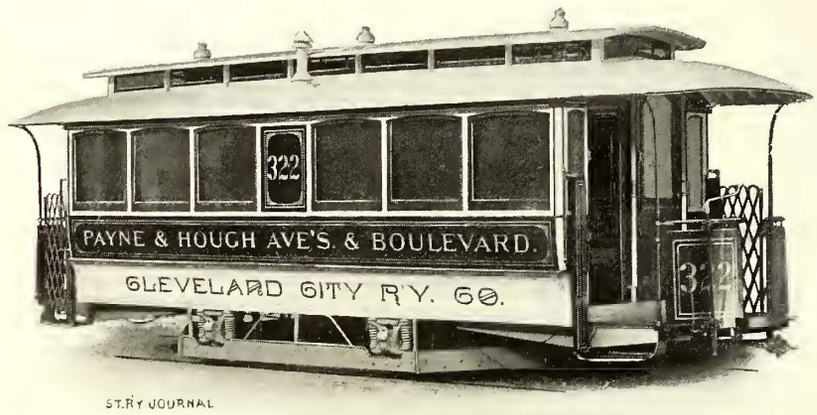


FIG. 4.

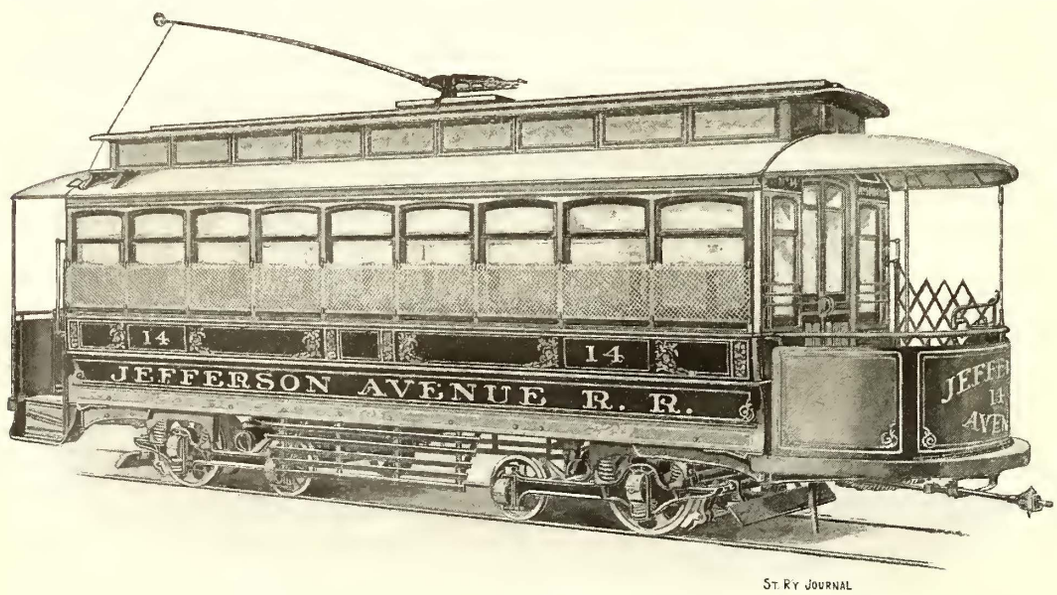


FIG. 5.

The car has a length of body over corner posts of eighteen feet seven inches; length over platforms, twenty-six feet seven inches; width at sills over panels, six feet six inches; width at belt rails, seven feet six inches; height from under side of sills to top of roof, eight feet seven inches. It is finished in cherry throughout, with birdseye maple ceiling, spring seats and backs covered with plush. The car has automatic twin doors, solid bronze trimmings and tinted muranese deck-lights. The Laclede Car Company has also built fifty cars of the same type for the Consolidated Traction Company, of New Jersey.

One of the recent cars built for interurban service by the Laclede Car Company is shown in Fig. 2. It is a combination baggage and passenger car employed on the Binghamton, Lestershire & Union Railroad, a model interurban line, ten miles in length, extending along the Susquehanna River from Binghamton, N. Y., to Union. For this service, the style of car shown seems to be well adapted, and the cars attracted no little favorable comment from visiting street railway managers during the recent convention in Binghamton of the New York State Street Railway Association.

Fig. 8 shows one of the cars built by this same company for the Third Avenue Cable Railway, of New York. The dimensions of this car are as follows: length of car body over corner posts, twenty-two feet, length over platforms, thirty feet one inch; width at sills over panels, six feet two inches; width at belt rails, seven feet six inches; height from under side of sills to top of roof, eight feet eleven inches. The cars are extremely handsome without and within, and the tinted decklights give a particularly rich effect.

Fig. 10 illustrates the interior of an interurban electric car built by the Laclede Car Company. This car is in use on the Baltimore, Pikesville & Emory Grove Railway. For the accommodation of passengers, parcel racks have beon built over the windows at each side, a novel feature in electric car construction.

Fig. 5. illustrates one of the double truck Laclede cars used on the Jefferson Avenue line of St. Louis. This car is described elsewhere in this issue.

A characteristic type of car is that shown in Fig. 4, built by the Brownell Car Company for the Cleveland City Railway Company. The length of body of this car is twenty-one feet and width seven feet six inches. The length of each platform is four feet. The special feature of the car is, of course, the location of the doors at the sides of the car. This Accelerator type is urged very strongly by the Brownell Car Company, and the fact that the company has built 471 of these cars is a very good indication of their popularity. The interior of the car is very handsome, being finished in mahogany with ceiling enameled white and decorated in gold. The seats are longitudinal and covered with Wilton carpet. The curtain shades are of Burgess cloth with Burrowes fixtures. The windows are glazed with $\frac{3}{16}$ in. French plate. The middle sash on each side of the car is replaced by a beveled mirror on the inside, adding much to the attractiveness of the car.

Fig. 3 is a Brownell open car built for use in Baltimore. The car is fitted with nine benches, seven of which are reversible, and the ends are closed with three drop sash. The dimensions of the car are: length over corner posts, twenty-three feet nine inches; length over platforms, twenty-nine feet nine inches; width over posts, seven feet five inches. The car is equipped with metal side panels and curtains of duck, shrunk, and mildewproof and fitted with Acme fixtures. There are side guards on each side arranged to slide up under the eaves.

The car illustrated in Fig. 7 was recently built for service in Kansas City by the Brownell Car Company. It is of the convertible type with permanent vestibules fitted with drop sash. The dimensions are: length of body, thirty-four feet six inches; width of body, eight feet; length of platform, four feet. The car has a center aisle with twenty-six spring seats, each capable of holding two passengers. The ceiling is of three-ply veneer, and

FIG. 6.

FIG. 7.

the gates on the rear platform of the Minneapolis pattern operated by the motorman and described in a recent issue of the STREET RAILWAY JOURNAL. The curtains at each seat are of pantasote with Acme fixtures, and a large duck storm curtain, capable of covering the entire side of the car when used as an open car, is carried rolled up under the eaves. For winter use sashes are put in the car, making a closed car.

Fig. 6 shows a closed car built by the Brownell Car Company for the Metropolitan Street Railway Company, of Kansas City. One of these cars will be exhibited by the Brownell Company at the St. Louis convention.

FIG. 8.

The general dimensions are: length of body, twenty-six feet, length of platform, four feet. The platforms are closed on one side by continuous dash and have the Minneapolis pattern of automatic gates. The platforms are also provided with removable vestibules. The doors "at the step," Accelerator style, at diagonal corners, are of such a width that exit and entrance can be quick and comfortable.

The interior finish is cherry, no attempt being made to destroy the beauty of it by embossing the woodwork or by machine carving. The seats, which are longitudinal, are covered with the best quality Wilton carpet of a color to harmonize perfectly with the woodwork. The ceilings are birch veneer neatly decorated. The curtains are of pantasote on spring rollers with Acme fixtures.

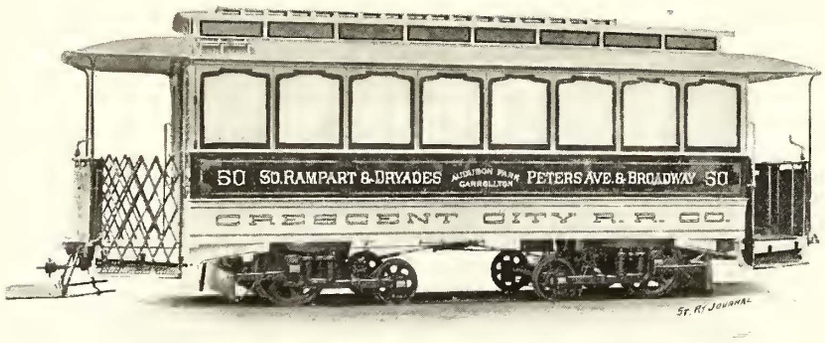


FIG. 9.

The car is abundantly lighted by fifteen incandescent lamps, nine inside and six distributed between revolving signs, headlights and under side of bonnets. The car has also electric call bells, and "Columbia" heaters, and while no effort at elaborate finish has been made, the car presents the neat and tasteful appearance usual in the Brownell Car Company's work. The comfort and convenience of the patrons of the road, in other respects, has not been neglected.

Among the novelties on this car, are illuminated revolving signs on each bonnet, indicating four different routes. They are operated by a handle inside the vestibule. The destination of the car can be readily seen and read from a distance.

The cars are painted Metropolitan Street Railway Company's standard both in color and decoration. General Electric equipment is used.

Another type of long car, but built by the J. G. Brill Company is illustrated in Fig. 11. It is one of seventy supplied by the Brill Company during the present year for use in Buffalo. The cars are twenty-five feet long in body with four foot six inch platforms. This size has been found a very convenient one for certain kinds of traffic. The inside is finished in solid cherry with decorated veneer ceiling and bronze metal trimmings. The windows are fitted with Burrowes spring roller curtains. The cars have monitor deck roofs with high ventilators. Portable vestibules enclosing the entire platform, except at one side, are used in winter. The cars are mounted on Eureka maximum traction trucks.

A good example of an eighteen foot car, of which the Brill Company has furnished many hundreds during the present year, is shown in Fig. 12. This car, which was built for the Portland (Me.) Railway Company is finished inside in solid cherry, with decorated veneer ceiling, monitor deck roof, bronze metal trimmings, cherry seats, the backs covered with handsome Wilton carpet. The car is furnished with Brill patented angle iron bumpers and the platforms with safety gates. The car is mounted on Brill No. 21 C truck. This is the longest car which these manufacturers recommend for single tracks. Having a large carrying capacity, they are well adapted to lines having ordinary travel.

A good example of double truck cars for city service is shown in Fig. 9. This represents one of a lot of cars, 225 in number, furnished

FIG. 10.

by the Brill Company to the New Orleans Traction Company. The cars have monitor deck roofs, palace No. 2 finish throughout, and are mounted on Eureka maximum traction trucks.

In Fig. 13 is shown one of the ten bench open cars in use on the Broadway cable line, New York. These cars measure thirty feet over all and have seat spacing between intermediate seats of three feet. They are very spacious cars except in the width, which was made necessary by the tracks on Broadway line which are close together, necessitating rather a narrow car. The cars have spring cane seats with solid cherry backs, monitor deck roof, decorated veneer ceiling, bronze metal trimmings, spring roller curtains, post grab handles of turned ash extending from water table to seat and forming a guide for the entrance guard. The steps are folding, and when the steps are turned up

FIG. 11.

and the entrance guard lowered as experience has shown that no passenger will attempt to get on the closed side of the car. The style illustrated is that built both by the J. G. Brill Company and the John Stephenson Company. The former company also furnished 150 similar cars, with the exception of the cane seats, during the present year to the Nassau Railway of Brooklyn.

Fig. 14 illustrates one of a large number of cars, recently built by the Stephenson Company for the Detroit Citizens' Railway, of Detroit, Mich. The car is of the well known Broadway closed type, similar in construction and dimensions to the cars built by the Stephenson Company for the Broadway line of New York, except that the car is six inches wider and is fitted with vestibules. These cars have proved very popular on a large number of lines owing to their large carrying capacity and broad platforms and have come to be regarded as one of the standard styles in this country.

FIG. 12.

FIG. 13.

Fig. 15 shows a car recently supplied the Toledo, Bowling Green & Fremont Railroad, of Toledo, O., by the Pullman Company. The cars are thirty-two feet six inches body, forty-three feet over all. They are finished in solid cherry throughout with quarter sawed oak headlining nicely decorated. There are twelve seats on a side with thirty inch centers and twenty inches aisle. The seats are of the "walkover" type without arms on the aisle side, thereby giving really more seating surface than is permitted in a seat of the same length with arms. The seats have spring edges and are covered with rattan.

One of the special features of these cars is the arrangement of the windows. These are made as large as practicable, and are in two parts, and so arranged that both upper and lower sash can be dropped in a pocket in the side of the car, leaving a much larger opening than can be gained by making the sash in one part or by making upper ones stationary. The possibility of the sash rattling either in the pocket or when raised is entirely overcome. Another attractive feature is that when the sashes are in the pocket, the opening or top of the pocket is perfectly closed so that there is no indication of the pocket, and a perfectly smooth surface is presented for an arm rest. Roller curtains are also provided for the window openings. This arrangement overcomes the objection of storing the sashes away in summer where they are liable to be warped or otherwise damaged, thus making it difficult to reapply them when required, but being located where they can be readily gotten at, the car may be quickly changed from an open to a closed one. This is particularly desirable in case of a heavy storm coming up, or when in the fall or spring the car is to be used closed in the morning and evening and open during the balance of the day if weather is agreeable.

The trimmings in these cars are of solid bronze. The platforms are quite large, the rear platform being five feet six inches in length and enclosed the full width of car with sliding doors on each side. Operated in connection with the door is a trap covering the steps, thus completely enclosing the platform. The Pullman Company has patents pending on the convertible features of this car.

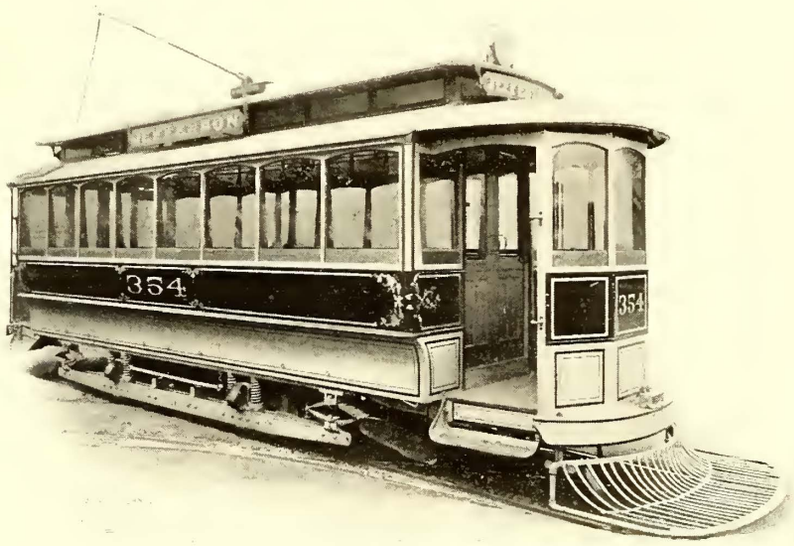


FIG. 14.

A car differing in design from any of those already illustrated is shown in Fig. 16. It shows one of a type of car very popular in Cleveland and Detroit and built by the G. C. Kuhlman Company. This style of car, which is adapted only for double tracks and one direction of running, has a side aisle close to the three doors shown in the

engraving. The benches, which are transverse to the car, hold four passengers each, and are at the side of the car nearest the other track. The arrangement, as will be seen, is a very desirable one for the easy egress and ingress of the passengers, there being three doors ready for them. The middle door is arranged to be closed from either platform, so that in winter the car is never unnecessarily cooled off on account of this door being left open.

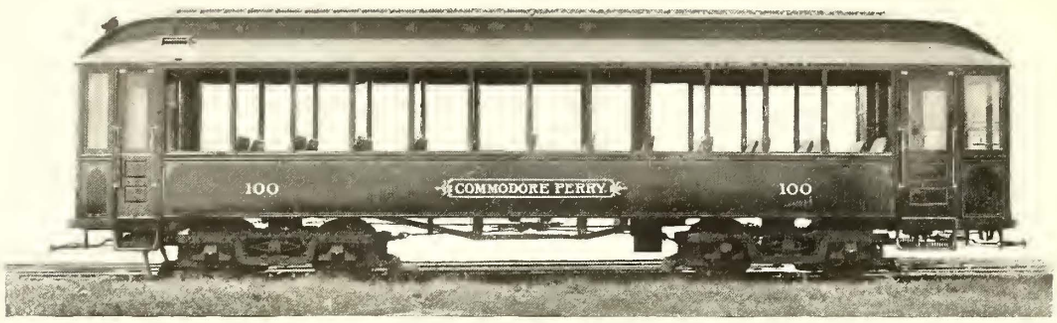


FIG. 15

Fig. 17 shows a double truck, combination baggage and passenger car built for the Saginaw and Bay City line by the Jackson & Sharp Company. The length of this car over body is about thirty-one feet. The vestibuled platforms at each end are five feet long, making the total length, over vestibuled fronts, about forty-one feet. The passenger compartment is about twenty-two feet six inches long. The baggage end is eight feet five inches in side length, or, with the additional space of one vestibule which is combined with the baggage compartment and entirely closed in at each side, it is about thirteen feet five inches long. By reference to the engraving this feature will be readily understood. The vestibule is simply enclosed as a continuation of the car and is not equipped with any side doors or steps of any kind.

The interior finish of the car shown in Fig. 17 is of quartered oak, with white birch veneer ceiling, handsomely decorated. There are twelve reversible-back seats in the passenger end and three stationary seats, all equipped with spring cushions covered with plush. In one corner there is a stove. The baggage compartment is also fittted with plain wooden seats, arranged so that they can be folded up against the side walls out of place. These can frequently be used to advantage by passengers who desire to smoke.

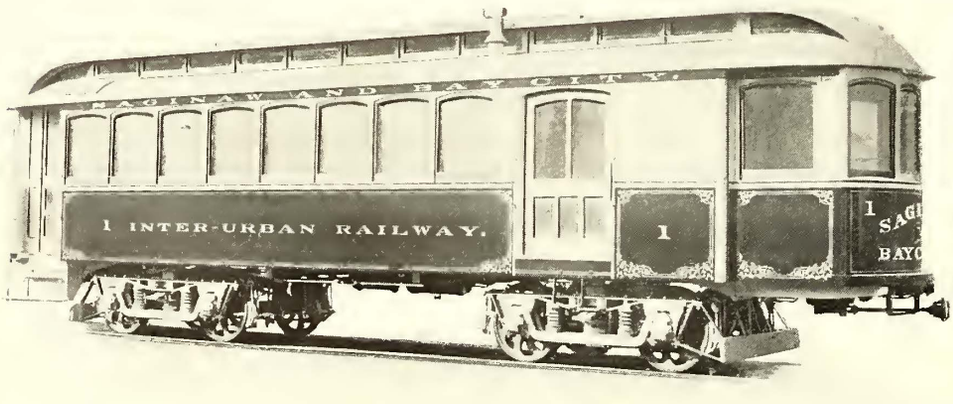


FIG. 17.

The trucks are the Jackson & Sharp standard for interurban electric cars, and are specially designed to meet the requirements of heavy loads and high speed. They are equipped with spring bolsters, which take up oscillation or sudden jar.

A convenient size of electric car for city and suburban service is that illustrated in Fig. 23 and was built by the St. Louis Car Company for the Midland Railway Company, of Staten Island, N. Y. The cars are extremely tasteful in finish.

The car shown in Figs. 19 and 20 is of the convertible type and was built by the Barney & Smith Car Company for the Oakwood Street Railway Company, of Dayton, O. Fig. 18 shows the car in its summer outfit, with no sashes in the windows. The space between the window openings is filled with wire screens, and the window openings are supplied with roller curtains on spring rollers and with automatic fixtures. In addition the cars are supplied with a storm curtain, on the outside of the car, shown rolled up in the engraving. This curtain can be pulled down and buckled to the under side of the car sill in case of stormy weather. As will be seen the car is fitted with wood slat seats and spindle backs.

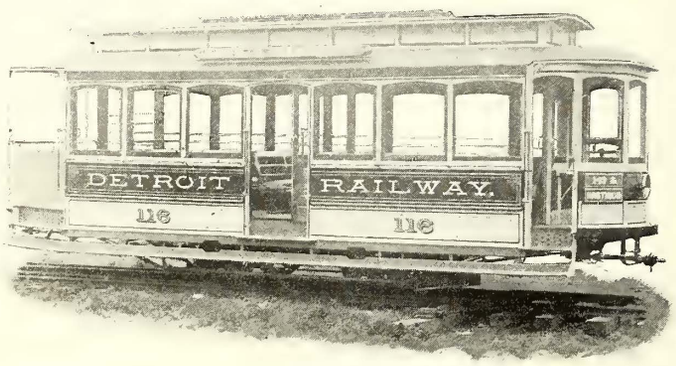


FIG. 16.

Fig. 20 shows the car in its winter arrangement, the side windows being closed with glass sash and the spaces below being filled with solid wood panels in place of the wire screens, the automatic roller curtains remaining in the car the year around. The slat seats and spindle backs are also removed for winter service and upholstered plush cushions and backs replace them. The reader will also note the window sash in place and the solid wood panels below same. In this connection it might be said that in fitting up these cars for winter use, it is claimed that the wood panels, which take the place of the wire screens, can be made

absolutely watertight, as well as the glass window sash, so there is absolutely no trouble from leakage. These cars are handsomely finished inside in cherry with birdseye maple veneer ceiling handsomely decorated.

The ends of the cars are fitted with automatic double sliding doors, and the front platform is enclosed with a circular vestibule, the form of which makes a very handsome appearing car. The car is mounted on the Barney & Smith standard class "A" motor car truck.

These cars can be made any length desired. The car illustrated is twenty-one feet four inches long over the body, twenty-nine feet four inches long over the platforms, and has eight of "Walkover" pattern seats on each side of the aisle, seating thirty-two people. The manufacturers have just recently equipped the Joliet (Ill.) Railway Company with this same style of car for single trucks, and also a number of cars with ten seats on each side of the aisle, seating forty people and mounted on double trucks.

bodies are of the type known as the Brooklyn Heights standard for double trucks. These double truck cars are being adopted for much of the long distance travel in Brooklyn.

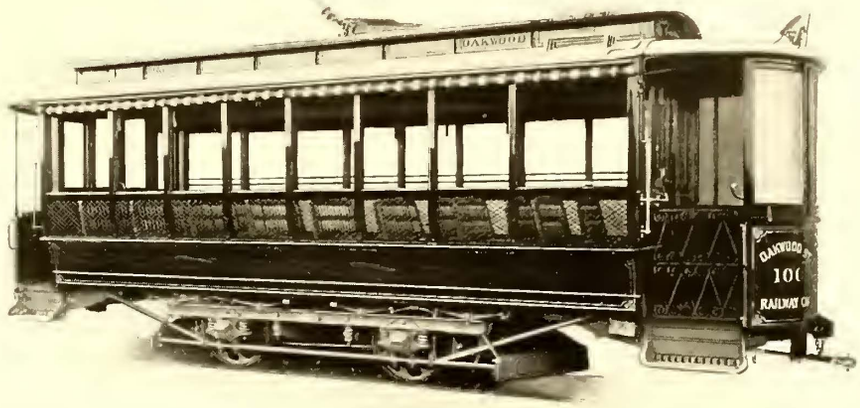


FIG. 18.

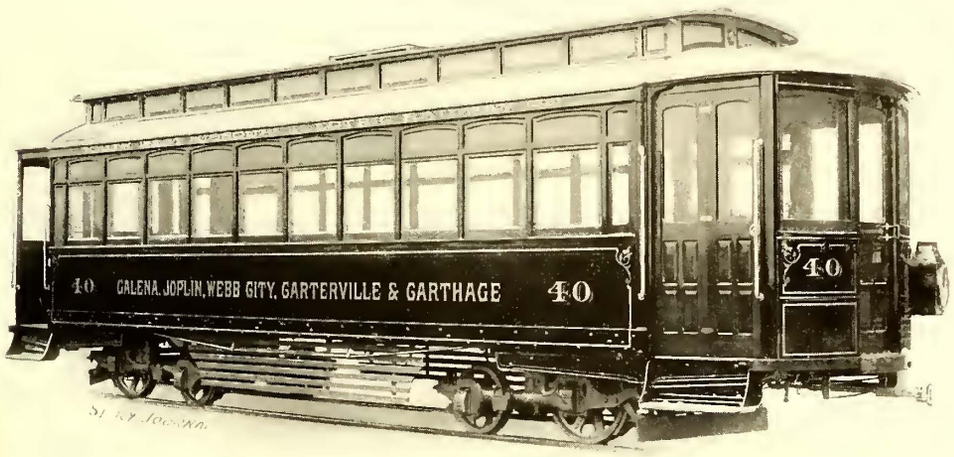


FIG. 19.

The length of body is twenty-five feet and the length over all is thirty-four feet. The width of body at sash rail is seven feet nine inches and the width over all is eight feet one-half inch. The height from bottom of sill to the top of roof is eight feet eleven inches. The bodies are very substantially framed and have extended platforms supported by T irons. The platforms have substantial dashes and are supplied with Wood's patent gates. The dashes have six substantial iron posts, two of which have a fork-shaped attachment screwed to the

Fig. 19 shows one of the convertible cars of the American Car Company. The car measures twenty-eight feet over corner posts and thirty-eight feet over platforms. The width of the car body at sash rails is eight feet six inches. The car is handsomely finished in mahogany, has reversible-back cross seats and is fitted with double sash at the sides. It is mounted on the American maximum traction, double motor truck. The car illustrated was built for the Southwest Missouri Electric Company and is equipped with vestibules and side guards. It forms a very attractive car for interurban service.

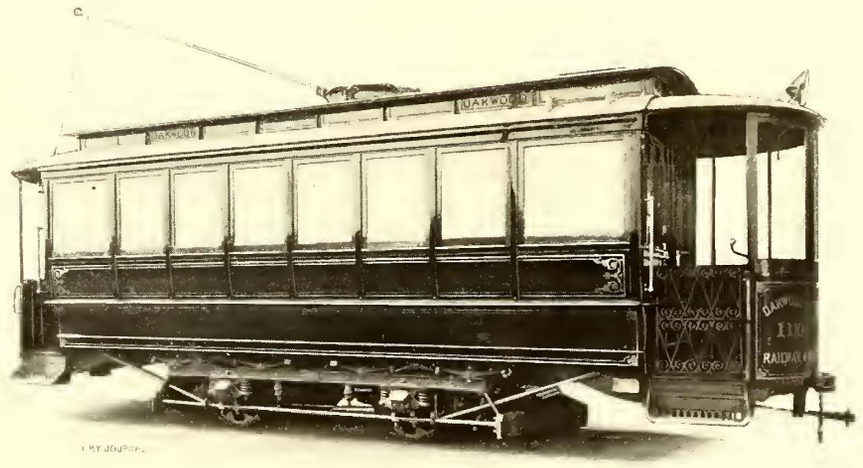


FIG. 20.

The car shown in Fig. 22 is one recently built by the Brooklyn & New York Railway Supply Company for the Brooklyn Heights Railroad Company, lessees of the Brooklyn City Railroad Company. The car

bonnet and a bronze sleeve on post of the dash forming a grab handle. The roof is of monitor type. The windows have cherry sashes with double thick selected glass set in

rubber. There are eight windows on each side. The inside finish is of cherry, and the head linings are three-ply quartered oak veneer. There are eight ventilators on each side furnished with white chipped glass with plain beveled edges. The seats and backs are covered with the best quality woven rattan. The seat risers are of cherry, handsomely paneled and having openings for electric heaters. The windows are supplied with rolling curtains with Burrowes automatic fixtures. Removable transparent signs are furnished for both ends of the monitor, this sign consisting of a sash in which is set sand-ground glass with lettering. Each body has two side signs, four-way, which can be operated from inside the car by means of a small hand wheel. The floor is furnished with wood matting and from the ceiling are suspended neat hand rails supported by solid bronze brackets of new design, the rails being supplied with necessary straps. Electric call bell circuits are run through the car, connecting with a touch button on each side pillar. The body is painted a Munich lake, striped and lettered in gold. The cover panels and dashes are painted straw color and striped in blue. The cars are fitted with register blocks and rod ringing device for register. The entire construction is substantial and the inside finish and decorating of neat design.

FIG. 21.

The car is painted the standard dark green body color adopted by the Brooklyn Heights Railway Company for all of its cars, and is lettered on the main panel with the name of the company, the route being shown by the street sign at the side and the end deck light. The car is equipped with an electric headlight.

Fig. 21 illustrates a twenty foot closed motor car built by the Wells & French Company for the North Chicago Street Railroad Company. The length of the car over all is twenty-nine feet. The width over side sills is six feet three inches; the width over window belts, seven feet five inches, and height from bottom of sill to top of roof, eight feet five and three-quarters inches. The car is finished in natural ash with birdseye maple headlining, longitudinal seats, bronze trimmings, single sliding doors in diagonal corners, roller curtains and automatic fixtures. It makes an attractive size for city service and one that has proved popular in Chicago.

But a faint idea of many of the cars illustrated in the foregoing pages can be derived from the illustrations given. Structurally the cars differ widely from each other and still more widely from the former horse cars which were their predecessors in street railway service.

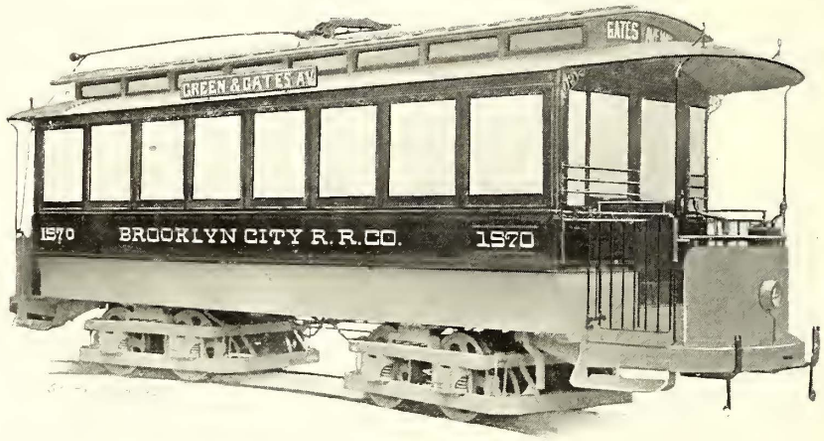


FIG. 22.

FIG. 23.

As in length and design so in decoration and finish current practice follows widely differing lines. Some railways employ the same body color on all of their cars, and use as lettering only the name of the company and numeral of the car. In this case the route is indicated by the street sign at the sides or end. The principal advantage claimed for this method is that cars used ordinarily on one route can easily be changed to another division of the system to suit the conditions of traffic, by the simple change of a sign.

On other systems care is taken to designate the main routes or divisions of the company by the employment of a different body color, it being thought that the advantage of readily informing the public, especially those who cannot read, of the destination of a car by its color more than counterbalances the advantage of interchangeability of rolling stock.

THE STATE ASSOCIATIONS

THE NEW YORK STATE STREET RAILWAY ASSOCIATION

The fourteenth annual meeting of the Street Railway Association of the State of New York was held at the Bennett House, Binghamton, N. Y., Sept. 8. There was a good attendance.

President G. Tracy Rogers called the meeting to order at 10.30. In his annual address which followed he referred to the principal events of street railway interest and important improvements of the past year and said in part:

THE PRESIDENT'S ADDRESS.

The past year has not been marked by any startling or radical changes in the street railway world. The same tendency toward better building seems to prevail. The extension of roads into the country, the construction and adoption of high speed motors and larger cars, and the rolling and laying of sixty foot rails, have all been tried successfully. The exercise of greater care in providing for the return current is to be observed, but perhaps the most important advance is in the universal adoption by large plants of the direct connected generators; indeed, I am informed that over eighty per cent of the generators produced during the past year are of this character.

However it still remains a question whether the adoption of the direct connected units is true economy in smaller cities or towns where the total demand for power is not great, real estate comparatively cheap and the road variable, necessitating the use of several small units. The relative cost is greater than where the sizes are larger. The advantage of connecting several small units to shafting to avoid an entire shutdown is also to be considered. In short, each type of generator is adapted to certain conditions to be met.

The experience of the past year has demonstrated that where very long lines of street railways are to be operated, power can be economically delivered twenty miles or more from the power station by the three phase system and the use of high tension current. It has also shown that with direct current machines, longer lines than we had previously supposed can, by the addition of boosters, be operated economically. Some fifteen or twenty different roads in the United States are now using this system. All of these improvements are enlarging our field of business and opening the sole available field of connecting suburban towns.

The great City of New York, which should be at the head and front in all matters of progress and improvement, is forced to confess that she is far behind all other cities of the state in modern transportation facilities. The fact that she occupies this out-of-date position in respect to the construction of surface roads is not a reflection on the enterprise of the railroad interests of that city, but upon the municipality, because of the restrictions put upon the railroad people by the authorities.

New York is debarred from the up-to-date overhead trolley construction that prevails in all neighboring cities and country towns. It is forced to content itself with the old horse-car method of transportation together with a limited mechanical system, which many smaller cities have abandoned for the trolley. While the unpopular elevated assists largely in serving the demand of three or four million people, still the principal city of the United States should have the most approved facilities and means of rapid transit.

The Empire City has declared absolutely that she will have none of the trolley on her thoroughfares and on account of this prejudice the existing conditions cannot be improved until something as good or better than the present overhead trolley has been discovered. The railway people are forced to experiment with what has heretofore been considered impracticable, with the hope of developing something that will take the place of the horse and be a good and acceptable substitute for the very efficient service of the overhead trolley.

The remarkable growth of traffic in New York City during the past thirty years, and the necessity of the most improved facilities for transportation and the best possible method of traction, is plainly illustrated in the following table :

	Total Traffic.
In 1865, eleven street car lines carried	79,618,818
In 1875, thirteen street car lines carried	140,582,793
(with the elevated's first year, Third and Ninth Avenues	644,025)
In 1878, fifteen street car lines carried	169,105,739
(with the elevated open on Sixth and Second Avenues	9,236,670)
In 1883, fifteen street car lines carried	266,164,236
(with elevated carrying	92,121,943)
In 1893, sixteen street car lines carried	453,652,964
(with elevated carrying	219,621,017)

A number of interurban and suburban trolley roads have been completed and operated during the past year with almost phenomenal success. A well built road of this character, starting from a fair sized city, and owned and operated by the city company and tributary to its system, connecting one or more thrifty villages with the city, to my mind, will pay. Such has been our experience with the Binghamton, Lestershire & Union Railroad. In this case we own most of the right of way, obtained where necessary by proceedings under the laws as amended in 1895. We generally found the farmer along the route welcomed the trolley road, since it served him personally, which a steam road would not, and he was very reasonable in his demands. I would suggest that such a road cannot be too well built or graded. The first cost is staggering, but in the end it will pay a dividend.

The question as to the profit from carrying freight, express and United States mails has been fairly discussed. There is no doubt but that ultimately this traffic will be profitable and we are assisting in building up our territory in a most substantial manner. I consider carrying the mail less profitable than the freight and express business, but it has many obvious advantages to the road, as well as the convenience to our patrons.

The street railways of this country can take but one position on the money question which is now forced upon us. Our bonds, both principal and interest, are almost uniformly payable in gold and should this country adopt the silver basis, we must pay gold and accept the depreciated currency of the country for our fares, which are fixed and cannot be advanced. We cannot place the situation before our employes any too forcible or plainly as they will be the greatest sufferers. The situation is a grave one for all railroad interests and demands our careful consideration.

From the Railroad Commissioner's Report of 1895, I find that it has cost all roads of the state 91½ per cent of their gross receipts for operating expenses, interest, taxes, and rentals. Ninety-one and one-half per cent of the five cent fare we receive is four cents, 5¾ mills, leaving but 4¼ mills profit for dividends. In New York City, one can legitimately ride 12½ miles for five cents, transportation, .004 per mile; in Brooklyn eighteen miles, transportation .0028 per mile, and in Buffalo 13¾ miles, transportation .0037 per mile. The street railway in the State of New York to-day affords the cheapest transportation in the world.

The question of fenders is still confronting us and is a most perplexing problem. More patents for street car fenders have been granted during the past few years, than for any other class of inventions. It is stated upon good authority that there are upwards of 4000 on the market, and I dare not estimate the number left in the brain of would-be inventors. It is the opinion of many street railway men that the fender is a menace.

Your Executive Committee was anxious that an act be passed regarding fenders. There were a number introduced. The one introduced by the chairman of the Assembly Railroad Committee seemed to meet the approval of the public and was heartily endorsed by your Executive Committee, but for some reason it never became a law. The street railways are anxious that the state should share some of the responsibility. I stated last year, and still believe, that the best fender for the front end of a car is a clear headed motorman.

Now that the limit of indemnity in this state is removed by the Constitutional Amendment, the question of accidents and accident insurance is one of the most important questions of the day. A street railway company before the average jury is at a great disadvantage. It is a grave question whether it is wiser to take our own chances without insurance, or to pay the high premiums asked by the indemnity companies, and still take chances of being indemnified. If some of the principles of state insurance in Germany could be incorporated in our American system, or if, perhaps, some system of mutual insurance could be adopted, railway companies might be relieved from the tremendous injustice frequently done by juries. It is gratifying to say in this connection that during the past year there has been a decided decrease in the number of accidents.

No question is of greater importance to the street railway companies, and the manufacturers of equipment and electrical apparatus, than that of having some definite standard as regards the rating of motors and generators, and as regards the features involved in application of the same, such as diameter of car axles, wheels, height of car body from track, etc. The steam roads of the country have done much towards fixing standards and rendering interchangeable material and parts. This gives to the railways, aside from all other advantages, a cheapened cost to the manufacturer, and consequently to the road, due to the reduction of the number of different parts and sizes. These and many other points which will suggest

themselves apply even more forcibly to street railways than to steam railroads.

The pleasant relations now existing between the steam railroad and street railway companies of this state are a subject of congratulation, although in many instances the interests are conflicting. In many states it is almost a case of the Kilkenny cats. It is a pleasure to be able to state that the existing situation in New York has been largely brought about by the Executive Committee of your Association. A proposition to consolidate the two organizations in one association is now under consideration.

The report of the Executive Committee was then presented. From it the following is taken:

REPORT OF EXECUTIVE COMMITTEE.

Never before in the history of the Association has there been such a large number of measures introduced in both branches of the Legislature in a single year, pertaining to the organization, operation and maintenance of street railroads. This result is in accordance with the prophecy embodied in the Executive Committee's report submitted at the last annual meeting, viz.: "With increased number of representatives comprising the next session of the Legislature, it is consistent to anticipate the presentation of an increased number of bills affecting our interests." This has been more than fulfilled by the introduction during the last session of the Legislature of eighty-seven Assembly and fifty-three Senate bills, making a total of 140 bills and amendments directly affecting street railroad interests.

We most heartily approve of the zeal, fidelity and persistency displayed by the officers of this Association in advancing and protecting mutual business interests throughout the year. We also heartily commend the Counsel of the Association, Hon. Edmund O'Connor, and hereby express our appreciation of his activity, and effective work in our behalf. We believe that his forcible arguments and wise counsel have proven an important factor in the advancement of our interests. We also desire to commend the general interest displayed by the individual members of this Association and their liberal attendance at all hearings and special meetings.

That this Association has a work of importance and usefulness ahead none who are familiar with its record for the past few years will gainsay. The benefits and advantages arising from entrusting our important general business interests into the hands of a well organized association, equipped to properly care for and foster the same, is apparent. Questions of great moment and emergencies of a grave character are liable to arise at any time, which individual companies might experience great difficulty in confronting, whereas as an association, the same issues and emergencies might be easily encountered and overcome. A business of the magnitude and extent of the street railroad interests of the state of New York requires careful attention and the combined deliberation of the representative men from the various companies.

An important, if not the paramount, factor in the usefulness of the Association is the annual convention, affording representatives of the various street railroad companies of the state an opportunity of forming pleasant acquaintance with each other, discussing important practical questions of organization, operation and maintenance, and a beneficial interchange of ideas.

We are pleased to note an increased attendance each succeeding year, and suggest that as far as practicable every company send one or more representatives, including the practical men, to the convention.

In view of the increased attendance and volume of business to be transacted, we recommend that two days should be devoted to the convention, in order that one entire day may be given up to the business sessions, and the second day to the entertainment of visiting delegates and guests.

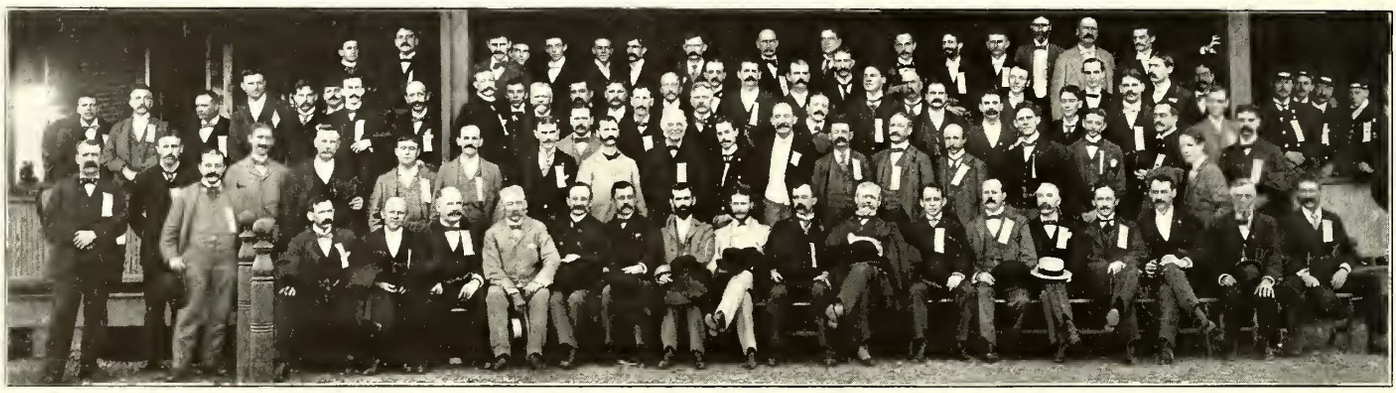
The reading of reports was then taken up, the first being by J. H. Stedman, of Rochester, "The Matter of Transfers." In part, the report read as follows:

TRANSFERS

One of the most important things to do and to do promptly, is to educate the average man and woman to ride. That this is largely a matter of education every street railroad manager knows. When a new line is opened, even through a thickly settled district, the people for some time continue to walk. Bad weather, the necessity of haste or some other thing induces a person to ride once. The next time he rides with less inducement, especially if the cars are clean, the service prompt and if he does not have to pay more than five cents to get to his destination. So the habit grows, and soon the rule is to ride, when before it was the exception. A liberal transfer system, properly guarded to prevent fraud, pays. This is, I think, now generally recognized.

A large road in Baltimore three years ago employed me to arrange a transfer system. They yielded to my advice to the extent of four transfer points, but I argued in vain for more. One year after, the manager again sent for me and said, "When you urged me a year ago to increase my transfer privileges, I thought you were a fool; and I am now convinced by a year's experience that the fool was another party." The expediency of a liberal transfer system is beyond argument—it is an established fact—it does increase cash receipts. The more liberal, the more advantageous.

Whether it is better to ring up transfers is a subject which has provoked much discussion. To ring them up does, of course, give them at once a cash value; but not to ring them paralyzes the spotter or detective, and the latter, I think, is generally admitted to be of greater importance. No detective can properly check up a car unless the conductor of that car is compelled by the company's rules to take up cash, transfer ticket, or pass coupon from every passenger, and to ring the register for every passenger. The weight of opinion seems now to be to ring up transfers, and preferably on a separate register. Nothing is absolutely a safeguard except the transfer method itself. With a protective transfer guarded by the coincidence of time and consecutive number in sequence of issue, honesty may be secured.



GROUP OF ATTENDANTS AT ANNUAL MEETING NEW YORK STATE ASSOCIATION—BINGHAMTON.

President Rogers: We have adopted transfers on our road, with a great deal of benefit to ourselves and also to the public.

Mr. Moffit: We have used them on one part of our system in Syracuse for two years and are much pleased. I think the transfer is a means of helping them to get into the habit of riding.

Mr. Rossiter: We have a very liberal system of transfers in Brooklyn. We carried 2,600,000 passengers on free transfers last month, and increased our earnings about $40,000. But we might have made doubly as good showing, if we had not given any transfers. There are a number of reasons why we should increase. We give a transfer to a passenger who is riding on a transfer. We have considered this question carefully, and believe the percentage is, comparatively speaking, very small, where passengers take a second transfer; and if you eliminate certain lines where we do not run our cars direct to the Bridge or ferries, or some other point, I doubt if two per cent of the passengers having a transfer take a second one.

Mr. Deming: In Buffalo, there are a number of lines where it is necessary to give a second transfer, and in some cases a third. We have more or less trouble with the people abusing the transfer system, and it is hard to devise means to stop it. It is a matter which must be left to the intelligence of the conductor, in a great degree; but I do not think there is a very large part of the public that endeavor to beat the transfer system. Our system is laid out in such shape that it is possible to ride all day long on a transfer (Laughter). I have been studying a new form of transfer, which may put a stop to it. That is the idea of having every street that we run by printed on each transfer. When a passenger gets on one line, and wishes to go to a certain part of the town, he must ask for a transfer to that street, and that transfer is good on any car connecting the two lines. The transfer will be taken up by the conductor, and another issued to the passenger punched for the same street, and the moment the street is reached the ride ceases. I think we will have to come to something of this kind to prevent them from riding too much. It may work, or it may not.

Mr. Robinson: A great deal of difficulty arises in New York from the use of transfer tickets. There are some lines on which persons can get five or six transfers, and continue riding all day, if desired. We also have difficulty at the points where we have transfer agents and the tickets are punched. The passengers give the

tickets to boys (and the boys sell them) or they put them in places where other people can get them. Some investigations have been made to see whether people use tickets illegitimately, and although no record is kept of it, it is found from general observation that the abuse is not great. There are not many transfers to one person of more than three in number; such cases are few and far between. We consider that on some lines the result of issuing transfers has been large increase of travel, particularly in the retail dry goods district.

MR. MOFFITT: In Syracuse, we carry about twenty-five per cent of our passengers on transfer, which, I think, is a low average.

MR. DEMING: In Buffalo, it is from thirty-five to twenty-five per cent, about thirty-two per cent.

MR. CLARK: In Binghamton, our percentage is twenty-two to twenty-five per cent; a little under twenty-five per cent.

MR. RUSLING: The Rochester Railway Company used to issue from thirty-five to forty per cent. Recently we have introduced a new transfer system, and we now issue from twenty-seven to thirty per cent.

MR. ROSSITER: We issue from twenty-two to twenty-five per cent in summer, and from sixteen to twenty per cent in winter.

MR. FRICK: The Atlantic Avenue system in Brooklyn issued from fifteeen to twenty per cent; sixteen per cent was the average for nine months in the year.

The paper of C. Loomis Allen, of Syracuse, on "General Track Construction, and the Most Approved Method," was then read. It was in part as follows:

REPORT ON RAILS FOR STREET RAILROADS.

Rails of hard steel, the analysis of which showed a greater percentage of carbon than the standard specification of rail steel have been advocated by some of the steam railroad systems for some years, and I might add that their use has been a success in every way. The most notable instance of high carbon rails is that of the New York Central Railroad, upon the Hudson River Division near Spuyten Duyvil. These rails have been subject to as heavy traffic as any rails laid on this continent. They have been under traffic for nearly six years, and up to this time I believe none have broken. When these rails were first delivered by the makers, so certain were they that the rails would become broken under traffic, that due warning was given the railroad company by the makers, that they would not be responsible for the damage which would most certainly occur from breakage. It was my good fortune early this year to consult with one of the firms of inspectors of steel in regard to the wearing quality of high carbon rails as compared with that of rails known as Bessemer rail steel, and their judgment was that high carbon rails will give from forty to sixty per cent greater life than rails of standard Bessemer steel. When steam roads began to ask for steel rails the composition of which called for high carbon an extra price from $2 to $4 per ton was asked by the rail makers, but to-day these rails are obtainable for the same price as those of standard rail steel specification.

In Syracuse this year we are laying rails sixty feet in length, nine inches high, and the half groove section. Our joint is ribbed or corrugated twelve-bolt, thirty-six inch joint. Our contract with the rail makers calls for rails the composition of which is as follows:

Carbon from .53 to .63.
Phosphorus not to exceed .095.
Sulphur not to exceed .07.
Manganese .80 to 1.00.
Silicon .10 to .12.

We have had five miles of track of this specification and are in hopes to lay this year twenty miles. We are expecting great results from these rails. I have noticed that the wear on the head of the rail by car wheels in the course of a month, does not make any impression other than brightening the head of the rail; while in rail of standard specification I have seen under the traffic of two weeks, the metal in the head of the rail roll to the outside of the head to a very perceptible degree. The fact that there is longer life to rails of hard steel will appeal to every street railroad man as an economy which cannot be sacrificed.

MR. ROSSITER: We call for practically the same rail as that described, but in thirty foot lengths. We have had a few rails break in handling, but the results under wear of these high carbon rails are very satisfactory.

MR. RUSLING: Our road is not changing any of the specifications.

MR. EVANS: The Nassau Electric road uses the regular Bessemer rail specification. The West End road, in Boston, uses a little harder rail than any other road in the country. It is very seldom that the rail makers are asked for rails made up on any other than the regular Bessemer rail specification.

PRESIDENT ROGERS: There is no question that the heavy rail of the height we are all using has been found to be the best. I do not know that there are many roads adopting the high carbon standard.

The next topic was the paper by W. W. Cole, of Elmira, "How Can We Prevent Accidents and Increase the General Efficiency of Employes." An abstract follows:

HOW CAN WE PREVENT ACCIDENTS AND INCREASE THE GENERAL EFFICIENCY OF EMPLOYES?

One of the first and most important requisites to improving the efficiency of the road and preventing accidents, is the selection of employes, and to this end the application blank is an important factor; and such questions should be asked as to generally outline a man's past.

The question, Do you own real estate or personal property? is important, as a man who has accumulated property while working for small pay, must necessarily be economical, and appreciate laws governing the protection of property, and is apt to have care for the property of others.

To what extent are you in debt? I think we will all concede that a man who is badly in debt will not only prove a nuisance to a company, but he is apt to take but a short lived interest in his work, and become careless. Constant requests are made upon a company to compel a man to pay his back bills, and a company loses many friends unless such matters are given attention.

Do you use intoxicants? and Have you ever been addicted to the use of intoxicants? These questions need no comment.

What are the highest wages you ever received? Now the best man for a place is the satisfied man, who thinks he is doing well. And a man who has commanded higher wages than you pay, is sure to believe sooner or later that you do not appreciate his real value, and he becomes dissatisfied, and will either take more interest in looking for another place, or in airing his trouble before the other men.

The other questions are such as will tend to delineate a man's stability and character. I believe that all men should be placed under at least $200 bonds, as it not only has a restraining influence upon the man, but so many business men, in order to get rid of a man with little trouble, will give him a first class recommendation, but they will hesitate to go upon his bond unless they know something of his ability, reputation and personal habits. When you employ a man under bonds, you have practically got him registered with his friend's approval.

Great care should be taken in the choice of instructors of motormen and conductors, and to this end it is well to keep a book recording all acts of disobedience or carelessness of each employe and then select as instructors the men as having the best record. It has been my experience that a new man is apt to learn very readily any little tricks of carelessness his instructor may have acquired. After a man has been turned in as competent to run by his instructor, I think he should pass an examination as to his duties, and upon the rules and regulations of his company. I submit examination papers containing such questions as generally apply to the operation of street railroads.

Such an examination is beneficial in several directions, as it makes a man think about his duties, and he will discuss the questions with other employes and get their ideas, and the men will generally take more interest in their duties; and it also enables the men to frame readily into words intelligent answers to questions as to their duties, and the rules and regulations. It is sometimes very important that a man should be able to make proper answers to such questions especially when called upon to testify as a witness in a law suit. I think all motormen should be furnished with a blank report, to be filled out each evening, or after his run, as to the condition of his car; and report all trouble with brakes or any defects with running gears or apparatus, and place his report on file for the foreman of the shop, who should have an immediate inspection made of the car reported. The report should be O. K'd. by the man making such inspection, and then sent to the master mechanic or superintendent. Where verbal reports are made by motormen, the men in the shop are apt to give them careless attention; and when an accident is the result of defective brakes, or an armature burns out from a broken connection run too long, it is difficult to fix the blame upon the individual, as when the motorman makes a verbal report, no man in the shop can be found who heard it. Or when a car has been reported twice for the same trouble, you have a check upon the man who has made the inspection, and he has been careless, or the motorman is a fault finder, but these are facts for individual inference.

One of the most important preventives of accidents is a thorough system of shop inspection, and such reports should be made as would show when a car is in shop just what repairs were made, and the time and material consumed. If a car is in the shop for brake shoes, and is allowed out of shop, and two hours later is pulled out of service for split trolley wheel, or some loose contact, I should consider that the system of car inspection was faulty, and cars liable to be let out of shop when they were defective; and either the man or the system needed a change.

A system of reports in all departments that will form a connected chain, to check the work of the individual, is of benefit, when such reports are not complicated, and are always attended to. I do not claim that such a system will make a good man out of a poor one, as my experience has been that it is much easier, and the result more satisfactory, to discharge a poor man, and get one in his place.

Accidents are frequently occurring from loss of power, when it is most needed. No road should, from an economical point of view, try to run too close on a theoretical consumption of power. This is especially so in the case of small roads, operating from five to fifteen cars, and is of special significance where there are grade crossings; as in case a trolley flies off, it is apt to be placed in a hurry with the power on, and this means a sudden jerk, especially

on a jump-over crossing; and where a road is running close to its full power capacity, and the power goes off, it is very liable to be several minutes before the circuit breakers can be kept in, and the car got under motion again.

When it becomes necessary to reverse a car to prevent an accident, it is very liable to pull the circuit breakers out at a most critical moment.

I doubt if a too slow schedule decreases the number of accidents, as I have found out that on a division where the cars run slow, the public are inclined to take dangerous risks, rushing in front of moving cars, that they will not take where the cars are moving at a brisk rate of speed.

Mr. Robinson: The Metropolitan Street Railway Company, of New York, organized a club, the chief object of which was to educate the motormen and conductors and held meetings to which all other operatives of the company were invited. The president opened a room in one of the depots, and during the last season, ending the first of May, there were a series of lectures held every two or three weeks. We had competent lecturers, the lectures being illustrated with appropriate stereopticon views, and the subject of underground trolley, cable machinery, cable apparatus, in fact, the general operations of the road were made plain by means of the photographic views. I think individual instruction is preferable to that received at the lectures; but the lectures are entertaining, and they have been largely attended, I am glad to say. On the whole, they are considered very advantageous, and it is proposed to continue and in fact, enlarge them during the coming winter.

Mr. Rossiter: We have rooms in our depots, but depend entirely on the instructors at the present time to turn the men over to the superintendents, competent to run the motors, and the superintendent is supposed to instruct them in regard to the details of each division, grade crossings, stops to be made at certain streets, etc. I was much interested in listening to the paper. I think it is an excellent suggestion. The only difficulty in the larger cities is in securing classes of men that are able to answer those questions. We furnish our men with rooms where they can secure papers, etc., and we have gone into the instruction and examination of the men closer than we ever did it before, with very beneficial results. I think the men take more interest in their work, and we are having less accidents which shows an improvement in the class of men we are securing. I think only fifteen or sixteen motormen out of 1600 left the service of the company in the month of August. Some months we have had even less than that: out of 1500 motormen we have had less than six men that left the service in a month from all causes, dismissal and resignation. It shows the men are interested in their work, and glad to keep their places.

President Rogers called upon Mr. Fitch of the Erie Railroad to give his views on the question:

Mr. Fitch: We could not get along unless we had a system of examination of that kind. There has always been more or less examination on our train rules for several years, but since we have gone into the signal and other improved details, we have to examine our men thoroughly, and they must know these rules perfectly before they are competent to take charge of the train. On several of the divisions we have these schools of instruction. We appoint our road foreman, or our master mechanic, or train master, to take charge of the schools, and instruct our men in their duties.

President Rogers called C. D. Hammond, of the Delaware & Hudson Canal Company, to give his experience:

Mr. Hammond: We found it not only desirable, but absolutely essential that we should have frequent examinations of our men of all grades as to their duties. We have, perhaps, a different method from some other roads. We do not examine our men in any set questions. I have always opposed any set questions to be asked employes. If we promote a fireman to be a locomotive engineer, he is directed to go to the man who is supposed to know most about the duties of a locomotive engineer, and that man takes him in charge and gives him a thorough investigation as to his knowledge of the duties of a locomotive engineer, and certifies to his ability, or otherwise, as it may be before he is promoted. If he is to be a conductor, having served as a brakeman, he is sent before the assistant superintendent or train master, and is examined by him. Such questions are asked as have been suggested to the examiner from time to time, growing out of errors or mistakes of men in performing their duties. I would be loth, indeed, to do away with our system of investigation.

A paper by H. S. Newton was then read. It was in part as follows:

POWER FROM THE TROLLEY CIRCUITS. IS IT PRACTICABLE?

The distribution of electric power from the railway power station for industrial purposes has long been recognized as a possible and highly practicable source of income by railway men generally, but a systematic move has never been made to compel the insurance companies to modify their rules covering this case, with the consequence that the rule still remains and our surpluses of power are still undisposed of.

It is my intention to first point out the chief advantages possessed by our railroad systems as producers of power for private consumption and then to follow with a statement of the objections raised by the Board of Fire Underwriters and others towards its adoption throughout the cities of New York State. Hitherto the electric light station has figured as the chief factor in the production of power for stationary motors. It is too often hampered, though, by circumstances of small units and insufficient reserve to consent to take hold on a large scale of a business necessarily offering what is, as compared with that accruing from lighting, a reduced margin of profit. In lighting stations, too, employing large engines driving many machines, the variation in load always attendant on the use of motors is also objectionable from the fact that the lights are affected to some extent. In these particulars the railroad station is prepared. The compound condensing Corliss engines which are showing themselves in all our power stations are run at an economy in coal consumption which converts what would seem a very poor price for power into a figure containing a neat margin of profit.

Take for example a station in one of our cities containing a 1200 h. p., direct coupled Corliss engine held in reserve, and estimate what could be done with this engine and its attached generator were it thrown into active duty on a private consumer's power circuit. Figure on an investment of $75,000 in the engine generator, and other apparatus relating to the two. Then assuming coal to be worth $3 a ton and the engine to have a fuel duty of three pounds per horse power per hour, we have:

Coal consumed for each day of ten hours, eighteen tons at $3	$54.00
Cost of labor, engineer, firemen and oiler, say	10.00
Oil and waste	2.00
Incidental repairs	10.00
	$76.00
Add to this ten per cent depreciation for one day	20.55
And interest on the investment at five per cent	10.27
	$106.82

Then figuring on an ability to sell the output for ten hours in the day at 2¾ cents per 1000 watt hours, we have 1200 h. p. for ten hours equals 8,952,000 watt hours at 2¾ cents equals $246.18.

With cost of production as stated above, the net profit amounts to $139.36, a very fair sum to go towards reducing operating expenses. The recording wattmeter has been brought to a high state of perfection and by its aid there is no necessity for the consumer to pay for one iota of current more than he uses.

The objections as advanced by the Board of Fire Underwriters to the use of the trolley circuit for stationary motors seem to be embraced in one feature, the ground return.

The insurance man will relate to you long tales of the disastrous effects produced where the experiment has been tried, will suggest to you that you build a fireproof house outside your building to hold your motor and run your machinery inside by means of a belt and line shaft (the very thing you do not wish to do) and will conclude by assuring you that if you will install a motor on the plan proposed, he will have to increase your rate by two per cent on the face of your policy. This, he claims, is because a reliable method of insulating has not been discovered to make the installation a good risk.

In Syracuse we are using for supporting our various lines, some four or five hundred iron poles. Every pair of poles is a dead ground to the trolley wire suspended between them, and yet in the last three years, during which time I have held my position on the street railroads there, we have never had one ground on these poles. And yet these insurance men tell us that they cannot find an insulation sure enough to warrant their insuring a building into which the trolley circuit runs, with every precaution taken for most careful insulation, without an addition to the premium such as I have noted.

It is true undoubtedly that results speak, especially in the insurance business, and there is little reason to doubt that a great many disastrous fires have been started by the defective installation of electric light and power plants. It does not necessarily follow, however, that because a large percentage of these fires resulted from the contact of a current-carrying wire with a gas or water pipe that a system of electric transmission between one of the wires of which, and the same gas or water pipe, no difference of potential exists by design should be barred out. Ninety per cent of the arc light circuits in our cities, if subjected to the gas pipe test, will show as great a capacity for kindling conflagations as the much abused trolley circuit, and yet the arc circuits with their three to five thousand volts difference of potential and their invariably grounded circuits come into all our buildings. With protected wiring and reliable insulators for holding the wires, both systems may be rendered absolutely safe except as against criminal carelessness or evil design.

To bring the insurance bosses to our way of thinking and to gain entrance for the trolley circuit into the factories and workshops would seem to be an imposing task. These men have been known to yield to pressure, however, in other things and there is always the rivalry and greed among them arising from competition to favor an effort in any direction.

Mr. Cole: Some of the small roads run so close to the entire output of their generators, that if they supply the power consumers they can never figure on the power they are going to have on the line. On any special occasion, they would not be able to tell how many more cars they would be able to put out for excursions, etc., on that account.

Mr. Story: In Hoosick Falls, we experience the same difficulty Mr. Cole has spoken of—uneven speed, blowing the circuit breakers, and during thunder storms we find a great deal of diffi-

culty in maintaining a fuse that would protect a motor from the lightning. We found that it is much better to put in another generator and run another circuit.

PRESIDENT ROGERS: Is any road in the state, with 600 h. p. or 700 h. p., using the direct connected units?

MR. COLE: I think the road in Corning has direct machines, running some four or five cars.

The following paper, by James B. Cahoon, was read:

THE DAILY INSPECTION AND CARE OF CAR EQUIPMENTS.

In carrying out a system of daily inspection, or any system for he care of car equipments, we have in view a two-fold object.

1. To prevent break-downs when the car is out on the road.

2. The reduction to a minimum of the repairs necessary to maintain the equipments in good working order and the prolongation of their life.

In the ordinary electrical car we have two motors of fifteen horse power or upwards, with their various connections, placed in the very worst possible position in which to operate machinery in motion. They should, therefore, in order to secure successful operation, have careful attention paid to them and be subjected to a systematic course of inspection of all their parts from time to time.

The system of inspection whose adoption I would advocate is that which we have put in practice on our road and suggested to some other roads, which from actual experience, has shown itself to be an eminently satisfactory one. This system is as follows: a trip inspection, a daily inspection and a monthly inspection. The trip inspection may be made in one of two ways; if the car runs into the car barns at the end of each trip it may be gone over by inspectors ready to receive it who examine the boxes, see that there are no signs of heating, that the grease cups are properly filled, that the armature and fields are all right and that the brake mechanism is in proper condition. On small roads where cars are not run into the car barns, perhaps, until the end of the day, this inspection can be made by the motorman at the end of each trip, it being a brief one, and can be made in a couple of minutes and if anything is out of order the trouble can be remedied on the spot. To this end as well as to any repairs en route, each car should be provided with a tool bag containing a small ball pane hammer, a ten inch monkey wrench, pair of eight inch pliers and ten inch screw driver.

The Daily Inspection: when cars are run into the car barns after teh day's work is over, two inspectors board each car and go over every part of the car and equipment, removing dust and dirt from around armatures and fields as far as possible with a hand bellows, wiping commutator, removing brushes and seeing that they are in good order and the copper peeled back on them so they will not wear into the copper coating during the next day's run, thus avoiding the squeak which this would cause. Every electrical connection is carefully examined to see that it has not become jarred loose and if any defect exists in any part, it is immediately repaired, if such repair will not involve over ten minutes' work; if it does then the car is left over for the machinists to put in order on the following day. The same care is exercised in going carefully over all the nuts, bolts and washers, cotter pins, etc., connected with both motor and truck; brake rods are gone over and brake shoes examined and everything seem to be in proper working condition for the morrow. The car is then turned over to the car washer who goes over the outside of the car cleaning all parts carefully, the inside of the car being swept out by the conductor who brings the car in, and the conductor who takes the car out in the morning cleans the brass work and windows and dusts off the seats and the inside of the car. In this manner we have caught a great many troubles just commencing which cost comparatively little to fix at that stage but which, if allowed to continue, would have entailed quite serious outlay.

Monthly Inspection: once a month in rotation each car is run over the pit and motors dropped down, taken apart and thoroughly cleaned; gears, pinions and brasses, if they are so far worn that they will not last another month, are replaced. The armatures and fields are carefully cleaned and painted and the commutator turned down if necessary; in fact, the equipment is put into first-class order throughout, so that to all intents and purposes it is as good as new when again replaced on the car. The car body and truck receive the same care and attention and are also put into first-class running condition.

We have found by experience that a shoe having sections of harder material cast in it has effected quite a reduction in the cost of brake shoes, the average life of these shoes being about 3½ times that of the ordinary cast iron shoe. These shoes last a little over two months on our road, while the old cast iron shoe lasted only about eighteen days.

A comparison of figures on our own road of the two different plans of the careful system of inspection and the old way of letting things go until they go to pieces, shows that the saving effected more than equals the total wages of the men employed on inspection and the machinists employed in the day time repairing the cars.

MR. COLE: I think there are some objections, say, to the motormen or conductors making any special inspection; it soils the clothing in a short time, and the men will wear a poorer class of clothing, and you have an ill-dressed lot of men. It is unpleasant for the passenger to have a conductor with dirty hands to collect the fares, which he will be sure to have if he must clean his car at the end of the trip.

A paper was then read by H. S. Cooper, of Schenectady, on "The Desirability of Forming a Board of Claim Agents."

Mr. Cooper suggested the establishment, by the street railway companies of the state, of a board of claim agents, to consist of five claim agents (or local counsel), an equal number of practical operating officers and the Association Counsel. The objects, duties and powers of this board were to be primarily:

1. To collect and examine all the safety rules and regulations of all the companies belonging to the board, to amend them where needed, standardize such as are of general application, and to publish and distribute them to the companies and insist on their use.

2. To examine all safety appliances, to standardize such as can be generally used, to commend such as are of value, to condemn such as are valueless or dangerous, to make reports of same and publish and distribute to the companies.

3. To collect and examine all the "safety" operating and accidental forms and all accident legal forms, to perfect them legally and otherwise, and to publish copies of such forms, distribute them to the companies and insist on their use.

4. To require all the companies of the Association to transmit to the board as soon as possible a description, model or copy of any new and desirable safety device, any good and new safety rule and regulation, any improved form or document relating to safety provisions or accident cases, or any improved method of operating which they may find, invent or develop; the board to make proper examination of same and to publish and distribute to the companies description of such as are found to be of merit for general use.

5. To collect, publish and distribute, any new and important decision or ruling of any court in regard to accident cases, and to especially note the special features of the case that gave rise to such decision or ruling.

6. To collect, publish and distribute any new law or novel ordinance, or any new conditions or clauses in new franchises, that may bear on accident cases, or safety appliances, rules or operating.

7. To require all the companies of the Association to furnish the board with the name, description or photograph, the method of operating and the means used to detect any parties attempting the "bogus injury game;" also the name and address of such lawyer as may aid or abet the above or of any lawyer who is known to make "accident claims" his business or who takes such business on "speculation" or "shares;" the board to publish and distribute to the companies the information in regard to the "bogus injury" and—at its discretion—to do the same with the above described lawyers.

8. To furnish the electrical papers—especially the street railway publications—with any information as to accidents, suits or awards that they may deem it best to publish; and to endeavor to get these publications to submit to the board before publication—their legal accident articles.

9. To use all possible influence with the lay press to prevent as much as possible the publication of "wild cat" and "scare head" articles in regard to accidents on street railways; in fact to see if it is not possible to eliminate the "deadly trolley" and "the juggernant cable car" from the columns of the daily press.

10. To investigate fully the New York State laws made or proposed to be made in regard to safety appliances, rules or operating, and in regard to accident cases and damages; to note especially where they are inimical or unjust to the companies, to draft new laws or amendments to obviate these defects, and to urge their passage in and by the Legislature.

11. To endeavor to have the Railway Commission of the state allow the board to advise with it in all matters pertaining to safety or accidents.

12. To endeavor to have boards of claim agents formed at once in all neighboring states and finally in all states, and to co-operate with them for mutual information and advantage.

The above was suggested as primarily the work or scope of the board, but the author believes that in time—and short time too—it will be found that the scope of the board will have to be enlarged and that its duties and powers will then be:

To have supervision of all the safety and accident business, both operative and legal, of all the companies included in it, with mutually agreed powers to enforce its decisions, instructions or recommendations; in fact to perform for all the companies that are part of it the same duties that are now performed by the separate claim departments, and to perform such duties immeasurably cheaper and better.

On motion of Mr. Cole, the subject matter was referred to the Executive Committee.

The meeting then took a recess.

AFTERNOON SESSION.

Meeting called to order at 2:15.

The first business was the reading of the following paper by F. O. Rusling, of Rochester:

THE USE OF OLD RAILS AS UNDERGROUND CONDUCTORS.

While the writer was the superintendent of the Buffalo Railway Company, serious indications of electrolysis of the pipes within a half mile of the power house made it necessary to call in expert advice to put a stop to the trouble. A careful and thorough electrical survey was made by an electrical expert. This was a long and difficult matter since there were three systems of natural gas pipes, two of illuminating gas, one of water and two conduit systems.

Although the pipes were already connected to the negative bus bar by large copper cables, it was found that these were entirely inadequate and that there were two points where the pipes at heavy

load were three to five volts positive to the adjacent rails. One of these points was 1500 ft. north and the other 1800 ft. east of the power house.

The expert calculated that until extensive changes could be made in rail returns, the former point would deliver about 1000 amperes and the latter about 3000. To bring this current to the dynamos with but five volts loss would need over $8000 worth of copper. While hesitating over this large expenditure, it occurred to us that there were about 300 tons of old tram rails on hand that might be used for the purpose. These were flat, center bearing rails, originally weighing fifty-six pounds to the yard, but worn down to fifty pounds or less; they were high in carbon, hard and brittle.

The best scrap price obtainable was $8 per ton delivered. Our expert carefully tested their conductivity with 1000 to 1500 amperes, using an instrument reading to .001 volt in order to secure accuracy. As the showing was satisfactory, he persuaded us to let him try the rails on the 1500 ft. length, which would require four rails in parallel to give the desired results.

As he guaranteed to bond them so as to make a continuous conductor, he was allowed to go ahead. A trench was dug between curb and sidewalk and a continuous trough of rough lumber put into it.

The rails were bolted together in pairs back to back, and arranged so that the end of one rail was at the center of its mate. The bonding was effected by scraping contact spots with a file near the end of each rail and amalgamating them with the Edison solid alloy. A steel washer ¼ in. thick, 1⅛ ins. inside diameter and 4 ins. outside, was dipped into hot insulating compound and placed against one rail so as to enclose the contact spot. The hole in the washer was then filled with the Edison-Brown plastic alloy, inclosing an amalgamated steel spiral spring. The upper rail was then bolted on and the completed conductor lowered to bottom of trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement, two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made sufficient to transit 1500 amperes. When the second set of rails was lowered into place, the trough was filled with a hot insulating compound and a cover nailed down. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather and has high insulating qualities. It is a product of petroleum distillation much lighter than asphaltum and costing about $25 a ton.

This four-rail conduit was connected up and carried at heavy load, 1100 amperes, 1500 ft., with a loss of but four volts. This result was so surprising that our expert suspected that his instruments were wrong, and sent them back to Weston for recalibration; they were returned, but proved that the measurements were correct. To appreciate the magnificent performance of these old rails and their bonds, I need only say that to give the same result, it would require 3.55 sq. ins. of copper, and 1500 ft. of this would weigh 20,532 lbs., and cost, at twelve cents per pound, $2,462.83. Our four rail lengths weighed fifty tons, and cost, as scrap, but $400. The resistance of steel, as compared with copper, is usually considered to be between 7 to 1 and 9 to 1, but this, including fifty bonds in each length, was about 5.63 to 1. The tests proved that the plastic bonds actually did make an "electrically continuous rail," and after a year's service, they are still maintaining their conductivity. This is more than can be said of any copper bond ever used. It will be noted that steel like this, even at $30 per ton, would be cheaper than copper as a conductor.

Our expert was then told to go ahead with the fourteen-rail conduit. As the steel was so hard and brittle, a great deal of time was required to file the contact spots and to bore holes for the bolts to hold them together, so another method was adopted. In the power house is an air compressor for cleaning out armatures and removing dust from the boiler house walls. An iron pipe was connected from the air reservoir to the yard, and a single layer of rails, bottom up, was put on each wagon. Each load was carried into the yard, and the contact spots were rapidly cleaned with a reciprocating pneumatic tool, borrowed from a boiler shop. To avoid drilling the rails, pieces of ¾ in. iron, about 24 ins. × 8 ins., were placed in the trough every fifteen feet.

These were bored at the ends for a pair of countersunk ¾ in. bolts and had four contact spots cleaned with an emery wheel. On these were laid the plastic bonds and four rails side by side, with base down.

The spaces between the treads were just right for a second layer of three rails bottom side up. Then another set of bonds and an iron plate ¼ in. thick, 20 ins. × 8 ins. On these more bonds, other layers of four and three rails and finally a ¾ in. × 24 in. × 8 in., top, bolting all layers together. The sides of the trough were but ½ in. from the rails between clamps so as to save wasting insulating compound, with wider spaces to accommodate the clamps. Rail joints were broken as before.

This construction allowed very rapid and satisfactory work compared with the first. The performance was also satisfactory, as the fourteen rails transmitted 3250 amperes, 1800 ft. with but four volts drop; an insulated pilot wire was put down with this conduit and permanently connected with a voltmeter in the power house. The rails used in this conduit weighed about 210 tons, which at $8 will amount to $1680.

It would require 12.48 sq. ins. of copper to equal the seventy square inches of steel. This copper, figured at 1000 ft. by one square inch, weighing 3854.2 lbs., would weigh 86,580 lbs., and at twelve cents per pound would cost $10,389. The total cost of the rails and bonds for both conduits was about $3322, as against $12,852 for equivalent copper. The labor to install the copper would, of course, be less, but on the other hand we had the rails in stock and the only actual outlay was for labor, bonds, lumber, bolts and insulating material. I have not the details of these now at hand; my recollection is that the total expenditure did not exceed $2500 and that we thus secured results which would otherwise have cost nearly $15,000.

From my experience with copper bonds I should not advise the use of buried rails for conduits if copper is used for connections. Even when new it is impossible to get the full conductivity of the rail and the contacts get worse and worse as time passes. The copper when covered with the damp earth will oxidize at a rate determined by the composition of the soil and the amount of current transmitted. But following the lines indicated on our second rail conduit, any road with a lot of old rails on hand can cut down its transmission losses at a slight cost.

There being no discussion on this paper, the meeting proceeded to consider the next paper, by Thomas Henning, of Buffalo, N. Y., given in extract below:

RAILWAY POWER STATIONS.

The first question of vital importance presenting itself in the construction of a power station will be the site. Should an experienced man be called upon to choose a site, it would cost a few dollars. For this reason inexperienced persons have at times done the work, and chosen the site, for the reason that it was in the vicinity of the work to be performed, regardless of the questions pertaining to fuel and water, or they may have chosen it owing to the contiguity of one factor and disregarding the remaining factors.

In the construction of a plant heavy losses are frequently borne owing to misplaced material, which being lost sight of necessitate duplicate requisitions. A clerical force sufficiently large to keep an accurate account of all material required, ordered, received and used, will pay a handsome profit on the outlay.

In operation we are again confronted with many wasteful outlets. The pumps may be kept in service without examination until convenience or absolute necessity compels action, the boilers with scale on one side of the tube and soot on the other, the steam pipe covering defective, the engines in service without overhauling until they quietly refuse to do further duty, the dynamo commutators rough or brushes not properly fitted to them, switches and loads of insufficient capacity, switches unclean, their faces rough and lug joints not properly made, the feeders inadequate for the work required of them, motor commutators and brushes neglected and finally the rails not properly bonded, if bonded at all.

I have known of instances of units having been kept in service under full loads and overloads (notwithstanding the fact that there were units idle) upon the theory that the larger the output from each unit the greater the economy. I believe that this is a delusion and should be avoided. It is not economical to overload any part of the plant unless absolutely necessary. When a weak spot is observable in any part of the system, repairs should be begun at the earliest possible moment. If allowed to run along until necessity compels them, it will prove to be a very expensive and a very dangerous practice.

In stations of 2000 h. p. or over, it will pay to extract the oil from the wipers. This may be done by enclosing them in a tank, into which a steam jet has been inserted. The oil upon rising to the top of the tank may be drawn off for purification, the wipers dried out and used again, and the operation repeated until the wipers are worn out.

There is nothing connected with a power station that will pay a larger dividend than cleanliness. If the station be kept scrupulously clean, the employes will take more interest in their work and the treasurer will not be called upon to pay for so many tools and other things lost and misplaced.

W. J. Clarke of New York, upon invitation of the president, contributed a paper on the general subject of electrical developments. Mr. Clark said in part:

THE STANDARDIZING OF ELECTRICAL APPARATUS.

Of course, it is fully understood that what is suggested herein is a more proper theme for action on the part of the National Street Railway Association, than that of any individual state, yet in street railway matters as in the National affairs, New York leads the way, so it is extremely proper that the reminder should be first given to you.

Unquestionably it would operate to your advantage, as it would most certainly to the electrical manufacturer, if some definite positive rule for the rating of all of the electrical apparatus were fixed. It makes but little difference what this basis of rating is provided it is universal, well understood and thoroughly insisted upon by street railway men; and I wish to be distinctly understood as not advocating the particular method of rating which has been followed by the corporation which I represent, but I do most emphatically place myself on record as being in favor of some system to be evolved through the wisdom of the street railway fraternity, and based upon such methods as may seem most just to them, which will fix definitely what a motor of, say, twenty-five horse power or 300 lbs. tractive effort is, or what, for instance, constitutes a 500 k. w. generator, and of even going farther than this and define the capacity of switches, circuit breakers, and kindred devices.

It makes no difference to the manufacturer whether some par-

ticular article of his production is called a horse or an elephant, providing his competitors' production, which should do the same work, is similarly designated. But, if he uses the term horse, and his competitor that of elephant, he is of course at a great disadvantage. While the purchaser, who may not be thoroughly conversant with the different terms as applied, may supposedly buy the larger animal, and when too late, discover that he has only secured a moderate sized pony.

The manufacturer who has used the larger term is not altogether to blame either, for no class of machinery has ever yet been produced which was susceptible to so many different methods of rating as electrical apparatus, and all of which may be considered honest, all such methods being entirely dependent upon the standpoint from which its producer views the matter; as, for instance, one producer may say, "I will rate a certain sized generator so that it will give a product of 300 k. w. continuously, and never rise to a dangerous limit of heating," so he calls this a 300 k. w. machine. Now, this very machine would, for instance, develop say, 400 k. w. capacity for a period of two hours without rising to a dangerous degree, so some other manufacturer says that in practical operation no generator ever had a continuous load up to its rated capacity, so a safe basis to go on is to rate the machine at what it will do for two hours, and he calls it a 400 k. w. The natural consequence is that some company buys a machine that is either larger or smaller than what they supposed they were purchasing, and if they are fortunate enough to escape paying more money than they should for a certain capacity machine, they are exceedingly liable to get tangled up on the proper sized engine unit to go with the machine and following in the wake of the transaction is the old story of engines being found too large or too small for the generators which they are coupled with.

What has been said on generator rating applies with equal or even greater force to the rating of street car motors; for even greater differences exist in defining their capacity than is met with in generator practice.

In natural sequence to the question of motors comes that of car wiring. It is customary with all the manufacturers of car equipments to furnish a liberal quantity of good material for this purpose, and as to a great extent the work of installing the same is done by railway companies themselves, troubles from this source are not nearly so numerous as formerly, yet there are cases where installation is done by manufacturing companies, car builders, and outside contractors, which would never pass inspection were the wiring done in any building of our larger cities. While the necessities for good work in this particular are, of course, far more apparent on a car body that is subjected to all sorts of movements and motions than in connection with the wiring of a building, the need of preparing for the last class of wiring was apparent years ago, and has been strictly followed ever since, so no argument is needed for the fixing of standard car wiring rules.

On standardizing switches, circuit breakers, and bus bars, etc., I can offer no better argument than to state that your engineers well know the carrying capacity of certain weights of copper on their line of work, and on the articles which I have mentioned the results should be as well known and established as any other feature in the transmission of current.

In conclusion, a word should be said on the important feature of protection against lightning. No detail of electric railway equipment costs so little, upon which so much is dependent as upon its lightning arresters. Defects in this particular may cause many thousands of dollars damage within an instant, so this question cannot be too carefully scanned and considered by your Association, and some standard fixed upon which will effectually protect your machinery.

H. A. Robinson then gave some notes on the management of accident cases as practiced by the Metropolitan Street Railway Company.

MR. ROSSITER: I would like to get some idea of how closely the car mileage is kept up in operation, and what might be called "dead-head mileage," and how it is arrived at.

MR. RUSLING: In Rochester, the mileage record is kept from motormen's cards, every line in the city is figured closely as to its length, and each trip is known as it is reported on the motorman's card, as he turns it in at night. The motormen that are taking cars from the different barns to the repair shop, make a note of that on a special card for that purpose. We do the same with the special cars. We find it comes very close to being a perfect record of every mile run on the road.

The president stated that an invitation had been received from W. Caryl Ely, president of the Buffalo & Niagara Falls Railroad, to hold the next convention at Niagara Falls; also that an invitation had been received from Saratoga.

On motion of J. P. E. Clark, it was decided to hold the next meeting at Niagara Falls, and that two days be devoted to the meeting.

The president appointed Messrs. Moffitt, Deming and Sliney a nominating committee.

The Nominating Committee reported, and the following officers were elected for the ensuing year: president, G. Tracy Rogers, Binghamton, N. Y.; first vice-president, W. Caryl Ely, Niagara Falls, N. Y.; second vice-president, John N. Beckley, Rochester, N. Y. Executive Committee, H. H. Vreeland, New York, N. Y.; John W. McNamara, Albany, N. Y.; Henry M. Watson, Buffalo, N. Y.; C. L. Rossiter, Brooklyn, N. Y.; secretary and treasurer, H. A. Robinson, New York, N. Y.

On motion of Mr. Moffitt, a vote of thanks was tendered to ex-Secretary Frick, for the able and efficient manner in which he discharged the duties of his office during the past year.

The meeting then adjourned to meet at Niagara Falls the second Tuesday in September, 1897, and the delegates started for a trolley ride to Ross Park, State Hospital, and other local points of interest terminating with a ten mile ride to Union. The trip over the line was a most enjoyable one and many encomiums were passed upon the excellent construction of roadbed and cars. A bountiful luncheon was served at the Casino, an attractive summer resort located about midway between Binghamton and Union.

The banquet in the evening was held at Hotel Bennett and was largely attended. Speeches were made by the Mayor of Binghamton, W. W. Cole, Joseph M. Johnson, Hon. Edmund O'Connor, Col. Sam Payne, Hon. C. F. Tupper and C. D. Hammond. J. H. Stedman, of Rochester, acted as toastmaster.

THE PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION

The fifth annual meeting of the Pennsylvania State Street Railway Association was held at Altoona on Sept. 2 and 3. There was a fair attendance of street railway men and others when the convention was called to order at the Casino, Lakemont Park, by the president, Hon. B. F. Meyers, of the Wilkesbarre & Wyoming Valley Traction Company. The attendants were welcomed in an address by the Hon. Martin Bell, on behalf of the Altoona & Logan Valley Electric Railway Company and the people of Blair County. To this address of welcome President Meyers replied in a fitting speech. The following papers were then read: "Long Distance and Heavy Duty Electric Railways," by F. W. Darlington, electrical engineer, of Philadelphia, Pa.; "Construction and Maintenance of Electric Railway Tracks," by George H. Neilson, of Altoona, Pa.; "Transfer Tickets," by J. H. Stedman, of Rochester, N. Y.; The unusual pressure upon these columns prevents the publication of these papers in this issue.

On the evening of Wednesday, the first day, a complimentary concert by the Altoona City Band was given to members and visitors of the Association, at Lakemont Park, by the Altoona & Logan Valley Electric Railway Company. The second day was devoted to an excursion over the lines of the Altoona & Logan Valley Electric Railway Company, and a trip to "Wopsononock." In the evening a most enjoyable banquet was held at the Mountain House, "Cresson."

The following officers were elected for the ensuing year: president, John Lloyd, of the Altoona & Logan Valley Electric Railway Company; first vice-president, Albert L. Johnson, of the Allentown & Lehigh Valley Traction Company, Allentown; second vice-president, Robert E. Wright, of the Allentown & Lehigh Valley Traction Company, Allentown; secretary, S. P. Light, of the Lebanon & Annville Street Railway Company, Lebanon; treasurer, W. H. Lanius, of the York Street Railway Company, York. Executive Committeee, John Lloyd, B. F. Meyers, S. P. Light, John A. Rigg and E. C. Felton. The place of meeting for the next convention was decided upon, and is Allentown, Pa.

THE OHIO STATE TRAMWAY ASSOCIATION

The annual meeting of the Ohio State Tramway Association was held in Mansfield, Sept. 23. There was a good attendance, and it is needless to say a most enjoyable time was had by all.

When the delegates and others in attendance had assembled in the morning at the Hotel Vonhoff, a trip over the lines of the company in electric cars was taken to several points of interest. After luncheon the business meeting of the Association was held and a visit was then made to the power station of the Citizens' Electric Railway, Light & Power Company where the machinery was inspected. A number of delegates also visited the car house of the company and the Aultman-Taylor Boiler Works. Supper followed at Hotel Vonhoff and the evening ended with an entertainment at the Park Casino.

The following officers were elected for the ensuing year:

President, A. W. Anderson, Youngstown; vice-president, Reid Carpenter, Mansfield; secretary and treasurer, J. B. Hanna, Cleveland; chairman of the executive committee, W. F. Kelley, Columbus.

The next meeting will be held at Columbus. A change has been made in the date of this convention. It will be held on the third Wednesday in June instead of the fourth Wednesday in September as has been the custom heretofore.

The Works of the Walker Company.

Cleveland, which through the efforts of its prominent citizen, Charles F. Brush, became perhaps the foremost city in this country in the development of the electric arc light, has always held a front rank as a center of electrical manufacturing interests. It has recently however, possessed more than usual interest to electric railway managers, as being the home of the Walker Company. The apparatus of this company, whose boast is that it is the only independent manufacturer of street railway and electrical apparatus in this country, has been adopted so widely and has proved so popular during the time in which it has been on the market, that a glimpse at some of the departments of the great factory in Cleveland, where the apparatus is constructed, will not be without interest.

FIG. 1.—VIEW OF THE WALKER WORKS.

Under the roofs of the extensive works of the Walker Company in Cleveland, where once was manufactured enormous cable apparatus for every section of the world, the workmen are still busily engaged in the manufacture of street railway apparatus. The works are so fully employed with orders that they are kept in operation every hour of the twenty-four. But the cable has given way to its old and now successful rival, electricity.

Surely, "times change and we change with them," and this old remark of Cicero was never more forcibly exemplified than in the present instance. A glance down any one of the three enormous bays of the works shows electrical apparatus of different kinds and in different stages of manufacture. Here, as shown on page 626 is a long row of men placing the motor armature coils in position, attaching the armature conductors to the commutators and placing on the binding wires; at another point the different parts of the controllers are being assembled; in another place are a pile of motors ready for shipment. One machine tool in the shop of great importance when cable machinery was being manufactured, was the pit lathe, used for turning the thirty-two foot drums used in the cable machinery. This lathe is eighty-six feet in length, twelve feet wide, and twenty-five feet deep, and is now an ideal machine for turning off the pole pieces of the immense 1200 k. w. generators of the Walker Company. These generators for direct connected use have fourteen poles and run at eighty revolutions per minute and can be handled in the lathe with great ease and dispatch.

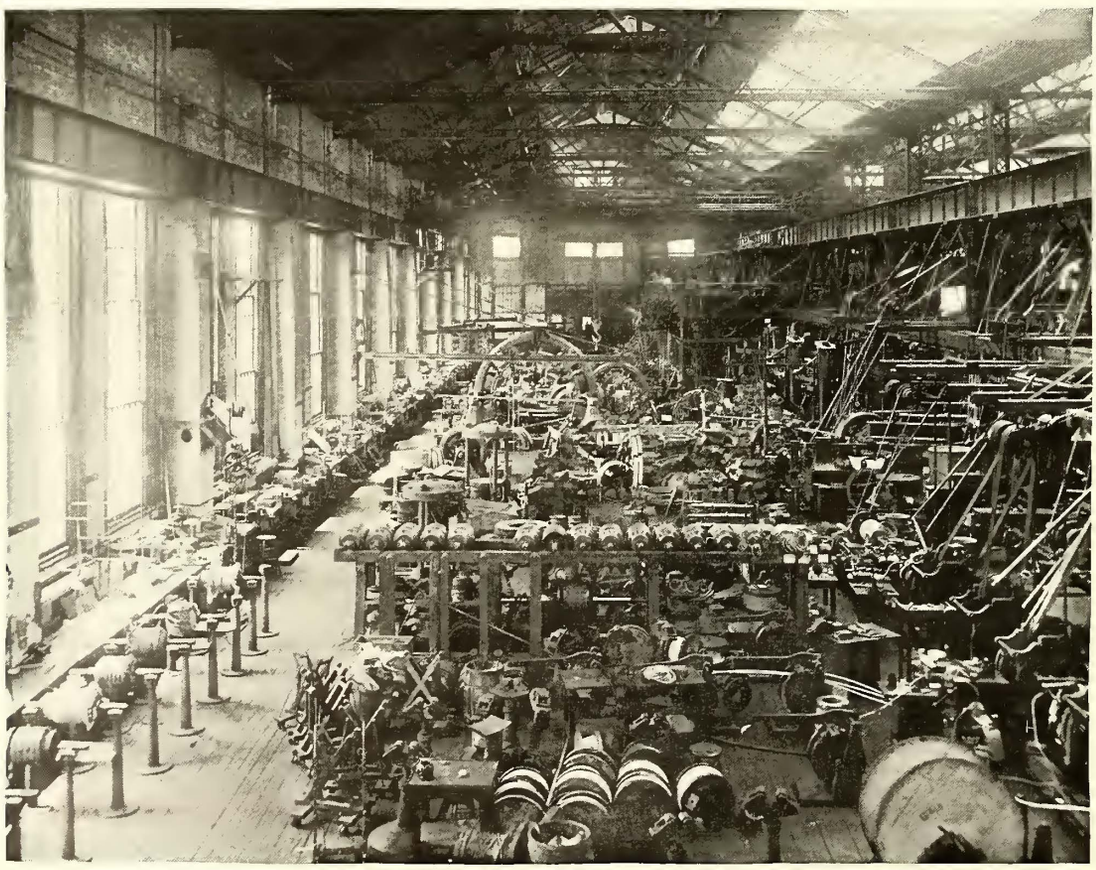


FIG. 2.—VIEW DOWN ONE BAY FROM GALLERY.

The construction of electrical apparatus is carried on at the Walker Works from the melting of the iron for the field castings to the final testing of the completed apparatus. The foundry has been described as the model plant of its kind in this country and is 300 ft. long, and 118 ft. wide and occupies three bays. The largest castings for electrical apparatus made here are the large spiders for the generator armatures and generator field magnets. The casting of the latter is an especially interesting process, the laminated pole pieces being cast welded into the frame. These pole pieces are made up of a large number of plates of soft, well annealed iron, about ⅛ in. thick. Each segment is punched with a slot in it to prevent cross induction. In the process of preparing the mould, and while the casting is being made, the pole pieces are held in a jig which keeps them in position while the metal is being poured. After the frames are cast they are taken to the machine shop for machining. The larger ones are bored in the giant pit lathe already mentioned to true the pole pieces. The generator is bored in an upright position, so that there is no danger that owing to its weight the work will not be perfectly true.

The casting of the spiders for the generator armatures is another very delicate piece of work, as that for a 1200 k. w. machine is

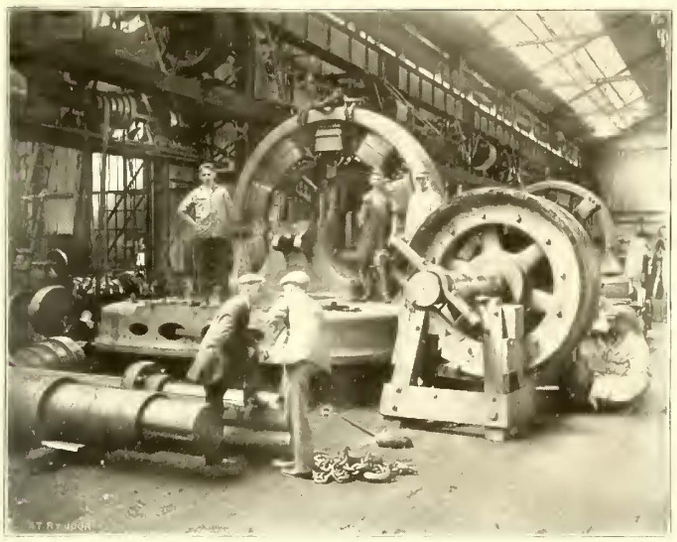


FIG. 3.

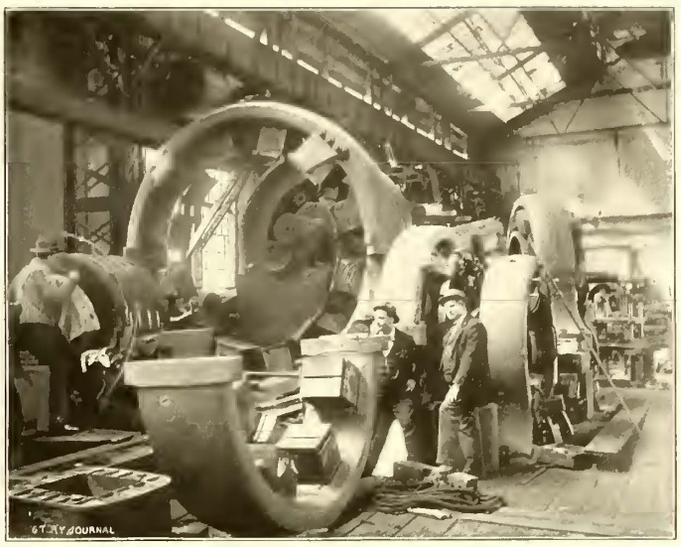


FIG. 6.

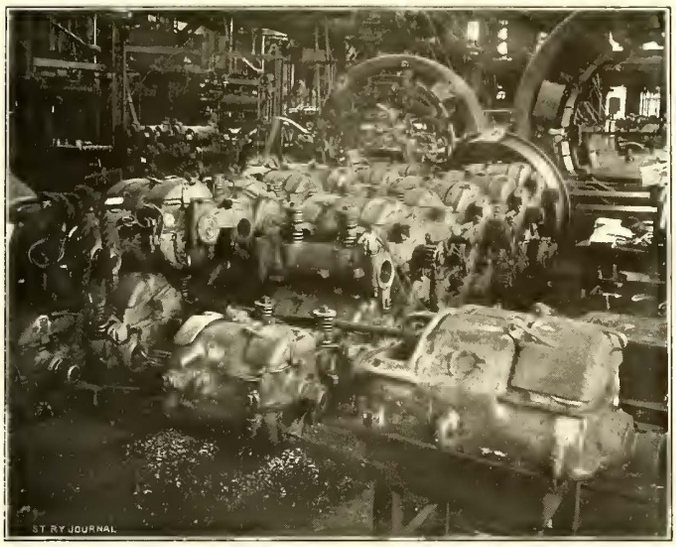


FIG. 4.

FIG. 7.

FIG. 5.

FIG. 8.

VIEWS IN THE WORKS OF THE WALKER CO.

between six and seven feet in diameter. The hub is not split, but is cast solid, a method claimed to be superior to the old way of casting it in sections. To eliminate all danger of shrinkage strains, the rims are not made solid, but the arms end in a sort of T head.

The armature plates, which are punched in segments out of soft, well annealed iron are secured by dovetailed projections, fitting into corresponding slots in the rim of the spider. Before placing the

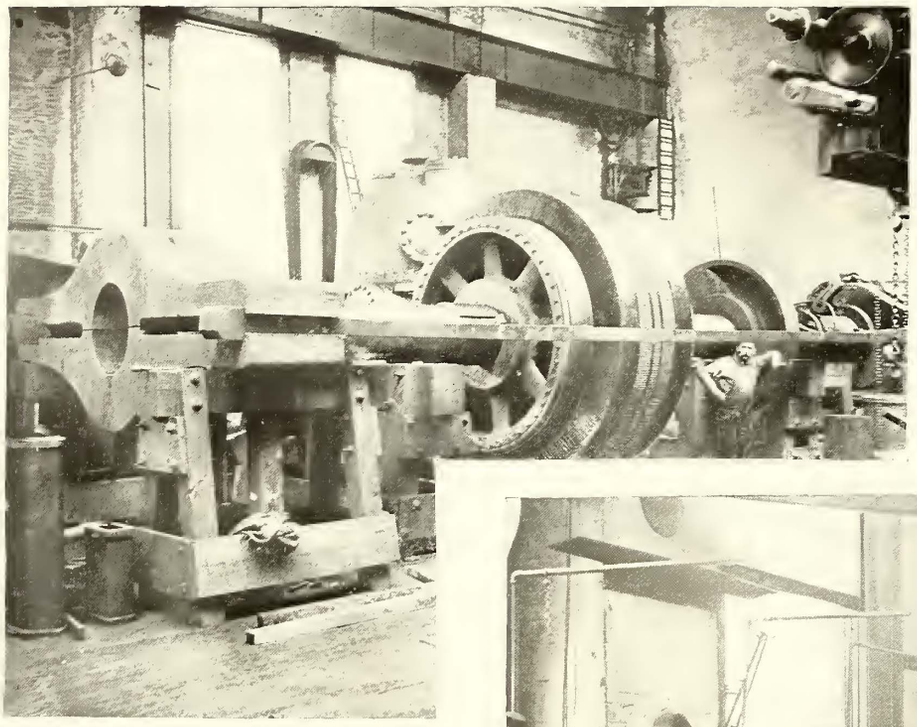


FIG. 9.—800 K.W. ARMATURE IN HYDRAULIC PRESS.

segments in position every other one is japanned to prevent the formation of eddy currents.

The excellent machinery equipment of the shop comes into valuable use in finishing the parts of these large generators, and many of the machine tools in use were built especially for the purpose for which they are now employed. This enables all parts, even the largest, to be finished both quickly and accurately, and has enabled the Waker Company to achieve the high reputation which it has gained for the excellent mechanical construction of both its generators and motors.

Some of the machines employed in finishing up the generator and motor parts are extremely ingenious in construction, and accomplish a number of results at the same time. For instance, one machine bores the motor frame and turns off the pole pieces, and at the same time, bores out the trunnions for the yoke.

The winding of armatures is carried on in a special department. For all generator armatures and for all motor armatures of over fifty horse power, the Walker Company uses flat copper ribbons in place of wires of the ordinary circular section. The ribbons are first cut to the length required for a single coil. They are then fitted to the proper shape by a special machine, designed for the purpose by the manager of the winding department, J. B. Elliott. This machine, which is extremely ingenious in construction, can bend the ribbon edgewise through an angle of 180 degs. on a very short radius without making a break in it. The terminals are then tinned, and the ribbons are straightened on the flat surface of a table. Several are then tied together, either two or four, depending on the size of the generator, and are placed in a wooden frame and bent to shape. They are then taped by girls.

FIG. 10.—A ROW OF ARMATURE WORKERS.

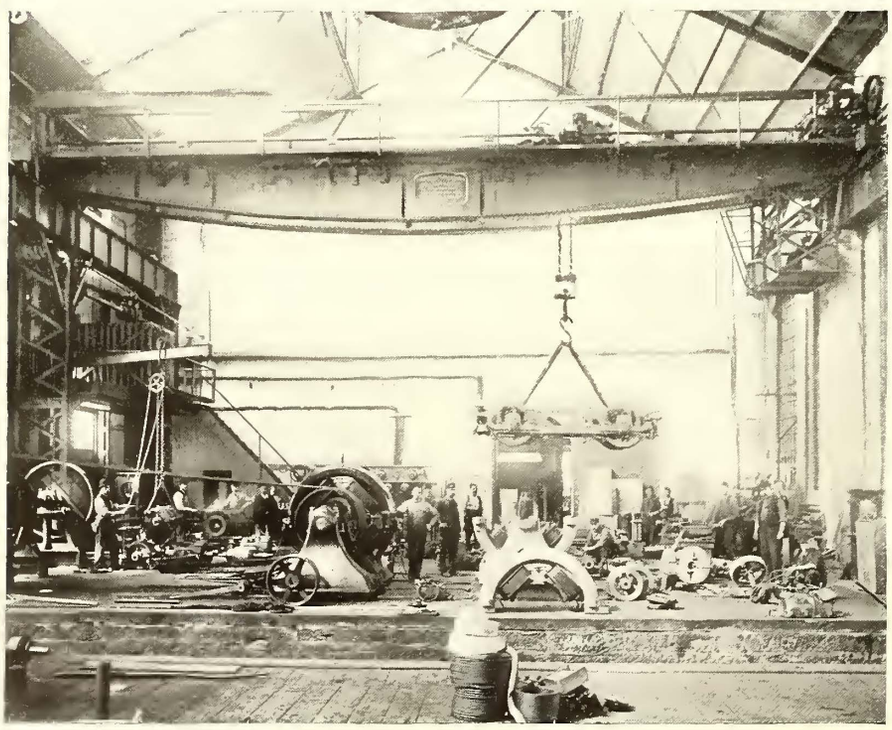


FIG. 11.—TESTING DEPARTMENT.

Samson tape is first used, a double layer of this being employed. Linen tape is then wrapped around the outside. When two parallel conductors are used in the same coil, fullerboard is placed between the two, and the same is then taped twice outside of the linen. With the seventy-five horse power motors, mica is then wrapped outside of the linen tape.

Fig. 3 shows a 400 k. w. generator armature in the process of winding. The trough in which the conductors rest when in the armature slot is composed as follows: first, fullerboard, then oiled paper, then mica, then oiled linen, then another trough of fuller board. The tape is protected by a hardwood strip in the top of the slot.

In the generator armatures flexible leads are used between the coils and the commutator bars. These leads are of copper soldered and riveted to the commutator bars. At each end of the commutator is a micanite ring $\frac{3}{16}$ in. thick.

The generator field spools are of iron with brass flanges. The spool is insulated with five thicknesses of .03 in. manilla paper and four layers of micanite all shellaced together. They are then wound and baked.

The motors are now made in six sizes ranging from 125 h. p. down. Every motor and every generator manufactured before it

leaves the works is assembled, and given a test by means of a water rheostat of from eighteen to twenty-four hours duration. All coils for both generator and motor armatures are tested with a 5000 volt alternating current before being passed.

The illustrations on page 625 are as follows: Fig. 3 shows in the foreground an armature and lower half of the field of a 400 k. w., 200 r. p. m. generator; the frame in the center of the picture is that of an 800 k. w., 80 r. p. m. machine; back of it is its armature. At the right are two small machines, one built for the Chicago & Englewood Electric Railway and designed for use with the Arnold-Quill system of direct driving. Fig. 4 shows a number of completed motors ready for testing. Fig. 5 illustrates

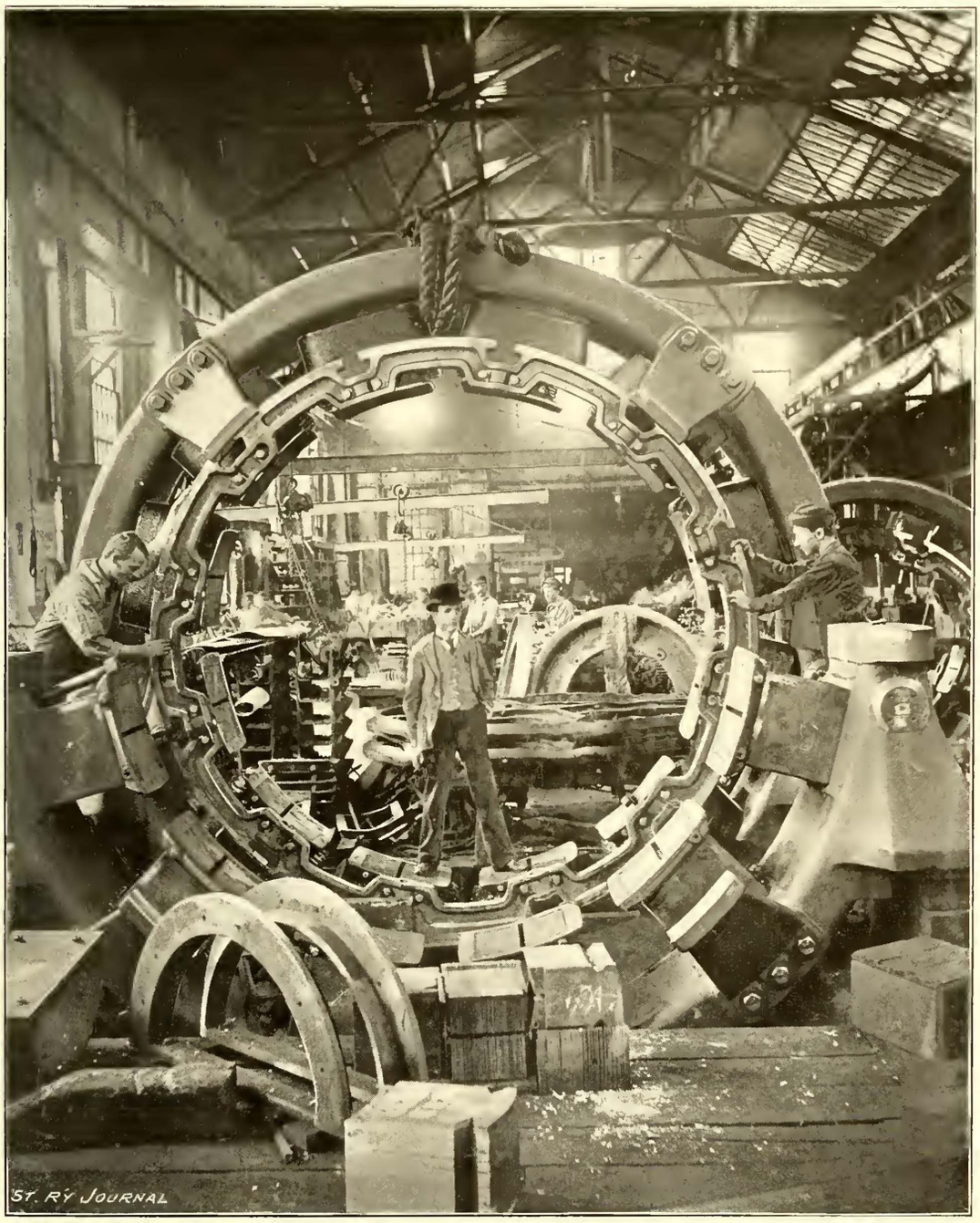


FIG. 12.—FRAME OF ROPE DRIVEN 800 KW. GENERATOR IN WALKER WORKS.

the draughting room of the company. Fig. 6 is a view in one of the bays of the machine shop. The machine in the foreground is an 800 k. w. generator for the Chicago City Railway Company; one of the armatures of this machine is shown at the right. This generator will be driven by ropes from the engine, and is a ten pole machine. Fig. 7 shows one part of the motor armature coil winding department, and Fig. 8 of the generator armature department.

On page 626, Fig. 9 shows an 800 k. w. armature in the hydraulic press; Fig. 10 a row of armature winders; Fig. 11 a part of the testing department. Another view of the works with the frame of one of the 800 k. w. rope driven generators for the Chicago City Railway Company is given on this page.

THE Buffalo Railway Company, of Buffalo, N. Y., has been granted permission to extend its lines.

Special Correspondence.

THE J. G. BRILL CO.,
PHILADELPHIA, Sept. 22, 1896.

EDITORS STREET RAILWAY JOURNAL:

The articles which have appeared in the STREET RAILWAY JOURNAL in relation to our new "perfect truck for passenger cars," have been very scientific and elaborate explanations of the new principles involved and the methods of application. The importance of the subject and the novelty of the construction justify me in attempting a short statement which can be quickly comprehended by busy and practical men who have no time for the more technical descriptions.

The truck is a new and radical departure from what has hitherto been the universal practice among car builders. It is the first improvement in the design of passenger trucks that has been made within the last twenty-five years. The new features are, first, the hanging of the equalizing bars upon the links so as to make them form a part of the moving motion, and second, placing springs in these links. In the swing motion or in rolling these links lengthen as the weight comes upon them and so prevent the bolster from pounding against the wheel piece. In ordinary trucks this pounding is a constant source of annoyance and danger. It is the cause of the quick and uncomfortable jerk always felt on entering or leaving curves.

The unusual ease of riding upon straight tracks comes from the fact that there are practically two sets of springs upon the spring plank, coiled springs under the elliptics which give an entirely different motion to the body from that of the ordinary elliptic. At the same time the journal box springs still further soften the riding of the car.

The increased spread of the equalizing springs in a longitudinal direction, which brings them nearly to the journal boxes has a great steadying influence upon the truck frame. The application of the brakes has little or no influence upon the springs and there is no tilting or "kicking up" in making a stop. This is a feature which adds largely to the comfort of the passengers. It also diminishes minor accidents among those who are leaving their seats as a stop is being made.

Greatly increased safety is found in the use of these trucks. This comes in the first instance because the distance between the links or points of support of the body is increased from eighteen to twenty inches. The angle of stability thus being greatly increased the tendency of the body to roll upon the springs is practically removed.

The trucks stay persistently upon the track, because while the wheels may have to change their direction of motion quickly, as at the entrance to curves, the body responds slowly, the elastic flexible connection between body and truck removing all shocks.

To show how well these trucks are performing I may mention the fact that the Akron, Bedford & Cleveland road has been using them in competition with many other trucks. After an exhaustive trial extending over a number of months the company is now replacing all these trucks with the "perfect passenger truck."

G. MARTIN BRILL, Prest.

THE Cincinnati Street Railway Company, of Cincinnati, O., will extend its Mt. Auburn line to Hartwell.

Motor Trucks and Cars.

The art of supporting passenger coaches on wheels is so old that it would seem that by this time all of the principles would have been determined. This is particularly true in regard to the support of long double truck cars for steam and electric railway service. As a result steam car trucks have for some time been patterned after precisely the same model and practically no improvement has been made in their construction since 1873. The attention of electric railway managers has, however, been directed to this subject with a great deal of interest during the past year or two, owing to the greater number of electric interurban lines projected and built in this country, most of which have desired to use a double truck car.

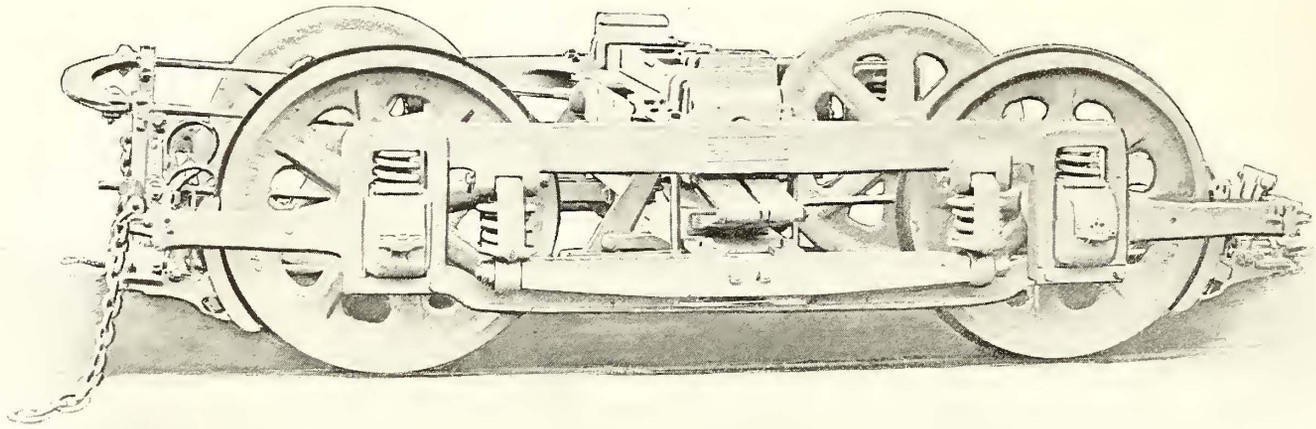


FIG. 1.—NO. 27 PERFECT TRUCK.

The theory of the American passenger pivotal truck for steam and electric railway service is that it is an independent carriage; its wheels are independent of each other in their vertical motion, while the truck frame itself can rise and fall at the ends or move sideways bodily without imparting any of these motions to the body of the car. Theory also calls for the extinguishment of the vertical motion of the truck by means of springs. A car considered as a carriage is supposed to be carried along in a plane parallel to the track, while the truck passes along the rails, conforming to their irregularities both horizontally and vertically, but without communicating any of its motions to the body.

The J. G. Brill Company which has always occupied a leading position in the development of electric railway rolling stock, both of car bodies and trucks, seems, however, to have discovered a new principle in the support of a double truck car body. These principles have been embodied in the company's new No. 27 Perfect truck. Thirty-two of these trucks are now in service on the Buffalo & Niagara Falls Electric Railway, and twenty-two of them on the Akron, Bedford & Cleveland road. There are also trucks of this type in use on several other roads. The cars carried have twenty-nine foot bodies, are thirty-seven feet over platforms, and weigh 29,700 lbs. These figures give a fair idea of what the truck is now doing.

The truck which is illustrated in Fig. 1 may be characterized as one with a wrought iron frame, having jaws forged on, with solid extension pieces, T-iron end pieces, angle iron jaw straps and angle iron transoms, with the spring plank formed of two Z pieces filled with wood. The equalizers are a part of the spring plank, carry the spring bolster, and take their load in the center; they are in turn carried by links and move with the swing motion. Eight inch journal box springs, nest spirals in the links, and quadruple or triple elliptics on the equalizer and spring plank furnish the vertical elasticity.

As will be seen, the differences between this truck and those now in use are principally as follows:

1. The swing links have springs on them and are outside the wheels.
2. They carry the equalizing bar.
3. The equalizer carries the spring plank and is an integral part of it.
4. The equalizer is a straight bar with the spring suspension at its extreme ends.
5. The load is carried at the center of the equalizer.
6. The truck frame is a forging.
7. The forged frame enables the manufacturers by means of low ends, to readily clear the draught timbers.
8. There are three sets of springs, in series, to carry the load, instead of two.
9. Motion from journals is cushioned by springs before reaching equalizers.

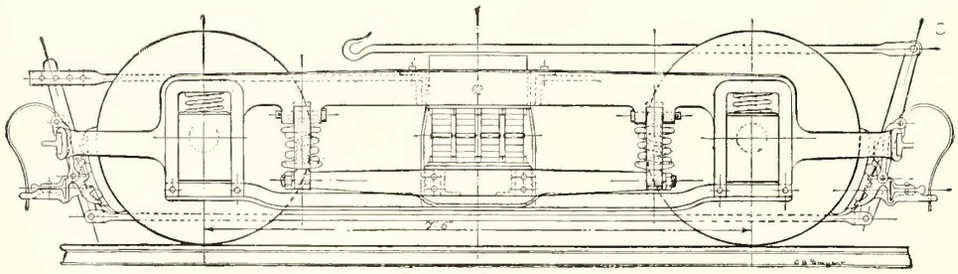


FIG. 2.—SIDE VIEW OF TRUCK.

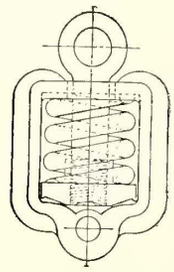


FIG. 3.—SPRING LINK.

The elliptics, spirals of the spring links, and journal springs are "in series," one set taking up motion, while the others cushion shock, etc.

10. The transoms of angle irons give additional room for motors on electric cars.

The advantages claimed for this truck are important and numerous. They are:

1. Side thrust is absorbed by greater transverse spring base.
2. Additional cushioning of the load in the spring links.
3. Springs directly over the journal boxes, reducing noise, jar and pounding of the joints.

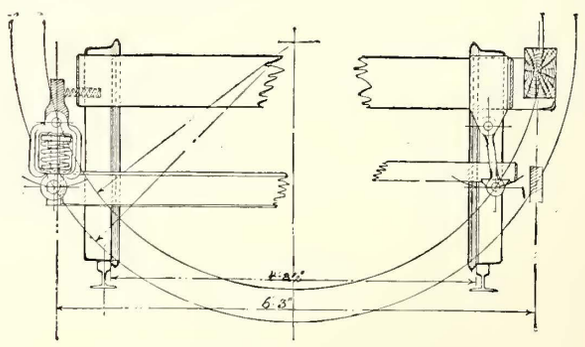


FIG. 4.—DIAGRAM OF SWING MOTION.

4. Reduction on the axles of the amount of weight which is unsupported by springs. No uncushioned load upon the journals.
5. Less lifting action when the brake is set, consequently less noise and jar in stopping.

6. Perfect equalization of the load on wheels, owing to springs of a draw-and-recoil character in the swing links, and because of the superior action of the equalizer.

7. Cushioning of the side motion by the swing link springs.

8. Reduction of lift of car body when the wheel rises.

9. Wheel piece, pedestal, wheel piece extension, solidly forged in one piece, which gives manifest economy of maintenance.

10. Straight low end pieces of truck frame clearing draught timbers and increasing strength.

11. Ability to shorten wheel base with same space for motors on electric cars.

The diagram (Fig. 3) shows the construction of the new spring link. It consists of a cast steel stirrup, in which there is space for an eight inch spiral. A follower is placed on top of the spring, and an eye bolt is screwed into it. The eye takes the end of the equalizing bar, which prevents the bolt unscrewing.

The spring links are a novel feature of construction, They differ from the ordinary link in position, action and in possessing elasticity. While they perform all the functions of the common swing link, they also cushion the side motion. These springs are double action spirals of the draw-and-recoil type. They are so placed that the motion of the journal is doubly cushioned before it

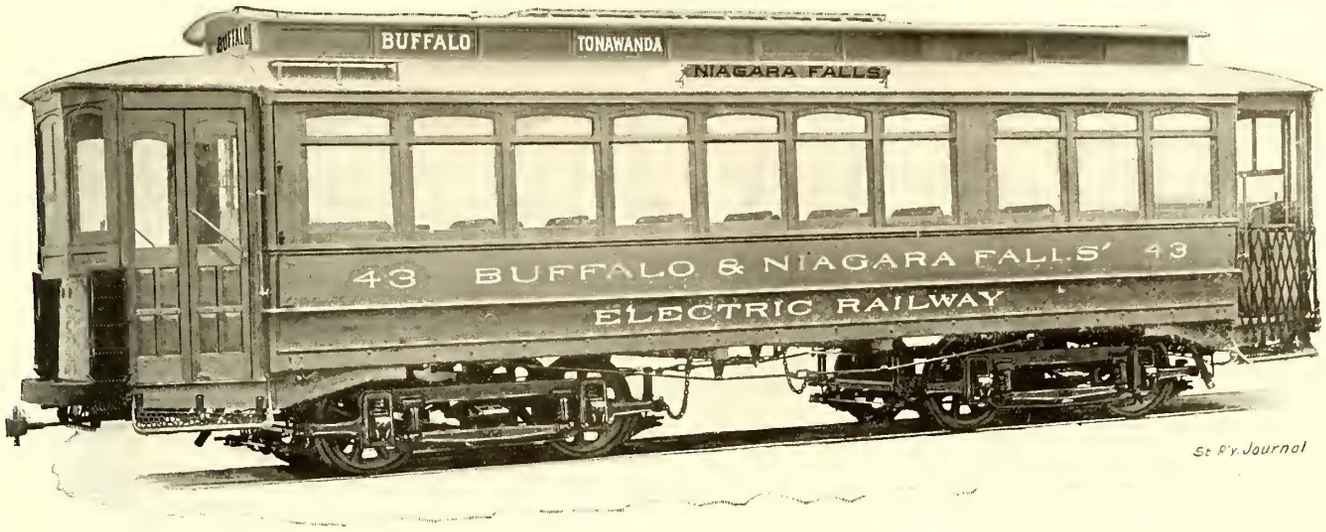


FIG. 5.—CAR—BUFFALO & NIAGARA FALLS RAILWAY.

The diagram (Fig. 4) shows the ordinary swing motion as compared with that of this new truck. The old style is shown on the right and that of the new truck on the left. In both cases the center plate is taken as the center of motion and support—the circles representing the lines of motion. With the old style of link the radius of motion is that of the inner circle. The radius of the outer circle is obtained by placing the hangers outside the wheel as shown. The motion, of course, will be slower in proportion to the greater radius, and correspondingly eas'er.

One of the novel and most ingenious features of the truck is found in the equalizers (Fig. 2). These are straight, forged bars, carried by spring links, or stirrups upon their ends. At the centers they are solidly connected with the spring plank. The equalizer, spring plank and swing bolster move together in the side motion. Its construction and disposition enable it to perform all that is possible for an equalizer. An ordinary equalizing bar is so in name only; it slightly reduces the motion of the wheels. In rare cases the movement of the body may be as small as three-quarters that of the journal, but this is all that can be expected. With the equalizer illustrated, all is accomplished that an equalizer can do theoretically, which is twice that of the ordinary form. This makes the motion of the car body at the king bolt only one half as great as that of the wheel.

The diagram (Fig. 3) shows the construction of the new spring link. It consists of a cast steel stirrup, in which there is space for an eight inch spiral. A follower is placed on top of the spring, and an eye bolt is screwed into it. The eye takes the end of the equalizing bar, which prevents the bolt unscrewing.

The spring links are a novel feature of construction, They differ from the ordinary link in position, action and in possessing elasticity. While they perform all the functions of the common swing link, they also cushion the side motion. These springs are double action spirals of the draw-and-recoil type. They are so placed that the motion of the journal is doubly cushioned before it reaches the equalizer itself. Their location is shown in the cross section (Fig. 4); it is one which brings them in line with the centers of the journals, giving a very wide base for the swing motion.

There are three sets of springs in the trucks. To use an electric term, they are placed in series. The weight rests on each set. There are double journal springs resting on the tops of the boxes. They also cushion the rapid motion of the truck frame before it reaches the equalizer, making this motion much more safe than in the usual form. Next above this in the order of load carrying come the springs in the links, and finally the elliptics.

The danger of jumping the track on curves, it is claimed, is practically eliminated, because the springs of the swinging links yield and prevent the blow which, with the ordinary type of link, comes with full uncushioned force when the bolster strikes solidly upon the wheel piece. The first trial made of this type of trucks was upon an interurban electric railway, of twenty-five miles' length, where, at an unusual speed for such service, and in spite of very narrow treads and shallow flanges and curves with thirty-five feet radius, its adherence to the rails has been perfect.

The construction and hanging of the brake is such that there is claimed to be no lifting and thumping when the brakes are applied—a feature which adds greatly to the comfort of the passengers.

This No. 27 truck answers not only all the requirements of

FIG. 6.—CAR—PEOPLE'S RAILWAY, ST. LOUIS.

steam passenger service, but is said to be equally well suited for street railway work where a pivotal truck is desirable.

The truck is peculiarly well adapted for service on all suburban or interurban lines, where height is not important, and where the car wheels have narrow treads, necessitated by being used on rails with narrow heads, with projecting paving on the city portions of line, run on both T rails and trams because of the tenacity with which it clings to the rails at all speeds and under all conditions. The low ends of the trucks enable it to swivel clear of platform timbers and steps. The frame is of such a character as to give a short wheel base for a given size of motor. The motors are carried from the transoms on springs.

Having discussed the new work of the J. G. Brill Company in the line of trucks, reference should be made to the magnificent showing made by the company during the last year in the construction of cars. The position taken by the company in this department has been a prominent one and Brill cars are now common in nearly every large city in the country and in most of the smaller ones. Several of the company's cars are illustrated elsewhere in this issue in the article upon "Street Railway Cars of the United States." In the engravings on page 629 are shown several other cars built by the company during the past year.

The cars for the Buffalo & Niagara Electric Railway have attracted much attention in a variety of ways. The fact that a large number of them are upon No. 27 trucks gives them especial interest.

These cars are 29 ft. long and 8 ft. wide at the belt rails. They have side sills of yellow pine 3 4½ ins. × 6¼ ins., plated with ½ in. 5½ in. iron, and end sills of oak. The framing is of the standard type of the Brill Company which in this style of car has a heavy truss plank 1¾ ins. × 9 ins., at each side beneath the window rail The stringers, two in number, are 3½ ins. × 5⅜ ins. and run the

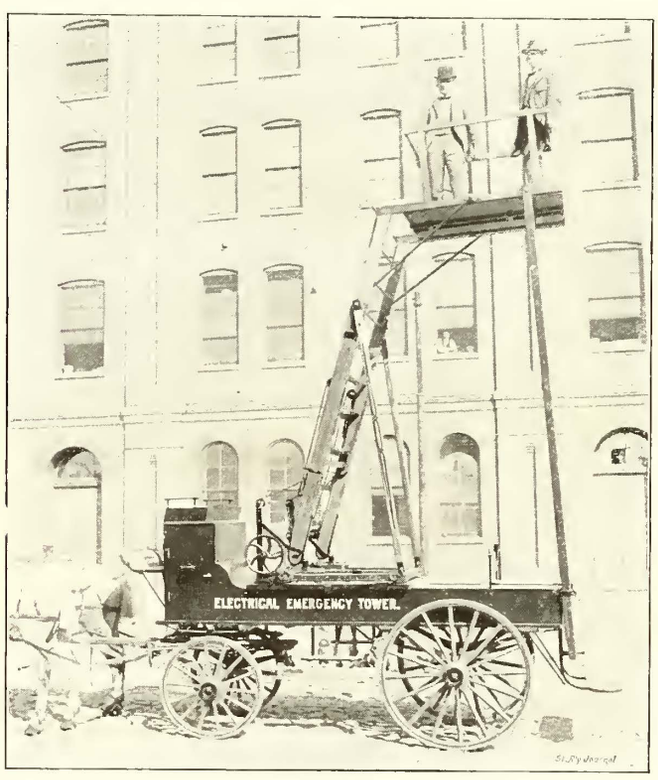


FIG. 3.—PARTLY EXTENDED AND ADJUSTED FOR HEAVY WORK.

entire length of the car, There is also an inside truss rod for holding the ends of the car up and the sides of the car from giving out, and a tie rod for holding the corner posts and keeping the frame solid. The usual outside truss rod is also used. The trimmings are of bronze throughout. The seats are reversible, rattan covered, and there are ten on each side, giving a seating capacity of forty passengers. The cars are finished in cherry and have birds-eye maple decorated ceilings.

The exteriors of the cars have but little ornament, but are very neat. The platforms have removable vestibules which are closed by double doors. The platforms are also closed by gates where the doors are not used, the latter folding up against the outside of the dash. The windows are furnished with curtains.

Fig. 6 shows a single truck car built for St. Louis, to go on the Fourth Street & Arsenal route, People's Railway, of St. Louis.

The body is twenty feet eight inches long. The platforms are closed on one side and are four feet long, making the car twenty-eight feet eight inches outside the crown pieces. The car is mounted on a No. 21 E truck, with a seven foot six inch wheel base and solid forged frames. The wheels are thirty-three inches in diameter. The platforms are protected by extra high lazy tongs gates, with patented link connections. These gates are made to fold against the body of the car. The windows of these cars are protected by a wire screen going the whole length of the body, a feature made necessary by the fact that the cars are necessarily wide and operated where the tracks are laid close together, and finished in wire and are reversible.

The company has also done a large foreign business. Among its other orders from abroad filled during the last few months is one for the complete equipment of the new electric railway at Cape Town, South Africa, put in operation during August. Engravings of the cars used on this line were published in the April issue of the STREET RAILWAY JOURNAL.

Convenient Tower Wagon.

The Leonhardt revolving tower wagon, built by the Leonhardt Wagon Manufacturing Company, has recently been improved and is now put on the market by Messrs. Ives & McClernan, of Baltimore.

As shown in Fig. 1, it is very compact and when the tower is lowered it does not project beyond the rear of the wagon, thus taking up very little room in the street. The tower is easily raised and can be made any desired height up to twenty-four feet. It can be made to stand on the side of the track four feet from the latter, permitting the widest cars to pass while work is being done on the line. The platform can be braced in case heavy materials are carried on the platform as shown in Fig. 2. The wagon is not top heavy, and

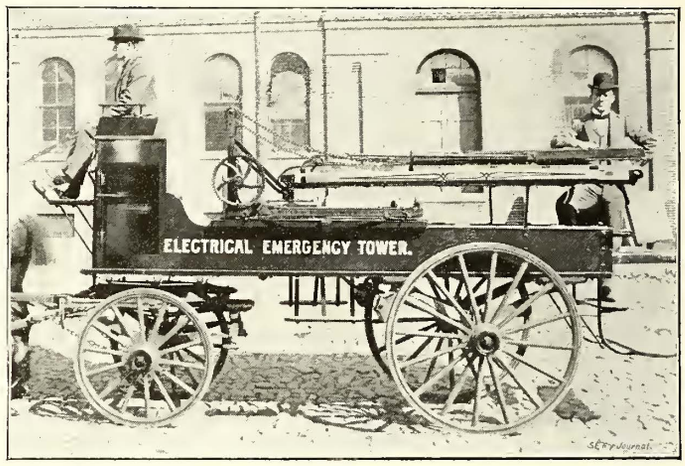


FIG. 1.—TOWER LOWERED AND FOLDED.

when lowered no part projects above the driver's head, the highest point being less than eight feet from the ground. This permits fast driving through the streets without danger of upsetting. The tower

FIG. 2.—TOWER RAISED.

can, of course, be revolved and when in the position desired can be locked in place.

The wagon is fitted with appliances for fire and wrecking purposes in addition to everything necessary for construction, having ten separate compartments for tools, wire ladders, hose bridges, and block and fall. It can be constructed to run on any gauge. It is built in three sizes, all of which will be shown at St. Louis.

Laclede Car Company.

During the past four or five years several thousand freight cars on the principal trunk lines of the country have left St. Louis, bound for all parts of the United States and bearing upon their platforms the street cars of the Laclede Car Company, of St. Louis. Few companies manufacturing for the street railway field have met with more pronounced success in making friends and securing large orders than this company has done since the days when electric traction first began to make its severe demands upon the street car builders of America. The Laclede Car Company was among the first to adapt the methods of construction, formerly in vogue in the days of horse cars, to the new conditions of mechanical traction.

The company was organized in 1883 by James P. Kiely and others, and Mr. Kiely has been the company's president during its entire life. For several years the company built cars on a small scale, but in 1888 it received its first large orders—large for those times—from Kansas City, St. Paul, Minneapolis and Denver. In 1891 there came a change in the personnel of the company, and the present organization was made, Mr. Kiely remaining as president and Thomas F. Colfer as treasurer, while the "new blood" introduced consisted of Edward I. Robinson, who became vice-president and general manager and Abe Cook, who became secretary and who has also general charge of all purchases. Mr. Robinson has made the company's name known to street railway managers all over the country and has been an active instrument in securing its large and constantly growing business.

Since July 1, 1891, the company has sent to Philadelphia 1001 cars on twelve successive orders; to Cincinnati 496 cars on twenty-nine orders; to Pittsburgh 380 cars on twenty-seven orders; to New York City 227 cars on three orders; to Jersey City 176 cars on seven orders; to Buffalo 110 cars on three orders; to Washington, D. C. forty-seven cars on four orders; to Baltimore forty-four cars on four orders; and to Binghamton, N. Y., nineteen cars on six orders. This gives only a slight indication of the company's business, but it is sufficient to show the distances to which Laclede cars have been sent, as well as the satisfaction given by the cars originally ordered, leading, as is seen, to many additional orders.

The company's shops are located in North St. Louis between Broadway and the river in a section where the railroad facilities are practically perfect. The plot of ground on which the works are situated is 300 × 514 × 260 × 517 being thus slightly irregular in in shape. In addition to this the company has an extensive lumber yard covering 26,500 sq. ft. of ground in which is kept a large stock of selected lumber of all kinds thoroughly seasoned by air and sun for many months before use. The lumber yard is shown in Fig. 6.

FIG. 1.—MACHINE SHOP.

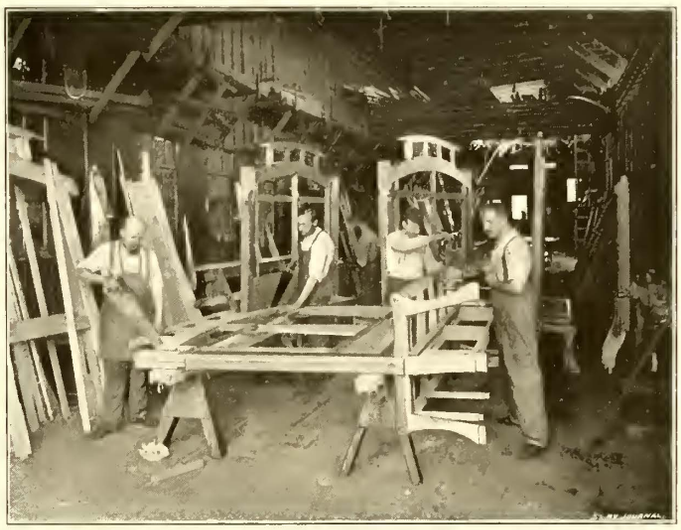


FIG. 2.—FRAMING THE BULKHEADS.

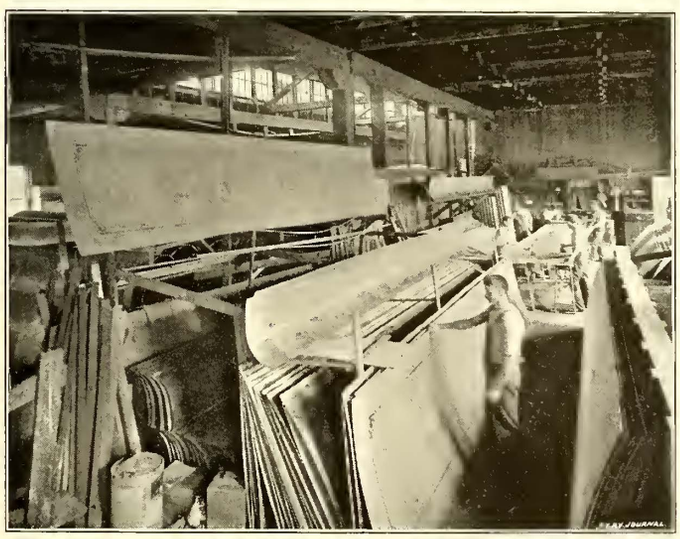


FIG. 3.—VARNISH AND PAINT SHOP.

FIG. 4.—LAYING-OUT ROOM.

SCENES IN THE SHOPS OF THE LACLEDE CAR COMPANY.

The general plan of the works is shown in Fig. 9 and illustrations of different portions of it are shown in Figs. 1 to 8. The main feature of the company's shop plan is found in the way in which cars are built from the foundations up in one place—the erecting shops—where also they are painted and made ready for shipment. This obviates the necessity of moving the cars from shop to shop, as the work progresses and it is thus possible to reduce the labor account quite materially.

Every effort is made by the company to build the most perfect car possible to produce, and no reasonable expense is spared to bring about this end. Some idea of the character of its work can be obtained from the illustrations. It will be seen, for example, from Fig. 4 that timber of great length is used so as to avoid splicing and consequent weakening of the car structure. In Fig. 2 the bulkheads of an open car are shown in process of construction and in

Fig. 3, is seen a stock of birdseye maple ceilings of great beauty in grain and finish. As before intimated, the peculiar and interesting feature of the Laclede shops lies in the number and extent of the erecting shops, which have a capacity for 100 cars at a time. In Fig. 8 can be seen a portion of an order for open cars received from the Consolidated Traction Company of Pittsburgh, Pa., for its 1896 summer business.

The Missouri Car & Foundry Company.

The Missouri Car & Foundry Company was organized in 1868, and commenced business as builders of railroad, freight and baggage cars together with the necessary trucks and wheels. Its business in its railroad department has been constantly on the increase, so that to-day its works cover an area of 20 acres, and consist of buildings of all kinds, together with wood and iron working machinery designed especially for the production of cars. Its foundries cover an area of 7 acres and have a capacity for turning out about 10,000 railroad, and 5000 street railway wheels per month.

The way in which the company was drawn into the street railway branch of its wheel business is interesting. Five or six years ago St. Louis began to be a great street car building center, and the Laclede, Brownell, St. Louis, and American Companies' cars were shipped in large numbers to all parts of the country. Naturally enough, the car companies were drawn into the manufacture of trucks, and naturally also, they appealed to the Missouri Car & Foundry Company to make the wheels for these trucks. This was done at first more as a matter of accommodation than with the expectation that the street railway branch of the company's business would assume large proportions, but before long the company began to receive orders for wheels from all parts of the country, not only from those Western, Central and Southwestern States which look naturally to St. Louis as a base of supplies, but even from the Atlantic and Pacific coasts. These orders were received with considerable surprise, the company's officers never having made any attempt to reach street railway companies, and hardly understanding how it should be known that they were in the street railway business. They found, however, that their street railway wheels had been making records in service which had been until then unknown on the roads to which they had been sent under St. Louis cars, and the managers of these roads had determined to order more of the same kind. The company then made a thorough investigation of the field, and finally concluded to develop this branch of the business with care and thoroughness, though it was for a long time a matter of doubt as to whether the general indisposition of street railway managers to discriminate between good and bad wheels would give the company a chance to secure business in competition with others in the field

The company is fortunate in having at the head of its foundry a man who, through many years of experience with all kinds of irons, has come to understand the mixing of brands and the way to secure any desired results, to an extent surpassed by few iron founders in this country. The Missouri Car & Foundry Company's railroad wheels are favorably known on nearly all of the great Western railroad systems—the Missouri Pacific, the Wabash, the Chicago & Alton, the "Big Four," the Chicago, Burlington & Quincy, the Missouri, Kansas & Texas, the Vandalia, the Iron Mountain, the Cotton Belt, the Baltimore, Ohio & Southwestern, and the Nashville, Chattanooga & St. Louis, being only a few of the number—and its output of railroad wheels averages over 100,000 per annum. This company was one of the first to recognize the peculiar character of street railway traffic, and the differences in mixture required in casting the wheels in order to comply with the new conditions. He was also among the first to insist that many street railway managers were making a mistake in using too light wheels, and the company universally recommends wheels not less than 350 to 400 lbs. in weight for any class of electric service, while for high speed interurban service 500 lb. wheels it believes to be none too heavy.

The company uses the best No. 3 and No. 4 charcoal iron as the basis of its mixture, on account of their chilling qualities and their toughness and durability. No. 1 and No. 2 irons would make a strong wheel, but would not have good wearing qualities. In the general superintendent's opinion toughness is more important than hardness, and a special effort is made to obtain this desirable quality in the finished wheel. A certain amount of "cold blast" iron is also used in the mixtures together with one-half or one-third of select scrap, chiefly old wheels, in judging of which from the fracture the general superintendent is an expert. Much care is taken also in the

FIG. 7.—CABINET SHOP.

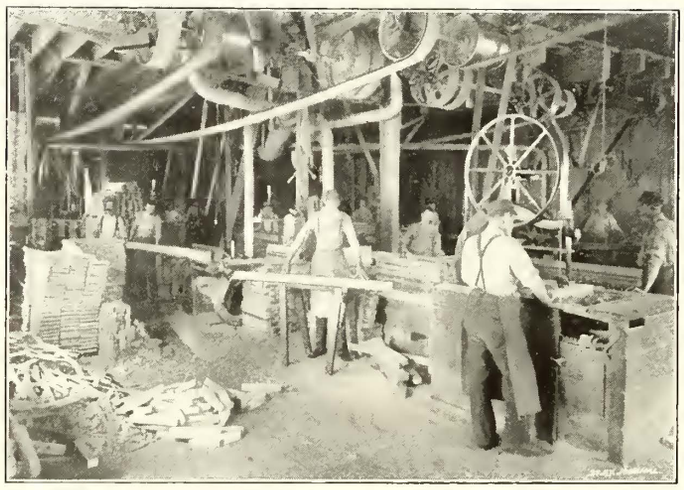


FIG. 5.—ONE OF THE MILLS.

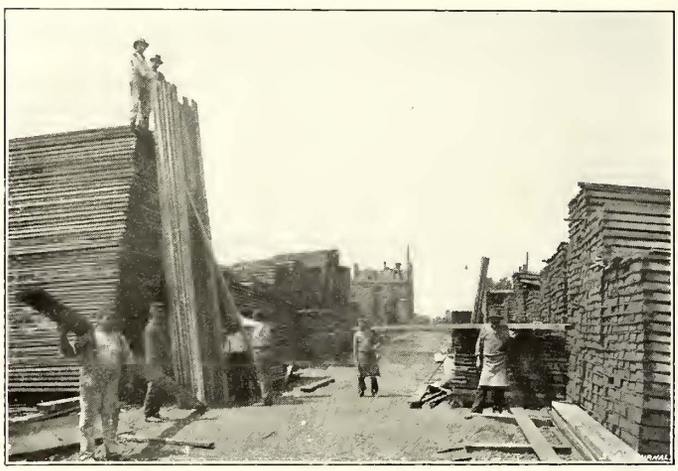


FIG. 6.—LUMBER YARD.

SCENES IN THE SHOPS OF THE LACLEDE CAR CO.

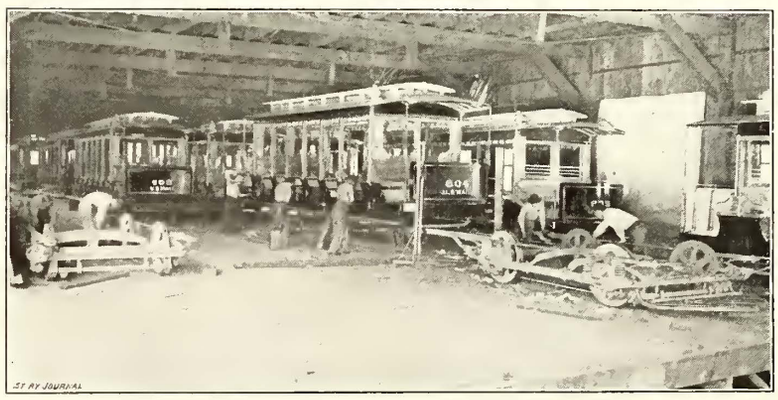


FIG. 8.—ERECTING SHOP.

selection of the coke employed in melting so as to avoid sulphur, which would be liable to mix with the iron. The iron is poured very rapidly and at a high heat, and the wheels are annealed for five or six days, after which they are removed from the annealing pits, and are then cleaned and ground, taped, mated and marked.

The company has been exceedingly successful in its street railway business, among those who have purchased its wheels being the principal systems of Atlanta, Brooklyn, Cincinnati, Columbus, Detroit, Evansville, Ind., Galveston, Indianapolis, Los Angeles, Louisville, New Orleans, Portland, Ore., Sacramento, Seattle, San Antonio, Tex., San Jose, Cal., Toledo, O., together with nearly all the roads in the Central and Western States.

The company's street railway business in St. Louis has been particularly large, all the companies in the city, with one exception, being its regular and exclusive customers, and the records of its wheels in St. Louis have been most gratifying both to purchaser and manufacturer.

The company's officers are William McMillan, president, who has been connected with the company since its organization; W. K. Bixby, vice-president and general manager, one of the best known business men of the country; Scott H. Blewett, secretary—a man who has made himself the personal friend of most of the street railway managers of the West—Melville Sawyer, treasurer; W. T. Hazzard, auditor; D. McCool, second vice-president, and William N. McMillan, assistant general manager.

A. S. Partridge.

Few men in the street railway supply business are better and more favorably known than Arthur S. Partridge, of St. Louis, who is one of the local entertaining committee. Mr. Partridge is a St. Louis boy, and has been identified with street railway work for a number of years in various lines and capacities. About five years ago he started in business for himself, after having been connected with a large car manufacturing company and a local supply concern. A careful business training, strict integrity and a pleasing personality have been the leading factors which have enabled Mr. Partridge to build up a successful business. From the beginning of his business he has been a strong advocate of high class goods, goods that could be safely recommended and guaranteed, and when sold stay sold, become standard and sell others. He early appreciated the truth of the old adage, "The best is none too good," and therefore made it a rule not to waste his efforts or cheapen his reputation by handling inferior goods at any price. Among the principal and more important lines that he handles are gears, pinions, bearings, trolleys and trolley repair parts, manufactured by the R. D. Nuttall Company; micanite rings, segments, troughs and special micanite products of the Mica Insulator Company; hard and soft drawn copper wire, feeder wire and magnet wire of every description, made by the American Electrical Works; stamped mica segments and washers, sheet India mica and India mica cut to exact size and shape, imported by the largest mica dealers in the world, viz., Eugene Munsell & Company, the well known self lubricating carbon brushes, manufactured by the Partridge Carbon Company; iron and steel poles, plain or ornamental, made by Morris, Tasker & Company; Empire oiled paper, cloth and linen, being one of the best materials for insulation, and which is manufactured by the Mica Insulator Company; coil, elliptical and springs of every description, made by the Charles Scott Spring Company. The above are only a few of the well known reliable concerns whose products are handled by Mr. Partridge. A glance at the list convinces the reader at once that they are the representative concerns in each line. Mr. Partridge also deals in high grade second hand material, such as rails; cars, motors; dynamos and generators. Mr Partridge enjoys the friendship and esteem of all the street railway managers of St. Louis and the territory tributary to the same. He is a strong home body, has a most estimable wife and very pleasant home.

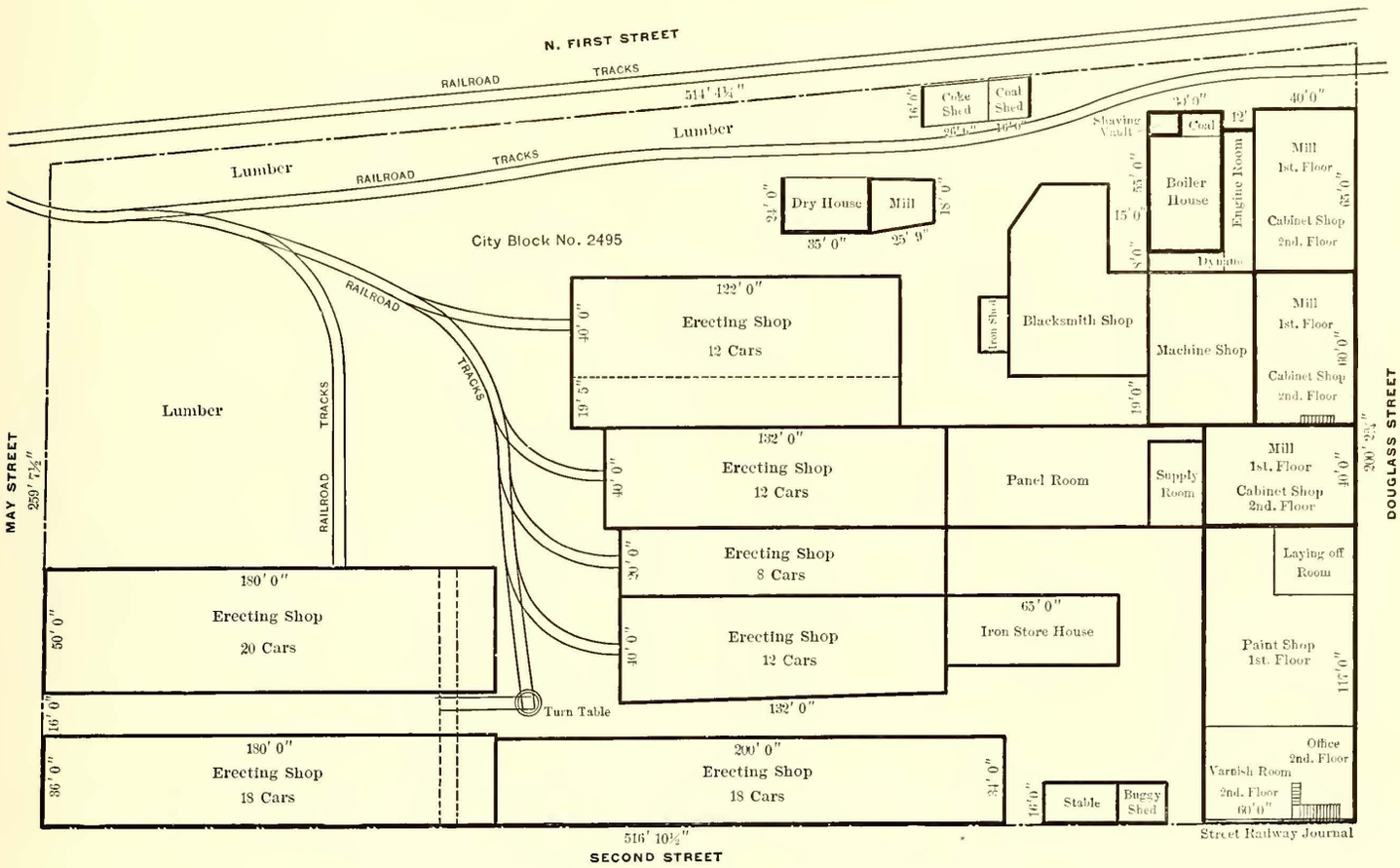


FIG. 9.—PLAN OF SHOPS OF THE LACLEDE CAR COMPANY.

Carbon Brushes for Motors.

One of the most important features in the successful operation of electric cars is the motor brush. The signal success of the Phœnix motor brushes now used by many electric railway companies throughout the United States, makes a reference to this company particularly interesting. The works of the Phœnix Carbon Manufacturing Company are equipped with the latest improved machinery and appliances of the company's own design for the special manufacture of this product. The company has now facilities for making 5000 brushes daily.

The Phœnix Carbon Manufacturing Company was organized and incorporated under the laws of the state of Missouri, and has a paid up capital of $160,000. It not only manufactures brushes, but everything in the carbon line—electric light carbons, battery and telephone carbons, and all sorts of carbon specialties.

S. G. Booker, the genial superintendent, has been in the carbon business from the start, and has made it a special study in all of its details, and through his untiring energy and perseverance the company is in a flourishing condition, and is prepared to occupy a high place in the carbon field.

THE Southern Engine & Boiler Works, of Jackson, Tenn., will erect the steam plant for the Jackson Street Railway. The power is furnished by two 200 h. p. engines built by the Ball Engine Company, one for electric lighting and the other for railway service.

St. Louis Car Wheel Company.

One of the important manufacturers of street railway supplies which have chosen St. Louis as a home, on account of the proximity of the large coal and iron beds and the cheapness of other products, is the St. Louis Car Wheel Company, whose foundries are located in Mill Creek Valley, where railroad facilities are excellent. This is one of the "Bass foundries," so called, the company's president being J. H. Bass, who is also president of the Bass Foundry & Machine Works, of Ft. Wayne, Ind., and the Lenoir Foundry Company, of Lenoir City, Tenn. Mr. Bass also carries on a large business in Chicago under his own name. Through these different establishments he is able to supply a large section of the West with car wheels, axles, car and locomotive castings and general machinery and foundry products.

FIG. 1.—VIEW IN FOUNDRY—ST. LOUIS CAR WHEEL CO.

The St. Louis Car Wheel works have a capacity of about 450 car wheels per day. The larger part of this product is taken by a number of steam railway systems which have been the company's constant customers for a great many years. Among them are the Union Pacific, Chicago, Burlington & Quincy, Missouri Pacific, Illinois Central, Baltimore, Ohio & Southwestern, Burlington, Cedar Rapids & Northern, Chicago, Kansas City & Texas, Des Moines & Kansas City, Denver & Rio Grande, Evansville & Terre Haute, Iowa Central, Keokuk & Western; Louisville & Nashville,

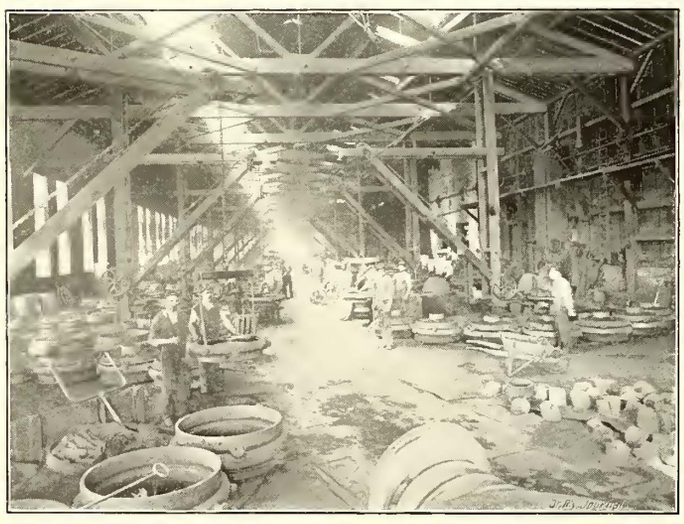


FIG. 3.—VIEW IN FOUNDRY—ST. LOUIS CAR WHEEL CO.

Los Angeles Terminal, Mobile & Ohio, Oregon Railway & Navigation, Terminal Railway Association, of St. Louis, St. Louis, Alton & Terre Haute, and others.

In spite of its large steam railroad business, the company pays special attention to the street railway branch, and its wheels have been sent to thirty or forty street railway companies in different parts of the country, among which are the following: Cedar Rapids & Marion City Railway, Colorado Springs Rapid Transit, El Paso & Juarez Railway, Fair Haven & New Whatcom Railway, Houston City Street Railway, Lindell Street Railway, Mobile Light & Railway Company, Mobile & Spring Hill Railway, Paducah Street Railway, Phœnix Street Railway; Pueblo Street Railway, Pittsburgh, Frontenac & Suburban Railway, Portland Consolidated Railway, Portsmouth Street Railway, St. Louis & Suburban Railway, St. Louis & Meremec River Railway, San Diego Electric Railway, Spokane Street Railway, San Francisco & San Mateo Railway, Springfield (Mo.) Traction Company, Denver Tramway, Leavenworth Electric Railway, Olympia Light, Power & Railway Company, Omaha Street Railway, Queen City Railway, of Dallas, Tex., and others.

The company makes wheels with both plain and contracting chills. For the latter class of work the form of contracting chill shown in the Fig. 2 has been designed. In this, as will be seen, the inwardly projecting plates contract on the periphery of the wheel in cooling and are made in a zigzag form. The object of this is to avoid the series of transverse ridges which are sometimes formed on the wheel with ordinary contracting chills, which produce more or less jar until these ridges are worn down.

The company uses various iron mixtures, according to the specifications of the different railway companies, but its standard iron is Rock Run (Alabama) charcoal iron with which is mixed a certain proportion of old wheels. The wheels turned out are exceedingly strong, as may be judged from a recent test. A 565 lb. wheel for the Chicago, Burlington & Quincy road was given twenty-five blows according to the Pennsylvania standard, in which a weight of 140 lbs. falls twelve feet upon the hub of the wheel; following this test the wheel was given 125 blows of the Chicago, Burlington & Quincy standard in which a weight of one hundred pounds falls seven feet upon the plate of the wheel. The wheel was finally taken to a large drop for breakage.

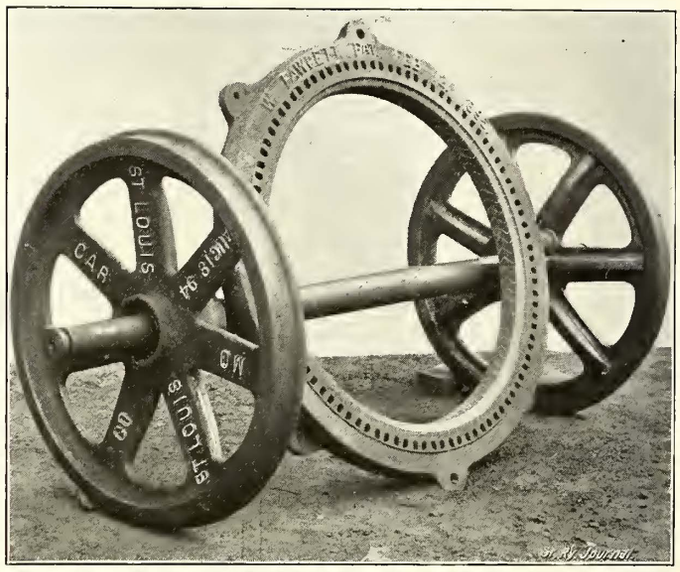


FIG. 2.—CONTRACTING CHILL OF ST. LOUIS CAR WHEEL CO.

The company's foundries are simple in design, but are conveniently arranged for turning out wheels. The main wheel foundry is 450 ft. × 80 ft. and is provided with twenty-eight cranes. The machine shop is 150 ft. × 60 ft. and the pattern shop 50 ft. × 60 ft. All the wheels are carefully ground, taped and mated before shipment so that they can be carefully paired for use on the same axle.

P. & B.

To the electric railway superintendent, car house foreman and master mechanic, two of the most useful letters in the alphabet are P. & B. The adoption of this compound of the Standard Paint Company has been very general. The variety of forms in which it is manufactured, tape, armature varnish, preservative paint, ruberoid car roofing, insulating papers and cloths, makes its application to different uses very convenient. As a result electric railway companies abroad, as well as in this country, have found wide employment for it.

The company has recently brought out a new material known as P. & B. Ruberoid motor cloth. The base of this material is strong canvas, making it much lighter in weight than the old style motor cloth which was on a burlap, more flexible, easier to handle and just as strong. The material used for saturating the canvas is the company's well known ruberoid, from which it manufactures the P. & B. ruberoid roofing that is now in use all over the world. This material will undoubtedly find an extended use during this season, for it is now that most railroads are making their winter repairs. For protecting the motors against the snow and sleet ruberoid motor cloth has been found very useful. It will last for a very long time, will not become brittle and crack, but remain permanently elastic.

P. & B. roofing is another product of the Standard Paint Company, which is growing in demand for use on car houses, stations and buildings of every description.

Shultz Belting Company.

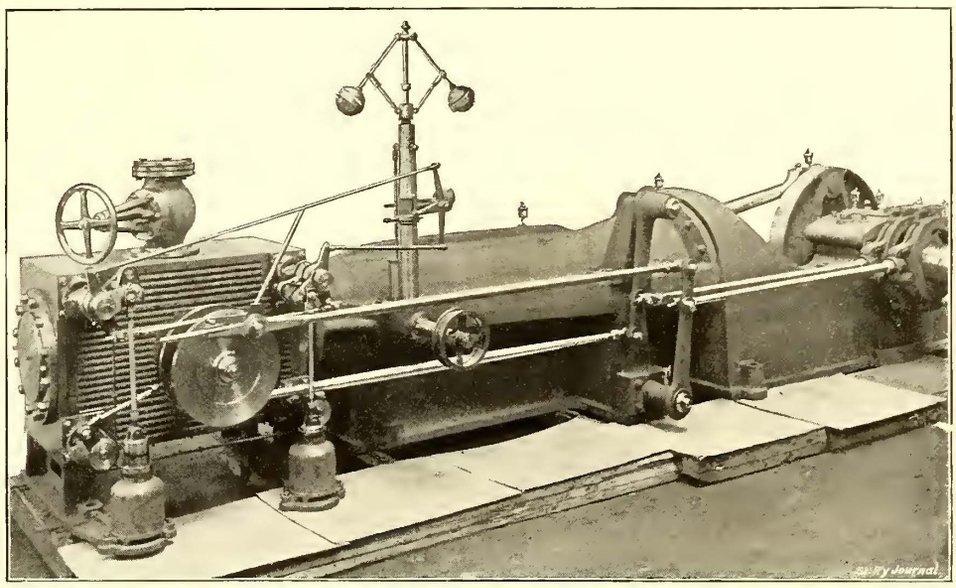
This company is regarded as the leading establishment of its kind in St. Louis. The business was founded by J. A. J. Shultz, and the superior character of manufacture gave the goods such demand that the productive capacity of the concern required frequent enlargements. The business was incorporated in 1877 under the title of the Shultz Belting Company. J. A. Shultz was made president; William J Millin vice president; B. C. Alvord secretary and treasurer. The paid up capital was $300,000 which enabled the company to carry on business on an extensive scale and to equip its plant with modern machinery and improvements. The building was specially designed for the company with an area 166 × 200 ft. and four, three, two and one stories in height. The establishment uses yearly over 30,000 hides.

The company followed an improved process of manufacture; it tanned the leather surface and left the interior untanned; this gave the belting the required pliability and durability, and a character of belting has been produced that has gained a world wide reputation as being one of the strongest and most lasting of any manufactured. The pliable character of this sable rawhide belting imparts to the interior of the rawhide all the advantages of tanned goods and retains the strength and durability of the raw material. Its soft texture enables it to remain on the pulley and its extraordinary power gives it wonderful driving force. It is well suited for heavy and rapid usage on pulleys of all sizes. Such is its availability and adaptation for mechanical purposes that it has surpassed other kinds in many factories in different countries. The belting is twice stretched before it is connected and every process for enhancing its superiority and preserving its value is observed. The company not only has a profitable trade among the manufacturing centers at home, but ships its goods largely to European markets. During the month of September over 40,000 ft. of belting, all sizes, double and single, were shipped by this company to Europe.

St. Louis Corliss Engine.

Members and visitors to the convention will find among other points of interest in St. Louis, that the extensive works of the St. Louis Iron & Machine Works, located on Chouteau Avenue, and occupying the blocks running from Main to Second Streets will well repay a call. The works are in the heart of the city, are easy of access and all visitors will be made welcome.

The company mentioned is the builder of the St. Louis Corliss engine, which has had extended use in electric lighting and power plants. The company is now placing upon the market a new type of Corliss engine, especially designed for electric power service and styled the "heavy duty" St. Louis Corliss engine. The illustration on this page shows one of the smaller sizes of this type of engine, of 250–400 h. p. The type of frame used on this engine is of novel design and of massive proportions. The long foot under the guides gives strength and rigidity to the guide section and serves to resist the vertical angular strains transmitted through the cross head and pitman. The heavy frame proper is so constructed as to give the main shaft a substantial journal of large area for sustaining the weight of the immense fly wheel and generator armature usually placed upon the shaft of engines of this type. The frame is further strengthened by the heavy longitudinal rib or backbone, running from the frame proper to the cylinder and directly in the line of transmitting strains.



"HEAVY DUTY" ST. LOUIS CORLISS ENGINE.

The valve gear is worked by double eccentrics operating separate wrist plates and giving independent control of the steam and exhaust valves. With this type of gear it is possible to maintain perfect control over the admission of steam to the cylinder, through a wider range of cut-off than is possible with the standard gear. This feature is of great importance in railway service, as with it, it is said, the governor will maintain perfect control over the engine, enabling it to meet the extraordinary demands of a seventy-five per cent overload, and still holding the speed of the engine practically constant.

The cylinders of these engines and all parts of the valve and valve gear are built to carry a safe working steam pressure of 150 lbs.

The company is now installing three engines of this type, each of 400 h. p., in the new factory of the Liggett & Myers Tobacco Company, of St. Louis. Each engine will be direct connected to an electric generator of 250 k. w. capacity, and when completed the plant, it is claimed, will be the most notable example of the electrical transmission of power for factory service in America. Power will be transmitted throughout the fourteen factory buildings by means of some sixty motors of various sizes. The engine from which the illustration is made is in daily operation in the basement at the Exposition building upon Olive Street and Fourteenth, where it can be readily examined by all interested.

Kraushaar Lamp & Reflector Company.

The Kraushaar Lamp & Reflector Company, of St. Louis, is an extensive manufacturer of bronze and brass car trimmings and supplies of every description. This company is the sole manufacturer of the St. Louis electric headlight, and also of the Kling latest improved ratchet brake handle. The St. Louis electric headlight is suspended to, but under the hood of the car, and can be turned at any angle. The connecting wires are encased in a hollow tube which supports the headlight. The light on the rear platform may be instantly reversed so as to light the inside rear portion of the car and platform and steps. The company's sales of these headlights have been very large and satisfactory.

The Kling ratchet brake handle is the latest improved type. The handle is made of solid bronze, twelve or fourteen inches long, and is furnished complete with stub ready to be welded to the shaft. The ratchet and dog are both made of steel, and have a wearing surface of two inches, and as the dog is placed so that there can be only compression strain on it, there can be no wear to it. The handle requires no attention as to adjustment; and it is claimed, will always work satisfactorily. Over 10,000 of them are manufactured annually.

The shops of this company are located at 2510 North Ninth Street, and are thoroughly equipped for the extensive manufacture of brass and bronze goods, either by casting or spinning. The plating department is also extensive and embraces every form of plating and finish. The company will make an interesting display at the convention, and Mr. Kraushaar will be in attendance and pleased to meet all visitors.

Commercial Electric Supply Company.

One of the principal points of interest in St. Louis to all members of the American Street Railway Association attending the convention in this city is the fine new home of the Commercial Electrical Supply Company, located at 1007 and 1009 Market Street. This firm, although only in existence a few years, has taken a prominent position in the supply business of this city, and it now occupies one of the finest electrical supply house buildings in the Western country. The firm occupies the entire building, contain- a floor space of more than 14,000 sq. ft. It has made an entire innovation in the arrangement of its building, as heretofore carried on by other supply houses in the country, and in this way using the entire first floor as a showroom—having it fitted up with show cases, in which are exhibited electrical supplies of all sorts and descriptions. In these show cases can be found samples of the latest improvements in street railway, lighting, telephone and telegraph goods It also carries the largest stock of goods west of the Mississippi River, and as one prominent street railway man of St. Louis was heard to remark one day, "if the Commercial Electrical Supply Company did not have the goods you wanted to-day, it would be sure to have them in stock to-morrow." It will repay any street railway man, or persons interested in street railway and electrical material, when in St. Louis, to pay this firm a visit.

Wheels and Wheel Records in St. Louis.

The principal wheel sections used by the street railway companies of St. Louis are shown in the accompanying illustrations.

Fig. 1 is a 33 in. motor wheel weighing 385 lbs. used by all the lines of the National Railway Company, the Union Depot Company, the Missouri Railroad Company, the Southern Electric Railway Company, the Midland Street Railway Company and the Fourth Street & Arsenal Railway Company. It has a 2 in. tread and a flange $\frac{9}{16}$ in. deep and $\frac{15}{16}$ in. wide. Its rim is $3\frac{1}{8}$ ins. wide and 2 ins. thick (radially). It is made by the Missouri Car & Foundry Company of its best mixture of No. 4 charcoal and "cold blast" irons. The illustration shows the deep chill and fine blending of the white and gray irons.

FIG. 1.

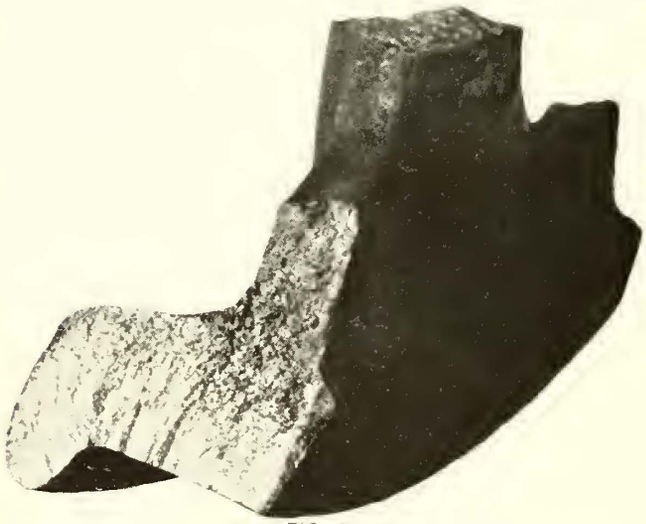


FIG. 3.

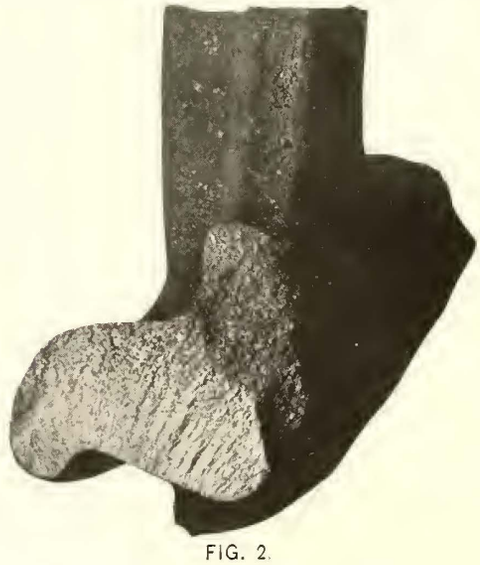


FIG. 2.

Fig. 2 shows a 33 in., 385 lb. motor wheel made especially for the Lindell Railway Company by the Missouri Car & Foundry Company. It has a $2\frac{1}{4}$ in. tread and a $\frac{5}{8}$ in. flange, $\frac{15}{16}$ in. deep. Its rim is $3\frac{3}{8}$ ins. wide over all and $1\frac{7}{8}$ ins. thick. This wheel is strong and serviceable, particularly in the flange, which is well reinforced and thick enough to have considerable toughness as well as hardness.

Fig. 3 shows a wheel section recently cast by the Missouri Car & Foundry Company for the St. Louis & Suburban Railroad Company's motor cars. It is 33 ins. in diameter and weighs 440 lbs. It has a $2\frac{1}{2}$ in. tread and a flange $\frac{7}{8}$ in. deep and $1\frac{1}{8}$ ins. thick. Its rim is $3\frac{3}{4}$ ins. wide and $1\frac{5}{8}$ ins. thick. This wheel is especially adapted for the combined slow and rapid running of the St. Louis & Suburban cars within the city limits, the company's lines passing at first through the business streets and afterwards over its own right of way where speeds are often considerable.

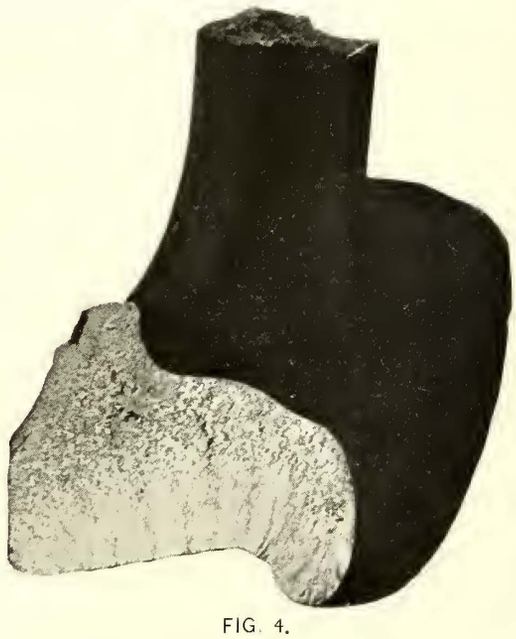


FIG. 4.

Fig. 4 is a 560 lb., 36 in. wheel made by the Missouri Car & Foundry Company for the St. Louis & Kirkwood Railroad Company on whose lines the cars reach very high speeds and require therefore a particularly strong and powerful wheel. The tread is $3\frac{1}{2}$ ins. wide and the flange $\frac{7}{8}$ in. deep and $1\frac{1}{4}$ ins. wide, while the rim is $4\frac{3}{4}$ ins. over all and 2 ins. thick.

Fig. 5 shows a 30 in., 230 lb. wheel used on the Broadway cable cars and on the trail cars of the Citizens' and Cass Avenue lines. This wheel has a 2 in. tread, a $\frac{9}{16}$ in. flange, $\frac{15}{16}$ in. wide, and a rim 3 ins. wide and $1\frac{1}{4}$ ins. deep. It is made by the Missiouri Car & Foundry Company.

FIG. 5.

Fig. 6 is a 24 in., 225 lb. "pony" wheel used on the maximum traction trucks of all St. Louis companies, except the Lindell and the St. Louis & Suburban. It has a $2\frac{1}{4}$ in. tread, a $\frac{5}{8}$ in. flange, $\frac{15}{16}$ in. wide and a rim $3\frac{3}{8}$ ins. over all and $1\frac{3}{4}$ ins. thick. It is made by the Missouri Car & Foundry Company.

FIG. 6.

In Figs. 7 to 10 are seen sections of the wheels used by the St. Louis & Suburban Railroad Company and furnished by the St. Louis Car Wheel Company. Figs. 7 and 8 represent one class of wheels of which Fig. 7 is a new wheel and Fig. 8 one which has seen 80,000 miles of service. Figs. 9 and 10 represent another class of wheels, Fig. 9 before going into service and Fig. 10 after service.

It will be seen that all these wheels are thoroughly made as regards chill and blending of the gray and white irons. As a

matter of fact, the fractures show particularly beautiful iron with very few chill pockets, and the grain of the gray iron is closely interwoven in such a way as to suggest the strength and fitness which is said to be characteristic of these wheels.

Perhaps the most careful records kept by any of the St. Louis street railway companies are those of the "McCulloch lines," so called, controlled by the National Railway Company. C. N. Duffy, the company's secretary and treasurer, is an accurate and enthusiastic statistician, and has been thoroughly interested in watching every detail of expenditure since the conversion of the old horse railway lines to the electric and cable systems. These wheel records show very interesting results, some of which are as follows:

The Cass Avenue & Fair Grounds Railway Company put in service in August, 1893, seventy single truck, twenty foot motor cars equipped with wheels 30 ins. in diameter, $3\frac{3}{4}$ ins. bore, $\frac{7}{16}$ in. flange, 2 in. tread, and weighing 385 lbs. In 1894, the net cost of new wheels after deducting value of scrap was $1116, the cost of labor in taking off old wheels and putting on new, including boring and pressing, $465, and the total cost was therefore $1581, or $22.58 per car, and $.000543 per car mile. In 1895, the net cost of new wheels after deducting the value of scrap was $1406, the cost of labor, as above, $630, and total cost $2036, equivalent to $29.08 per car, and $.000695 per car mile.

FIG. 7.

During 1894-95 ninety-nine wheels of the National Railway Company made a service of 42,000 miles and over. Of this number fifty-four made from 42,000 to 50,000 miles, twenty-nine from 50,000 to 60,000 miles, ten from 60,000 to 70,000 miles, four from 70,000 to 80,000 miles, one 86,000 miles and one 94,000 miles.

The wheel records kept by the Southern Electric Railway Company are also valuable. During the six months from Jan. 7 to July 9, 1896, fifty-three pairs of wheels were taken out of service for various causes. Of this number six pairs had made mileages ranging from 80,000 to 108,000, one from 70,000 to 80,000, five from 60,000 to 70,000, four from 50,000 to 60,000, nine from 40,000 to 50,000, eleven from 30,000 to 40,000 and only seventeen less than 30,000.

The average life of the fifty-three pairs of wheels was 43,600 miles.

These records show remarkably good wheel material; and are a strong testimony to the value of the Missouri Car & Foundry Company's wheels.

Concerning the wheels of the St. Louis Car Wheel Company used on the lines of the St. Louis & Suburban Railway Company, the general superintendent reports that since the adoption of electricity as a motive power in 1890 the company has had 300 to 400 of these wheels in daily use and has not found a single cracked or broken wheel in that time. The chill is deep and uniform. The company's average mileage for all the wheels of this make put in service in 1895 was 80,000. The cars run from 120 to 170 miles per day, and the company says that not more than one wheel per month is removed for flat spots caused by sliding, this proving that the chill is hard as well as uniform. Mr. Sneed says that he rarely removes one of these wheels of the St. Louis Car Company that has made less than 50,000 miles, while he has several in service that have made over 125,000 miles. This is certainly a remarkable showing for street railway wheel service.

FIG. 9.

THE Waterloo (Ia.) & Cedar Falls Rapid Transit Company is securing rights of way for the extension of its lines from Cedar River Park to Cedar Falls. L. S. Cass, of Sumner, Ia., is president of the company.

Operation in Lansing, Mich., Suspended.

The difference so long existing between the Lansing (Mich.) City Electric Railway Company and the City Council culminated Sept. 18 when the railway company ran its cars into the car house and ceased to operate. This result, which was brought about by a vote of the Council to try punish the railway officials for not complying with an order of the court as to paving, has created a bitter feeling against the Council by a majority of the citizens and taxpayers and what the result will be it is impossible to tell at present. A monster petition signed by a majority of the business men and taxpayers was presented to the Council Sept. 21, asking that the difference between the company and the city be settled upon a basis which had once been offered to and accepted by the railway company, but the Council refused to act. Some weeks ago the Council voted unanimously to relieve the company from paving upon certain changes being made which the company accepted, and commenced making the changes, but at the next meeting of Council this proposition was reconsidered, and thus the matter stands. A committee of four prominent business men spent a day at the railway company's office examining its books and were satisfied that the company was not able to bear the burdens imposed by the Council.

FIG. 8.

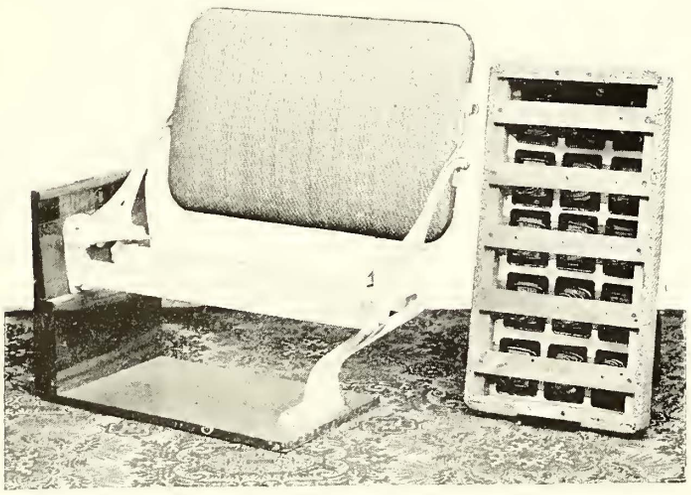
FIG. 10.

The road has been greatly improved during the past year and the service is acknowledged to be good and satisfactory to its patrons. But the Council seems determined to drive the railway out of the city. Maj. L. N. Downs, president of the company, states that the company will abandon the field and move its properity unless the city grants it a franchise under which it can live. The entire press of the city is on the side of the railway company and the citizens believe the members of the Council will be forced to accede to the wishes of the public.

Reversible Seats for Street Cars.

By Geo. T. Parker.

It is easy to remember when in most of our large cities the power was horses or mules, the time was slow, the seats were springless and invariably lengthwise, the lights were dim and the ventilation was most imperfect. Verily improvement is the order of the day, and at no time as much as the present has the improvement been so rapid or contributing in such a marked degree to the comfort of both urban and suburban travel. The new cars which



SPRING SEAT.

are being adopted are palatial. The system of seating passengers in seats running crosswise of car with spring cushions and backs is one of the most marked innovations. To this positive comfort, has been added heat, splendid light, good ventilation, cleanliness, and great speed upon smooth roadways.

The cross seat was hardly known to street car travelers five years ago, but it is now the prevailing type in use on railways in large cities and on interurban roads. In the city of St. Louis it is used exclusively; no new cars have been placed in service in the past three years equipped with any other seat. The advantages of cross seats are apparent to the average passenger who rides in them. When a seat is secured the passenger is comfortably seated to the end of his journey, no matter how crowded the car may become, nor are his feet trampled upon by the other passengers in their attempts to get out. The cross seats are also better for those who have to stand, as the standing passenger can brace himself against the backs of seats and need not hang on to the strap. In getting out of a crowded car he need not stumble over the other passengers as in the case of side seats.

The Scarritt Furniture Company has had a large sale of its reversible seats and reclining chairs for steam roads—where they had reached a wide use. As the street railways were extended it became more necessary to consider the comfort of the passengers, for longer journeys were necessary and the Scarritt Company brought to the notice of the street car builders and the street car managers, its new reversible street car seats patterned after the steam road seats, and made equally comfortable and serviceable.

The first line to adopt them regularly was the Lindell Railway, of St. Louis, in 1893. The cars equipped with them were very attractive and immediately became very popular. This was proof of the success of the experiment and it was followed quickly by competing lines. so that there are now upward of 9000 Scarritt seats in service on the street railways of St. Louis. They are also in use in forty other cities in twenty different states and in England, Canada and Mexico.

A cross seat being necessarily reversible it is essential that the mechanism be simple and strong. At the same time the comfort and appearence of seat should not be sacrificed to accomplish this. The reversing mechanism of the Scarritt seat is simple and positive in its action and while reversing back and tilting seat automatically, the back and seat are brought in such relation to each other as to give the greatest possible degree of comfort. The arrangement of springs in seat and back contributes in no small degree to the comfort of the seat. The cushion is tilted up in front, adding to the comfort and also preventing the tendency to slide forward and slip out.

Owing to its better adaptability for use in summer and winter and its cleanliness and durability, rattan is usually the covering used on these seats, but leather and plush or carpet can be employed when desired. The construction of the supports of the seats are such as to facilitate the cleaning of car floors. At the side the seat is attached to the lining of the car and is supported by a graceful stand so designed as to avoid the trap doors over the motors and presenting only a slight obstruction to the sweeping of the floor. The clear space under the seat is greater than in any other and affords ample room for the feet of passengers.

The Scarritt Furniture Company received the highest award on car seats from the World's Fair Commission, where an elaborate display was made. Its display at the St. Louis convention will be large and no doubt will be interesting to those in attendance.

Brazer and Blow Torch.

An appliance that is finding great favor among street railway and electric people generally is a combined brazer, soldering iron heater and blow torch or paint burner, practically three tools in one. It is known as the combination "hot blast" blow torch and uses gasoline. These torches are made in one piece, are practically indestructible and are tested to fifty pounds to the square inch. The seat in which the needle point works is removable and can be easily replaced at a cost of ten cents. As the heat of this blast torch is sufficient to braze with, it is particularly useful in street railway work. It is handy also for heating soldering irons out of doors as it will not blow out and has proven extremely serviceable for use either in doors or out in connection with electric wiring. It is manufactured by the White Manufacturing Company.

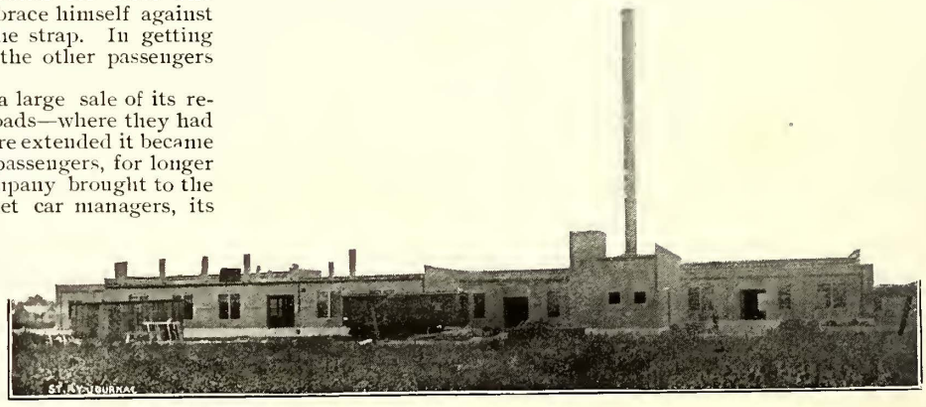
A New Car Manufacturing Company in St. Louis.

About six or eight months ago three men who have been for many years identified in the manufacture of street cars in St. Louis left their positions and associated themselves together to form the Union Car Company and to build a high grade of street cars for the American market. H. P. Wehrenbrecht, the vice president of the new organization was originally with the Brownell Company for several years; later on with the Laclede Company for seven years; still later with the Lindell Railway Company for a year, and finally, until November, 1895, with the American Company for five years as master car painter. In the new organization Mr. Wehrenbrecht will have charge of the important department of painting and his long experience in this class of work will be of great value.

H. Polst, will be the company's master mechanic. He held this same position with the Laclede Company for many years and for the last five years has been with the American Company.

David Will, is to be foreman of the woodworking department, a position which he has held at the American works for five years.

Associated with these three practical men are H. W. Rocklago, who has become the company's president and who is a well known



WORKS OF THE UNION CAR CO.

contractor and capitalist in St. Louis, while C. Knickmeyer is secretary and treasurer.

The company has obtained sixteen acres of ground favorably located for manufacturing purposes, and with switches to the tracks of the railroad companies in St. Louis, and has nearly completed a factory, an exterior view of which is shown in the accompanying illustration. The main building is 100 ft. × 340 ft, and is a one story brick structure of modern construction. This is divided into two shops, one the mill and erecting shop and the other the paint shop which is 100 ft. × 100 ft.

The blacksmith and machine shop is a separate brick building 50 ft. × 120 ft. and in another structure is found the engine room, 40 ft. × 25 ft. and the boiler room 50 ft. × 25 ft. The company has a dry kiln 26 ft. × 40 ft., but most of its lumber will be selected in the best markets in St. Louis and will be given an additional sun and air drying in its own yards.

With so long and valuable experience in car building this new organization ought to be a strong one and it will doubtless before long secure its full share of business.

Woodiline for Line Poles.

Much interest has been felt of late, in a method of preserving from decay, the line poles of trolley roads, that seems to offer some decided advantages over the usual method of setting the poles in concrete. One of these advantages is the low cost of the method, it being possible, the makers say, to effectively treat ten feet of the butt of a pole of largest size for about twenty-three cents including labor, or the entire pole for fifty-five cents. No expensive treating process is employed, and no transportation of the timber is necessary. Another advantage lies in the fact that the results are surer than those obtained with concrete settings, there having been recorded frequent cases of dry rot in poles in concrete settings.

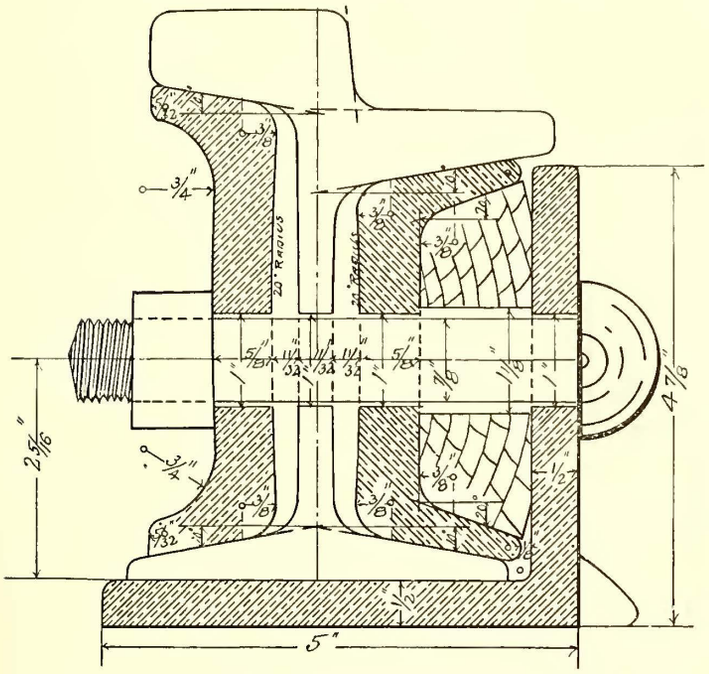


FIG. 3.—THE WEBER JOINT FOR 6 IN. GIRDER RAIL.

It is without doubt true, that the cost of such settings is an unnecessarily large item in the expenses of line construction. At the same time, it is generally accepted, that a reliable means of preserving poles from decay results in a large economy to the user.

A well known Philadelphia company, which has for many years manufactured a preservative, known as Woodiline, largely used in the treatment of bridge ties, cross ties, and similar work on several leading railroads has found that this preservative is especially adapted to use on the wooden line poles of the trolley roads, owing to its high preservative qualities, low cost, and ready application at any point. The liquid, composed largely of wood creosote, may be applied to the timber with a brush, or by dipping, as is most convenient, and it enters the pores of the wood, whether the latter is hard or soft, very rapidly, owing to its high natural penetrative powers.

The preservative was used on the line poles of the well known Burlington & Mt. Holly Electric Railway of which so much was heard last year, the poles being treated by applying the liquid with a brush. The cross ties were also treated and Woodiline bids fair to become very useful in such work. Thirteen years of service of the severest character made on one of the largest steam roads in the country justify the claims made by the makers.

H. E. HARRINGTON, general manager of the Camden & Suburban Railway Company, Camden, N. J., writes that his company desires prices on the following material delivered F. O. B. at Camden: forty-five pound to sixty-five pound T rail for 3000 running feet of track, and fishplates, bolts, etc., to be used with the same.

THE officials of the Long Island Railroad Company, Lynbrook, L. I., have been looking over the Long Beach branch with the idea of substituting electricity for steam as the motive power.

The Weber Rail Joint.

There is to-day a very large amount of street railway and trunk line track where the rails are in tolerably good condition except at their ends and in many cases they are here bent and depressed. At the centers and quarters of the rail there has been given only a moderate wear, but the poor condition of the ends makes the cars ride rough and hard and affects not only passengers, but the wheels, motors and the whole rolling equipment. A run over the city or suburban lines of almost any road reveals this trouble. These depressions and low ends will vary anywhere from $\frac{1}{16}$ in. to $\frac{5}{16}$ in., and in extreme cases will considerably exceed even these figures. A

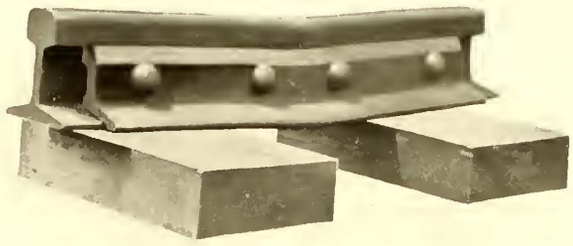


FIG. 1.—DEPRESSED RAIL ENDS BEFORE APPLYING WEBER JOINT.

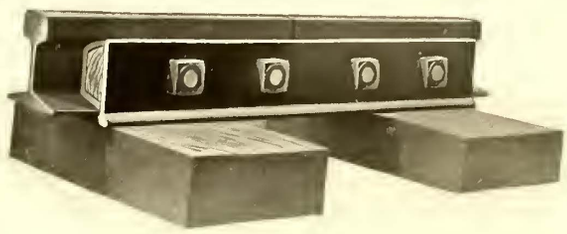


FIG 2.—AFTER APPLYING WEBER JOINT.

liberal expenditure on first construction for rails, ballast and tracklaying may defer the day of complete failure, yet, finally, despite the trackmen's efforts, it surely comes. The old angle plates are sometimes taken off and replaced with new bars of about the same, but heavier pattern. These in turn go down after a few weeks and never help permanently, if temporarily, the depressed rail ends. Some of the practical results of the Weber joint in this connection are of decided interest and of far reaching importance and should command the serious attention of every street railway manager.

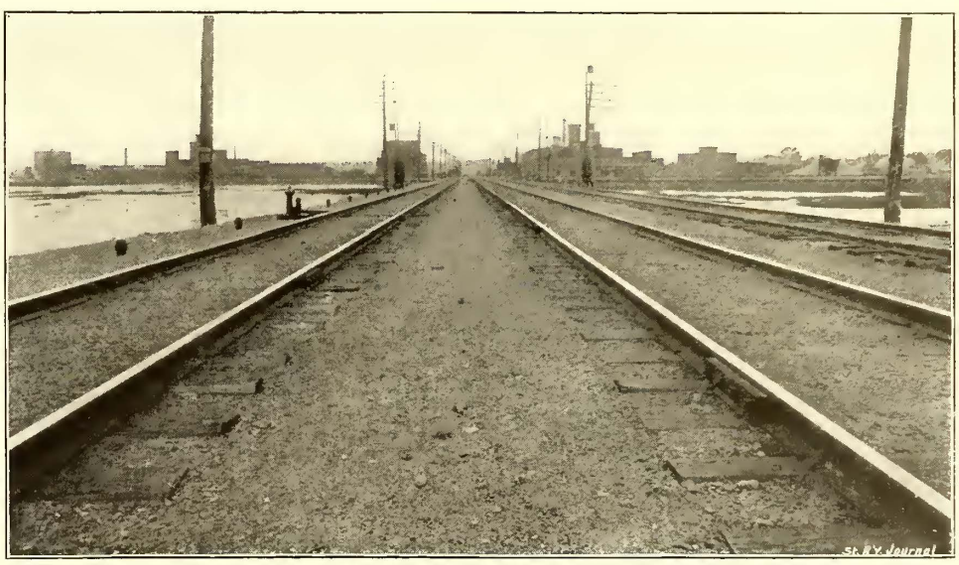


FIG. 4.—SUBURBAN STEAM RAILROAD TRACK IN BOSTON, LAID WITH WEBER JOINTS.

This joint has been placed on many miles of girder and T rail and has uniformly corrected the deflected ends—a process requiring from three to six weeks depending on the amount of the of the travel and the weight of rolling stock, and this connection is one

which is permanent and means an added life of several years where the rest of the rail is in fair condition.

Fig. 1 shows a case prior to using the Weber joint. When the rail ends are bent, of course their angle bars are bent. Street railway officials will recall "spots" of their own track of which this might be an actual view.

Fig. 2, shows the same rail after a short experience with the Weber joint. Here the rail has been "ironed out" and is up to a true surface. The rolling load—in this case the constantly passing

FIG. 5.—AN ILLUSTRATION OF RAILROAD TRACK LAID WITH POOR JOINTS.

trolley cars—have gradually rolled or "ironed out" the rail to conform to the joint. As track experience and mechanical tests show this joint to have far greater vertical and lateral strength than any rail, it follows that under loads the rail must give way to the joint. This being a gradual process there is no shock to either rail or joint and the result is as before stated, a permanent one.

The value for this work of the strong mechanical combination of channel and angle bars, shoe angle and filler found in the Weber joint is apparent, Extraordinary stiffness is given and yet by the use of the wood filler the whole is "cushioned" and a certain amount of elasticity is obtained, which is necessary if failure of the rail or joint by breaking is to be successfully avoided.

As before stated, the Weber joint has materially helped a considerable mileage of old street and steam railway track which has been in anywhere from six to twelve years and by the application of this joint it has been possible to prolong the life of this old rail some four years, and even then to take out the joints and use them for a full period of service in new track.

As this is the result of using the joint on old rail, it certainly seems worth while to use it for first construction with new rail; and so maintain from the beginning perfectly true ends until the rail is wholly worn out at centers, quarters, ends and all; for it is not until rails are worn out uniformly from end to end that managers can feel that they have gotten full value for their money.

The Weber Railway Joint Manufacturing Company seems to have thoroughly studied the track problem in general and the joint feature in particular. Its girder rail joint, its T rail joint, its step, or compromise joint for rails of unequal heights, and their insulated joints for preventing leakage of signaling circuit in steam railroad track, are all built on the same underlying principle, but are so varied as to meet the special needs. These joints are not only a well established practical success, but they bear the closest mechanical scrutiny. It can be demonstrated that they are theoretically correct, but what is of as great importance, they are commercially possible, that is to say, they can be made in large or small quantities all alike and without camber or warp. They are not dependent for a fit on the absolute symmetry of the rail, a thing which is well known to be impossible in the rolling and specially hard to obtain in different rollings. There are but two fits in the base and these are wedged alike. Hence, should the rail vary slightly or be bent down or worn under the head, there is no straining for a fit. In brief, the joint readily adapts itself to rails which vary slightly for any one of many causes.

The United States Rope & Supply Company, Cincinnati, O., has been incorporated by Thos. L. Gregson, Henry Marten, Enoch L. Stricker, John D. Meeker and A. W. Paxton to deal in wire cables and ropes and street railway supplies. Capital stock, $10,000.

The Toledo Traction Company, Toledo, O., has applied to the City Council for permission to build a double track line on Lower Summit Street.

The General Electric Company at the Convention.

The General Electric Company will be represented at the St. Louis convention by an exhibit which will embrace the newest developments in the electric traction field. The space occupied is the most extensive in the hall, and is located immediately to the left of the entrance. So far as at present arranged the exhibit will comprise examples of the standard apparatus of the company's manufacture, as well as the latest devices developed since the last convention, and street railway delegates and visitors will find that every item has a special interest to them and to their work.

A G. E. 1000 motor equipment will be mounted on a truck, and will be shown in operation with the electric brake. One of the Brooklyn Bridge car trucks will be exhibited, equipped with two G. E. 2000 motors, and near by, examples of the G. E. 800, 1000, 1200 and G. E. 51 types of motors. The controller section will include examples of the K 10, B 6 and L 2 controllers, as well as one of those used to handle the great ninety-six ton electric locomotives of the Baltimore & Ohio Railroad. A switchboard made up of generator and feeder panels, with full equipment of standard instruments, rheostats, etc., will be installed. Lightning arresters willbe shown in operation, and the magnetic blow-out device and the working of the principle will be fully explained.

A G. E 1000 armature, with one-half of the coils in place, will show to delegates the method followed by the General Electric Company in the construction of its railway motor armatures. An electric brake adapted to trailer use, with shoe and disk, will serve to explain the electric brake and its principle.

The branch of electric railway supplies will be represented by a series of ten Thomson railway arc lamps in operatiou, as well as some fine examples of the long burning type of lamp adapted to street railway use. Assembled commutators of G. E. 800, G. E. 1000 and G. E. 2000 motors, bound solid for shipment, will also be shown in conjunction with samples of the new frogs and overhead switches. Trolleys, K and L types of circuit breakers, the new M automatic circuit breaker for street railway car equipments and a fine exhibit board of punched clip switches will complete the display the supplies.

The conduit system of the General Electric Company will be represented by one of the plows designed for use on the New York and Washington underground conduit roads. The work of the company in the steam railroad field will comprise a sample section of the third rail in use on the main line of the New York, New Haven & Hartford Railroad, a direct connected air pump, with the automatic governor used on the cars operating on the same railroad, and a section of the overhead current device used in the Baltimore & Ohio Railroad work.

If time will permit, two rotary converters, each of 100 k. w. capacity, will be set up to show the method followed in the three phase, long distance transmission work and the manner in which Niagara Falls power is to be delivered to the Buffalo railroads. This is the system now employed with success at Lowell, Mass., to transmit power fifteen miles to Nashua, N. H. Direct current at 500 volts will be taken in at one of the commutators and converted into three phase current at a high voltage. At this voltage the current will cross from the rings of that converter to those of the other converter, and will be reconverted into direct current at 500 volts. This will then be used to operate the four electric brakes.

The exhibition space will be illuminated by miniature incandescent lamps and decorative signs.

The headquarters of the General Electric Company, at the Southern Hotel, will be in the two parlors in front of the dining hall, and here delegates and visitors will be assured of the warm welcome characteristic of the company. The General Electric Company will be represented by W. J. Clark, general manager of the railway department; W. B. Potter, chief engineer, L. H. Parker, assistant engineer, and H. C. Wirt, engineer of the supply department, of Schenectady, N. Y.; A. D. Page, of Harrison, N. J.; T. Beran, of New York; F. M. Kimball, of Boston, Mass.; Geo. D. Rosenthal, of St. Louis, Mo., and others.

E. S. Greeley and James W. Sands, New York, N. Y., have been appointed receivers for The E. S. Greeley & Company. The company's assets are reported to be $180,600 and its liabilities $160,000.

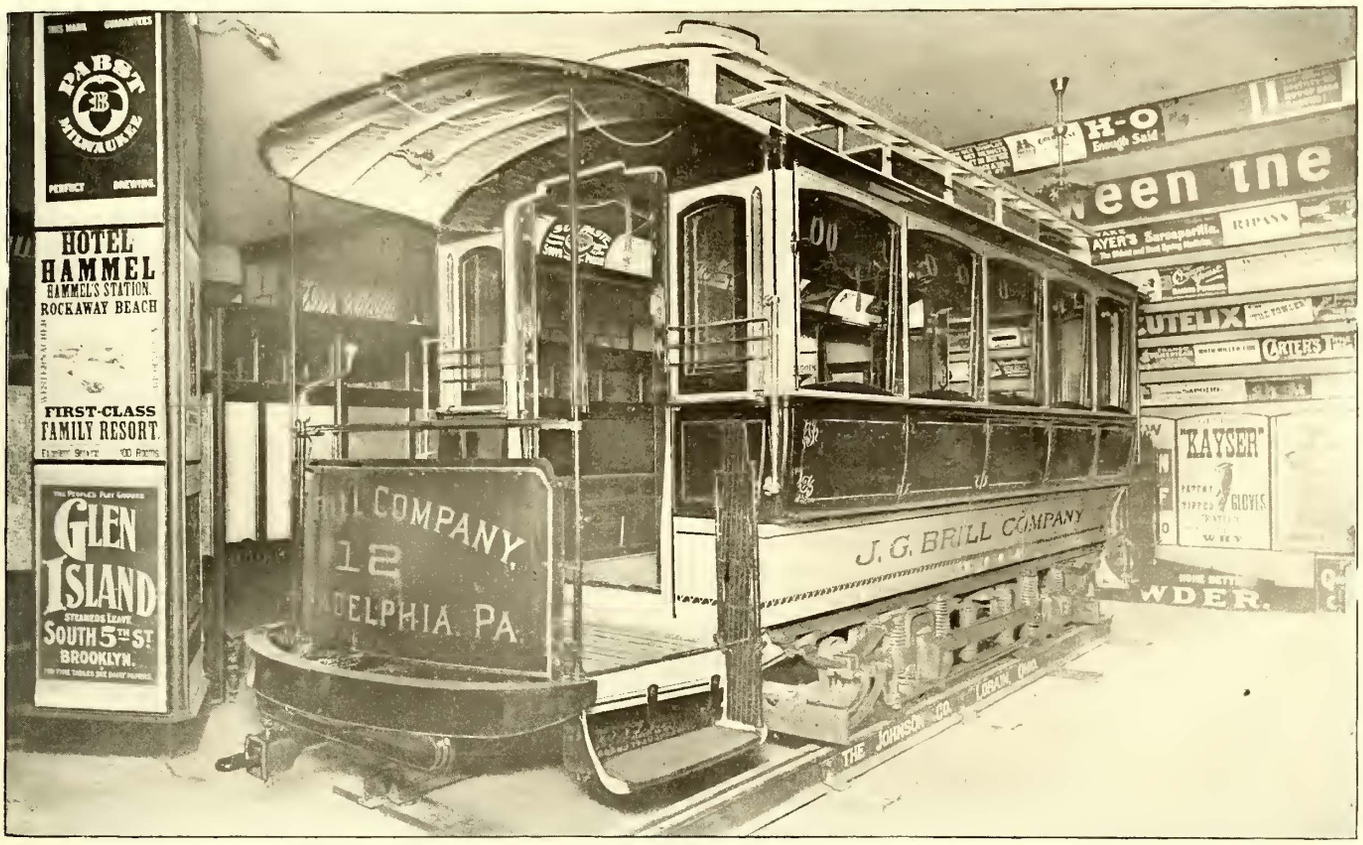
The roof of the car shed of the Metropolitan Railroad Company, Washington, D. C., fell in during the recent storm, and damaged the cars and building to the extent of $20,000.

Street Car Advertising.

Modern street car advertising has come to be a recognized factor in the street railway business and is now almost universally adopted. A brief history of this business will not therefore prove uninteresting.

Away back in the Seventies there were only a few street railroads in the United States which permitted advertising in their cars. Most of it was done in New York and Brooklyn, the advertising being placed in small frames occupying the inner spaces of the letter board, and they were mostly in the shape of glass signs. The smallness of the space for display, the accumulation of dust on the glass and the peculiar way in which the lessees of privileges at that time did business brought this excellent medium into disrepute, both with the railway companies and the public. It languished for a while until the introduction of the concave rack, the first patent of which was obtained by John N. Akarman, of Worcester, Mass. This patent is now owned by George Kissam & Company.

William F. Carleton, who was once a conductor on the Second Avenue road in New York, and subsequently a cash receiver for the same road, early recognized the possibilities of display in street cars, and he should be justly considered as starting the business properly.



VIEW OF CAR FOR SHOWING METHOD OF CAR ADVERTISING, POSTAL TELEGRAPH BUILDING, NEW YORK.

This was done in the City of Boston early in the Eighties. His success in Boston was immediate and he branched out in Chicago, Providence, Cincinnati, and a few small places around Boston. In 1889, he controlled eleven cities and towns. He then associated with him in business George Kissam, who had made a great success in the sign advertising business. The rise of the concern was very rapid, and city after city and town after town were added until the firm had over sixty principal cities under its control. Numerous rivals sprang up of more or less importance and ability, but with one or two unimportant exceptions the concern did not lose any of its holdings or franchises. The rivalry however created a demand for advertising privileges on railroads that forced the price for these privileges to figures that were abnormally high. Numerous concerns went to the wall and many of the railroads were mulcted heavily because the price for advertising did not keep pace with the rise of the amount paid for the privileges. The excessive hard times that have been and are now prevalent have still further contributed to render this industry still less profitable.

Mr. Carleton's death in September, 1895, threw the responsibility of the business upon Mr. Kissam. This he had been practically sustaining however for some two years previous, as Mr. Carleton's health was such as to prevent him from actively engaging in a business that requires immense energy, continuous work and able financiering. Mr. Kissam associated with him in business Charles A. Fish, of New Orleans, a man of great executive ability.

The offices of the concern are the largest and finest of any advertising firm in America. They cover a space 53 ft. × 42 ft. on the main floor of the Postal Telegraph Building, corner Broadway and Murray Street, and are luxuriously furnished throughout. In the main show room, around the walls and in appropriate places, are fixed advertising racks and poster boards for both street cars and the Brooklyn "L" road, which is controlled by this concern. In the center of the show room proper stands a beautiful trolley car, built for the firm by the J. G. Brill Company. The car is eighteen feet long in body, twenty-six feet over platforms, six feet two inches wide at the sill, and seven feet six inches wide at the belt rail. The body of the car is painted a dark, rich wine color, and the striping and lettering is in gold and silver. The hand rails at the ends of the car are of burnished brass, as are also the brake handles, bells and door fixtures. Extension gates are affixed to each platform. The interior finish is of mahogany, the seats are upholstered in crimson plush, and the head lining is beautifully decorated, the advertising display being, of course, in the appropriate mouldings for this purpose. The truck is Brill No. 21 E.

The electrical equipment complete was furnished by the Walker Company, which also put up the trolley wire. When the car is jacked up at one end the working of one motor on the forward wheels of the truck can be seen. The rails are of the seven inch Broadway groove type, and were furnished by the Johnson Company, of Lorain, O. They rest on steel ties. The overhead equipment with which the car is supplied—for it is fitted with trolley and a trolley wire, the latter being suspended from the ceiling—were supplied by the H. W. Johns Company.

The advertising cards in this car are changed daily, thus affording the numerous visitors a practical illustration of street car advertising as it is actually conducted by this firm.

The branch offices of this concern number sixteen, and are located in the principal cities, such as Albany, Syracuse, Rochester, Buffalo, Pittsburgh, Columbus, Cincinnati, Chicago, Milwaukee, Minneapolis, New Orleans, Denver and several smaller places. Most of these offices are connected with the principal office in New York by a long distance telephone, and the system is so perfect that a complete contract can be placed in every city within twenty-four hours, if necessary, or a change of cards made for an advertiser. The system of checking and listing is also so complete that not only can an advertiser be told what car his card is in, but he also can be told the location of his card in the car.

It is their attention to detail and the appearance of their cars that has made Geo. Kissam & Company popular with the railroad presidents, while their prompt payments of obligations is also pleasing to the treasurers. Their disbursements for rentals amount to over $300,000 annually, and for labor of employes and managers, many thousands more.

THE Colonial City Traction Company, of Kingston, N. Y., has made application to the Common Council for consent to construct and operate an extension of its street railway in the city.

The Design and Application of Electric Motor Trucks.

Experience in street railway operation has shown that a good truck is one of the most important parts of the equipment of any electric railway system. It not only exercises a large influence on the amount of traffic, but is also an important factor in the life of both car body and track.

Every business has its axioms and one of the fundamental principles in any transportation industry is that in preparing accommodations for passengers, comfort is more important than luxury. Beautifully decorated cars and tasteful fittings go very far toward attracting traffic, but if with these accompaniments the car is mounted on a poor and springless truck so that the inequalities of the track are communicated directly to the car body the purpose of the management in the attempt to attract passengers is defeated. To a passenger in a jolting or oscillating car it affords but little satisfaction to be surrounded by decorated ceilings or works of art, and it is for this reason that the selection of an easy riding truck is of more importance even from a traffic standpoint than a handsomely finished car body.

In the problem of the best method of mounting the ordinary single truck electric car we have what might be called a mechanical anomaly. The modern single truck electric car could be properly so termed because while electrical and economic considerations recommend the use of a long car, track conditions compel the use of a small wheel base. We have thus, in a study of the wheel problem, to devise the best method of supporting a long body on a base ranging from one-fifth to less than one-third of its own length and of driving that body at a high rate of speed without material oscillation or teetering.

But serious as this mechanical problem of itself is, it is not all. A study of the modern electric truck shows that it must not only fulfill the conditions just mentioned, but it must help as well the car body to do part of its work.

The modern electric car body with its long overhang on a single truck is by no means an ideal structure mechanically. To form a mechanical truss the upper and lower members should be laced together by cross members, but this is impossible from the very nature of things, as the windows have to be kept open and free. As a result the upper part of an electric car body can perform very little service other than to keep out the rain and wind and support the trolley pole, a no inconsiderable task. It cannot be depended upon to support the ends of the car to any material degree, and for this the side sills must be depended upon. If, however, these side sills were not supported from below they would soon become bent from the excessive loads on the platforms, and the car would soon present that broken-backed appearance which is so common on roads using trucks which badly support the car body.

A cursory view of the principles of truck construction, therefore, shows that the truck has two main functions to perform. First, and principally, it must support, on a base of from six to eight feet without teetering and oscillation, a heavily loaded car from twenty to thirty-five feet in length. Second, it must effectually support the lower part of the car body so that there shall be no tendency of the latter to drop at the ends.

Mr. Peckham, of the Peckham Motor Truck & Wheel Company was among the first to recognize the difference in the functions of an electric motor truck and the old running gear used on horse cars. While the early electrical engineers were attaching their motors to the car body and trying to use the old horse car running gear, Mr. Peckham boldly started out on the theory that an independent truck was essential to the proper support of the car body, and took as his model for a truss frame the standard cantilever bridge truss.

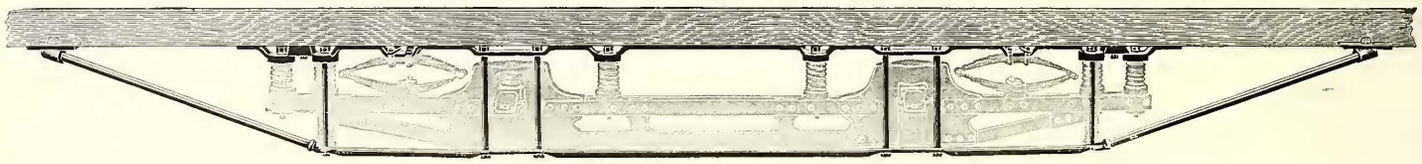


FIG. 1.—DIAGRAM SHOWING BRIDGE TRUSS IN PECKHAM TRUCK.

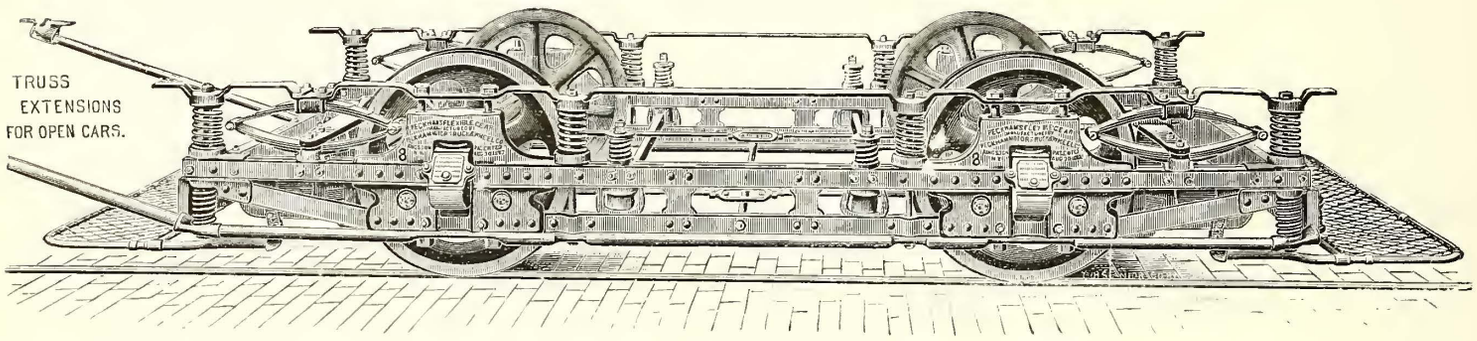


FIG. 2.—"STANDARD" TRUCK WITH EXTENSION RODS FOR LONG OPEN CARS.

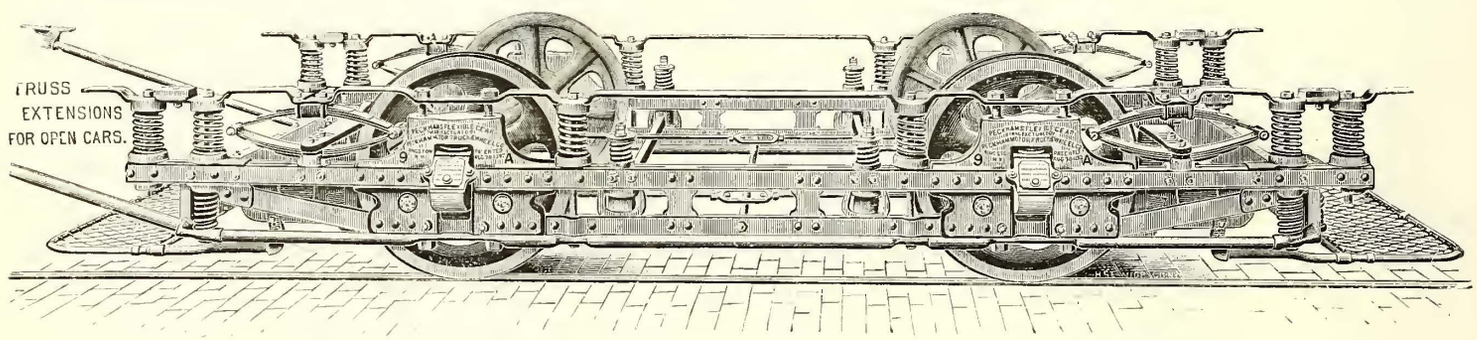


FIG. 3.—"EXTRA LONG" TRUCK WITH EXTENSION RODS FOR LONG OPEN CARS.

This experience in bridge building, as shown, gives the most rigid support for the least weight, and that Mr. Peckham's theory has been amply borne out by practice is demonstrated by the unanimous adoption of the independent truck idea and by general concurrence in the theory of the bridge truss truck frame.

While certain changes have been made in Peckham trucks from time to time to adapt the truck to different conditions and service under different car bodies, the fundamental principle has been embodied in all trucks.

In the application of a single truck to long car bodies, the problem becomes much more complicated as the length of the car increases. Could the body be raised a considerable distance above the track to admit the introduction of a long truss the question would be much simplified, but obvious operating conditions preclude such a step. As a consequence until very recently it was the universal opinion that a twenty-five foot car formed practically the limit in length suitable for use over a single truck.

Mr. Peckham, whose work in the field of truck design has always followed original and ingenious directions, has however recently brought out a truck capable of use under cars as long as thirty-five feet. This would seem at first sight almost impossible, but the fact remains that they have been put to this service with entire satisfaction. An engraving of one of three thirty-five foot, twelve bench open cars in use on the Coney Island & Brooklyn Railroad is given in Fig. 5. The wheel base of these cars is only seven feet, or just one-fifth of the entire length. These cars were formerly mounted on double trucks and at times carry one hundred or

more passengers, but the president of the company states that over the single trucks shown they ride with very little oscillation and much easier than when mounted on double trucks. The same truck is used in Baltimore on the City Passenger Railway, under thirty foot cars with six foot six inch wheel base, with eminently satisfactory results.

The method by which Mr. Peckham has solved this problem without increasing the distance between the car floor and the track is illustrated in Fig. 1. The angle of the truss extension rods has not been changed in any way to secure a longer support. Instead of terminating on the side bar of the truck, they have been dropped below the latter and are practically continuous from one end of the spring support to the latter. They thus make the lower horizontal member of a truss frame, of which the upper member is the car sill and the vertical members or tie pieces are the four pedestal bolts and the two additional spring bolts. A slight change in the form of yoke used was necessary to accomplish this, but the rest of the truck remains practically the same as in the extra long.

As will be seen in Fig. 1, the ideal condition already outlined for a single truck for long cars is secured by this construction. The bridge truss frame proper is shown in solid lines, and is flexibly supported on the side bars of the truck, which are themselves flexibly supported through the spring under the yoke upon the wheel boxes.

PECKHAM DOUBLE CUSHIONED SWIVEL TRUCK.

The new Peckham double cushioned swivel truck is illustrated in Fig. 4. For a long time the Peckham Motor Truck & Wheel Company declined to build a swivel truck, but as the demand from interurban railway companies was for a very much longer and heavier car than those employed in city service, and one which would run at a much higher rate of speed, Mr. Peckham, after carefully studying the conditions and requirements of this service, brought out a swivel truck. In it he has combined what he considers the most essential requirements for service of this kind. Its main features are great strength, simplicity of construction, easy riding and a powerful braking device.

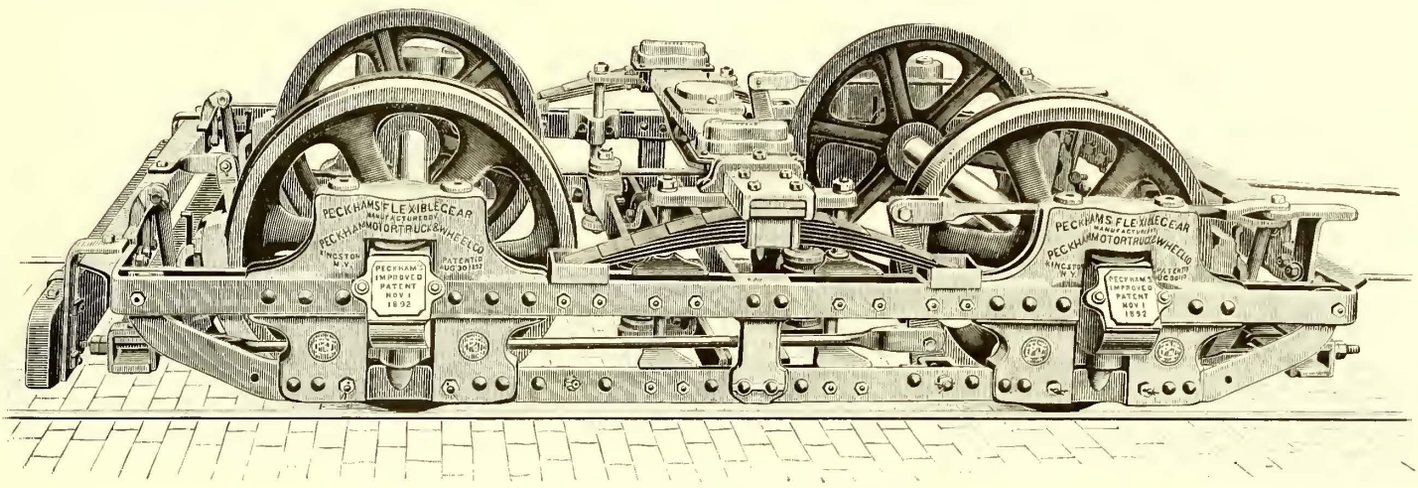


FIG. 4.—DOUBLE CUSHIONED SWIVEL TRUCK.

In general plan the truck follows very closely the lines of the steam railway truck used under the Empire State express on the New York Central Railroad. In fact, it is the production of the same designer, and the characteristic of the latter truck, the use of half elliptic springs on the side frames, has been adopted in the Peckham truck. The center of gravity of the truck has been brought down as low as possible, and with cars having straight sides the body of the car can be not more than 27½ ins. above the rail. The wheel base has been kept short, and the space between the axles kept clear, so that it is possible to mount two motors on the truck without difficulty. The truck is a very easy riding one, and its whole construction makes it both strong and durable.

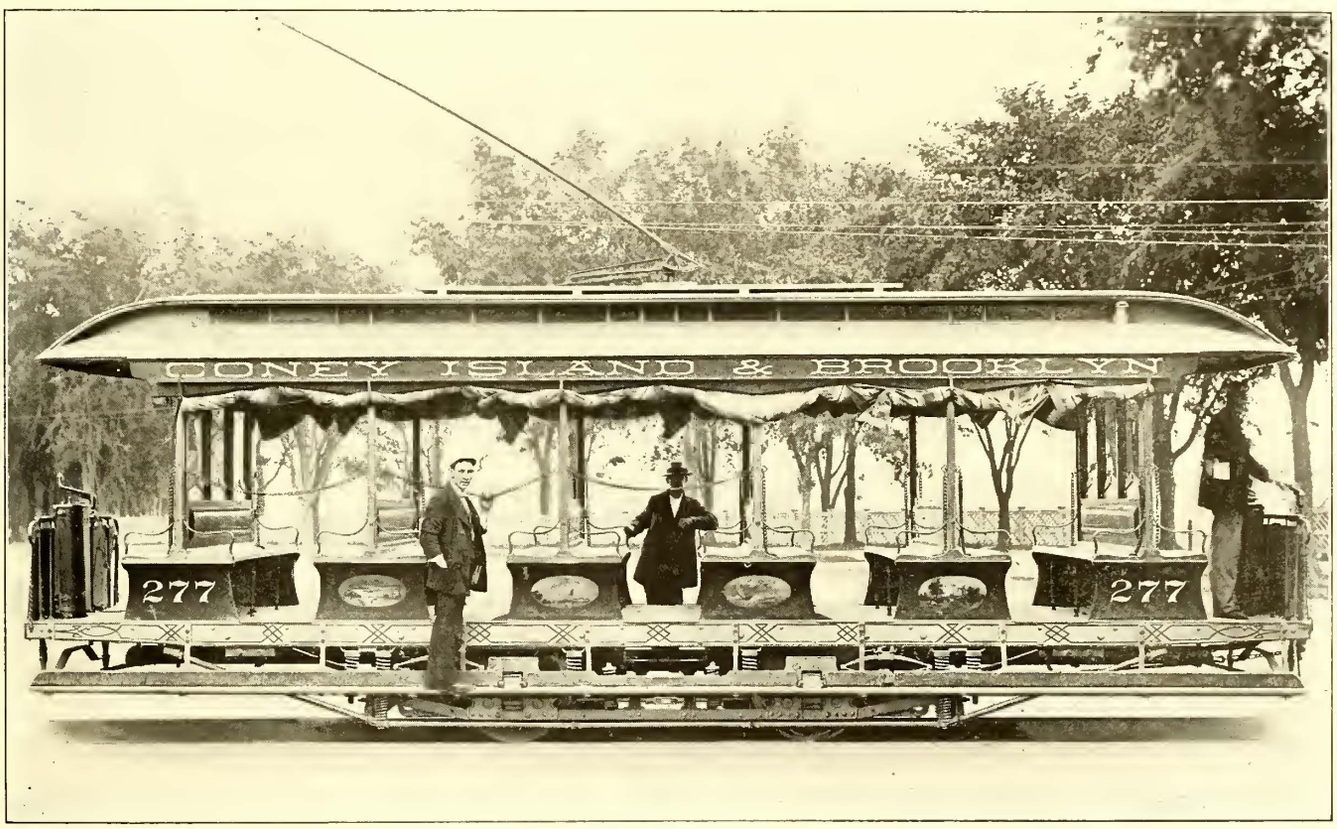


FIG. 5.—35 FT. OPEN CAR ON SINGLE TRUCK.

The brake gear is particularly ingenious in construction. The brake levers are double compound acting on the outside of the wheels, and so sensitive that they can be set at any degree desired, by the slightest motion of the brake handle.

Soon after this truck was designed, the Peckham Company received an urgent order from the Piedmont & Mountain View Railroad of Oakland, Cal., for seven of its double truck equipments. The grades on this line are as high as 14¼ per cent, and the cars are about thirty-five feet in length, and when loaded carry one hundred passengers. The front truck is set in such a position as to bring the end of the truck frame about one foot from the end of the car, and when the fender is attached to the truck it projects about a foot beyond the end of the car.

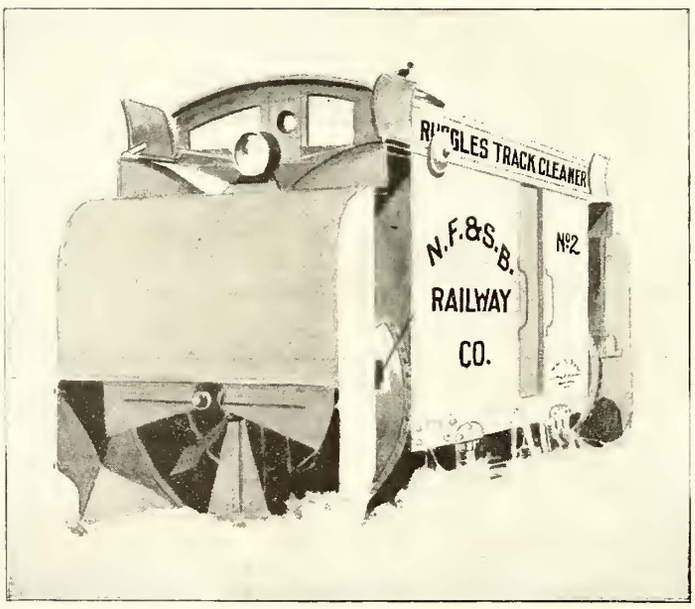
The rear truck is set well under the car for the purpose of carrying at least two-thirds of the load where the car is traveling up the steep grades. Two General Electric 800 motors are mounted on the rear truck. Their weight in addition to two-thirds of the load of the car and passengers gives sufficient traction to enable the cars to climb the hills without any slipping of the wheels on the track. There are no motors on the front truck. Separate brakes are used for each truck and the car always runs the same way. At one end the cars run around a loop and at the other end they are turned on a Y. In a recent letter received by the Peckham Company from Ira A. Bishop, manager of the Piedmont & Mountain View Railroad, Mr. Bishop says that the company has been using the swivel truck for six or eight months and that they are giving excellent satisfaction. No trouble has been experienced in running the cars down grades as the brakes are so powerful that the wheels can be locked anywhere in case it is found necessary to do so.

The arrangement of the springs on the truck makes it possible to remove quickly and easily the bolster and elliptic springs whenever it becomes necessary to examine and overhaul the motors.

The Peckham Snow Plow.

The large number of interurban railways being operated in different parts of the country and the large number of city railways which extend far out into the suburbs has emphasized the necessity for some efficient method of dealing with the snow problem. This is an important question on some roads, especially in the open country where snow drifts are common, especially in cuts, and where the track is depressed below the level of the surrounding region. The experience of steam railroads has shown that ordinary plows not only are often incapable of caring for this service, but with heavy drifts a greater amount of power is required than with the rotary track cleaner. As a result the latter style of plow is generally employed now on our Western steam roads, the managers of which would consider the operation of their lines without its aid as almost impossible.

The only difference between the plow illustrated below and a steam rotary plow is that the motive power is furnished by electricity, making it capable of use on electric roads. The plow is not a new one, having been brought out several years ago by



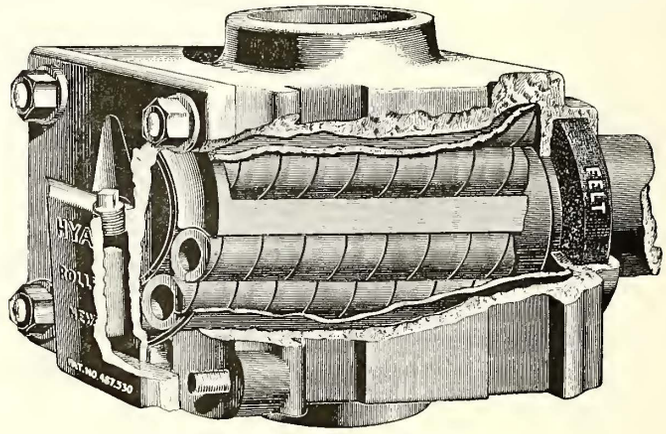
ROTARY SNOW PLOW.

George W. Ruggles, and plows of this description have been in extended use on the Rochester Railway, Buffalo Railway, Niagara Falls & Suspension Bridge Railway and elsewhere. The right to manufacture this plow however has recently been secured by the Peckham Motor Truck & Wheel Company, and this company is now placing them on the market.

The records in Rochester on the Rochester & Charlotte line show that the plow accomplishes more work in an hour than fifty men could do with shovels in a day. The cleaner went through drifts in many places four feet deep leaving a clean cut and not throwing up objectionable piles of snow on either side, and having gone through once the track could be widened—a strong point. The superintendent adds that no push plow or sweeper could have done the work accomplished by the rotary cleaner last winter. Four men only were necessary to operate the car. On the Niagara Falls & Suspension Bridge Railway the plow removed snow without the aid of a shovel to the depth of five feet, and the superintendent states that by means of the two used last season a saving of $1000 was made in the cost of removing snow. Similar records are given elsewhere. The general manager of another important line using the plows states that "without them it would have been impossible to have operated many of this company's lines extending into the outskirts of the city. No one can make a mistake in using the Ruggles rotary snow plows for exposed lines."

Roller Bearings for Street Cars.

Roller bearings have proved such an economical agent in so many varieties of machinery that it may have seemed surprising to some that they have not been more extensively used in the axle boxes of electric cars. The subject is one which should interest street railway managers as it relates directly to reducing the cost of operating electric cars. Experiments have been made in this line by the Hyatt Roller Bearing Company and this company has now placed on the market and will show at St. Louis one of its bearings for car axles. Anxious not to place a device of this kind on the market until it should be perfected, the company has done prac-



ROLLER BEARING FOR STREET CARS.

tically nothing until the present time in exploiting this device although it was invented several years ago, but has devoted the intervening time to careful tests of the bearing under different conditions of street railway traffic. These tests have given such universally satisfactory results that it is with full confidence that the bearing will satisfactorily stand the ardous conditions of electric railway service that it is now presented for public approval.

Soon after the Milwaukee convention in 1893 at which the bearing was exhibited one of the heaviest cars of the Milwaukee Electric Railway & Light Company was equipped with these boxes. They are in service on the car yet without having required any renewals or repairs and with no appreciable wear on the rollers. The boxes in use on the Albany Railway have also had an equally good record. The chief point of difference between these and other roller bearings lies in the fact that the rollers instead of being solid are made of flat coils of unhardened steel. This, it has been found, keeps the bearings in line and reduces the tendency to wear.

The end thrust is taken up by a cap instead of a check plate, and dust guards prevent the introduction of dust into the bearings. Experience has shown that but little oil is required. This oil is carried up by the rollers from the bottom of the boxes and the journal and end of the axle are thus lubricated. The bearings are applicable to all well known styles of trucks and are the lowest in price of any roller bearings ever put on the market.

New Cable Railway in the Isle of Man.

On Aug. 27, the new cable railway built by Dick, Kerr & Company, Limited, of London and Glasgow, for the Isle of Man Tramway & Electric Power Company was put in operation. The event was made the occasion of a celebration by prominent citizens of the Isle of Man, officials of the railway company, and representatives of the builders. The town was gaily decorated upon the opening day and the exercises included a long procession of the principal gentlemen interested in the construction of the line, escorted by the military. A dinner given at the principal hotel in Douglas on the evening of the opening day, and which was said by the local newspaper to have been the most sumptuous which has taken place in the Island any time during the last fifty years, was tendered to Dick, Kerr & Company to celebrate their spendid work in completing the upper town line of the road in the short time of four months.

Standard Motor Compressor for Air Brakes.

From time to time, the various types of air brake apparatus manufactured by The Standard Air-Brake Company, have been described and illustrated in these columns, and it is largely due to the efforts of this progressive concern that more attention is being paid to improvements in braking electric and cable cars. Fig. 1, herewith, shows the latest type of Standard gearless electric motor-compressor. The company long since discarded open style compressors, having found that for lasting service under street cars, with the severe conditions existing, it was preferable to have all exposed parts of the air-brake encased. Particular attention has therefore been paid to making the various parts dust and water proof. It will be noticed that the machine is iron clad, and that there is no chance for dirt or water to accumulate. It is furnished in capacities ranging from one-half to two horse power. All moving parts work in oil. A very important feature is the small space the machine occupies. The dimensions of the one horse power type do not exceed 12 ins. high × 15 ins. wide × 28 ins. long. It is thus possible to install the outfit under an ordinary car seat, instead of having to mount it on the platform, where at times it might be in the way.

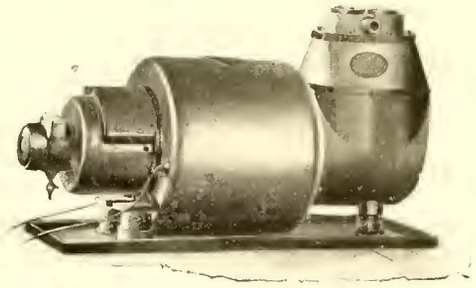


FIG. 1. INDEPENDENT MOTOR COMPRESSOR.

The running of this motor-compressor for thirty seconds will compress enough air to suffice for a half dozen stops. It will be seen from this that the motor-compressor is idle most of the time, thus ensuring long life of the apparatus. The vibration is taken up by cushions which prevent transmission of noise to car, and the motor-compressor runs very quietly. The compactness of the apparatus makes it practicable to suspend it under the floor of the car in case it should not be desirable to put it on the platform or under the car seat. It can safely travel in such exposed position without suffering injury or becoming inoperative. Oiling is necessary only at infrequent intervals. All parts are made to gauge, and replacements, should such become necessary, may be easily and economically effected. The Standard motor compressor differs from other types in that it is direct coupled, with corresponding absence from noise and the necessity of gear renewals.

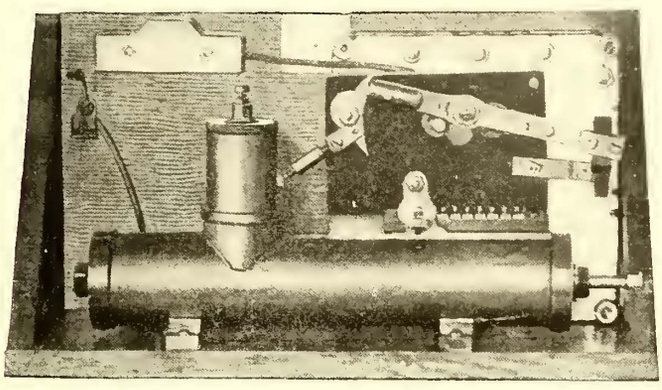


FIG. 2. CONTROLLING APPARATUS.

Realizing the undesirability of relying upon motormen to throw the current for operating air brake motor-compressors on and off, the company has for some time gone very carefully into the building of automatic controll ng apparatus which would relieve motormen from all such responsibility. The result of its labors is shown in the device illustrated in Fig. 2. This apparatus has been patented here and abroad and has been designed to meet every contingency. The action in starting and stopping is perfect and entirely automatic. When the current is interrupted by opening of circuit breakers, resistance is immediately introduced into the motor circuit. The same action occurs if the trolley flies off or the motorman removes the trolley on changing from one end of the car to the other. When the air pressure in the reservoir is released and when ordinarily, the motor would "run away" the resistance is also automatically placed in the circuit and the speed controlled. Conversely, when the motor-compressor is started with the reservoirs empty, the resistance is gradually cut out of the circuit as the air pressure increases. The speed of the motor is never excessive.

The Standard Air-Brake Company is now filling orders for motor-compressor air-brakes with its new controller. This type makes it possible to equip any electric car, train or locomotive, no matter whether there is any free axle space available or not. Where, however, there is a free axle space of from six inches upwards alongside of the motors, the company can also supply its single or double-acting compressors, driven either directly or indirectly from the car axle. Hundreds of these are in successful operation here and abroad.

A unique feature of the system is the interlocking controlling handle shown in Fig. 3. By using this, a mistake becomes utterly impossible when the motormen shift from one end of the car to the other. The handle must be inserted in one particular place and can only be withdrawn from that place. When inserted, it makes the air-brake operative from that end of car only. When withdrawn it securely locks the controlling valve at that end, leaving the other end locked until again opened by the insertion of the handle.

The pressure gauge is mounted on top of the controlling apparatus where the dial must constantly be seen. It is not possible for the motormen to be ignorant of the air pressure available. The pressure vane is not double headed, but is made in such shape as to make reading absolutely certain.

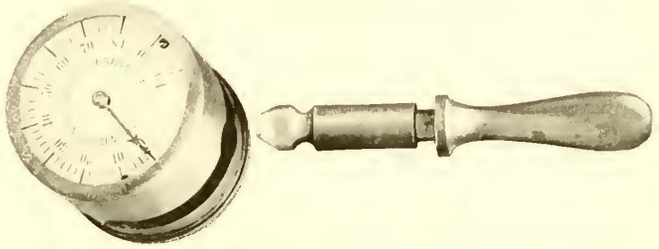


FIG. 3. CONTROLLING HANDLE.

Since last convention the company has made contracts to equip roads in the following cities among others: Pasadena, Buffalo, Brooklyn, Washington, Worcester, Akron, Philadelphia, Springfield, St. Catherines, Lorain, etc., and has shipped large orders to New South Wales, Germany and Switzerland. From a number of the cities mentioned as many as from three to six orders for additional equipments have come during the year.

The business has increased enough during the year to compel the opening of a store house in New York where a stock of air-brakes and sundries is carried. The location, 254 Water Street, is central and convenient for shipping. Since the company removed its factory from Chicago, and began manufacturing air-brakes within five miles from its headquarters, its business has steadily advanced. The company's general manager, Mr. Wessels, devotes himself very closely to the business, and it is due to his foresight, great business qualifications and unremitting energy that the company has made such enviable headway. Mr. Wessels' associates on the board of directors are chiefly international bankers of the highest rank. The company's chief engineer, Henry P. Merriam, has the reputation of being one of the ablest men in the field. His work has given him a wide reputation as an expert in the handling of engineering problems.

The Use of Belts in Electric Railway Power Stations.

While some of the larger electric railway companies of the country have installed direct connected apparatus, there are many electric railway engineers who are extremely partial to the use of belts, especially where the number of cars in operation is less than fifty. The first cost for a belted plant is undeniably less than that of a direct connected plant of the same output. This in itself is an important item, especially to those lines which do not have a very large traffic, or with new lines where the amount of traffic cannot be accurately determined, and where therefore the practice of economy in first cost is desirable. The other financial consideration, that of economy in operation, is one upon which engineers differ. That the advocates of direct connected machinery claim a higher economy is undeniable, but if this be so the difference is slight, if any, according to the advocates of belted machinery. The high economical figures, the latter claim, obtained from direct connected machinery, is due largely to better design of the recent machines, while it is undeniable that belted and rope driven plants have shown such excellent results, from an economical standpoint, that the total power lost in the belt must be an almost unappreciable percentage of the total.

Another advantage in belt drive, especially for small stations where the fluctuations in total load are very great, lies in the flexible connection existing between the engine and the generator. In a belted plant, the belt performs the same function between the generator and the engine that a car spring does between the wheel and the car body, in rendering the changes in load less abrupt. Again, the ability to operate several generators from the same engine gives less liability of the shutting down of the plant from an accident to

either one engine or one generator. All of these points affect particularly the roads in the smaller cities where real estate is cheap and where the increased amount of floor space necessary in a belted plant does not amount to a very large figure.

Among the manufacturers of belts, Chas. A. Schieren & Company state that there is still a large demand for their belts from electric railway stations, and believe that their advantages are becoming more generally recognized. Messrs. Schieren & Company have always occupied a leading position as manufacturers of belts of this description and have made a specialty of this kind of work. Their tannery at Bristol, Tenn., is illustrated on this page.

The plant has a capacity of 60,000 heavy belting hides per year and is used for tanning the best grade only of oak tanned leather for belting purposes, the leather being treated with a view to the longest possible life in leather belting.

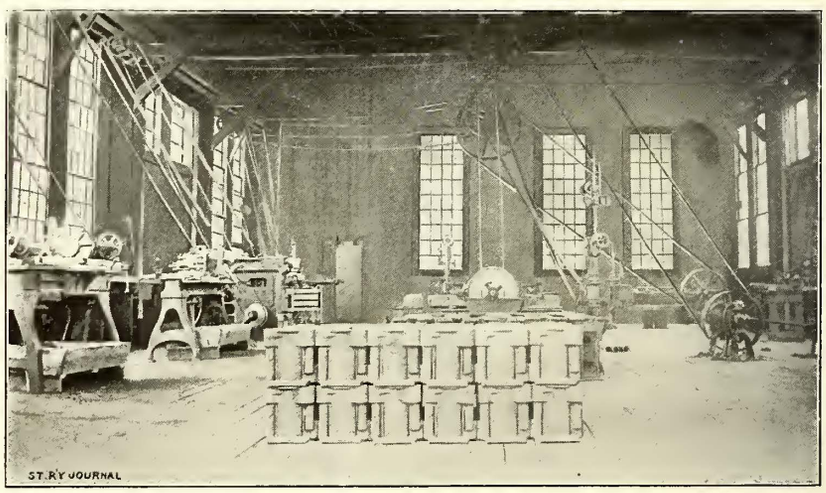
DIXIE TANNERY, BRISTOL, TENN.

The hides are brought from Chicago, the largest beef market in the world, where the greatest choice of quality is found. After remaining at Bristol for eight or nine months and being thoroughly tanned and curried, the finished product is sent to New York City where it is cut up and made into belting by Chas. A. Schieren & Co., whose extensive factory is situated in the old historic "swamp" district of the city. Thus it will be seen that in the history of their belts every factor from the choice of raw hides to the finished product is considered with a view toward perfect results.

This firm makes a specialty of wide main driving belts for electric light and street railway use. Among recent contracts awarded it are three sixty-four inch wide, three-ply leather belts and thirty-five dynamo belts for the Southern Electric Light & Power Company, of Philadelphia, and two seventy-two inch wide, three-ply leather belts for the Municipal Electric Light Company of Brooklyn, N. Y., the latter order taking the hides of 540 heavy steers in its construction.

Works of the Hunt Air Brake Company.

The Hunt Air Brake Company's works are situated at New Kensington, about eighteen miles from Pittsburgh, on the line of the Allegheny Valley Railroad, Kensington having the same freight rates as Pittsburgh. The works, which are 60 ft. × 150 ft., are located at the foot of Ninth Street, on property of sufficient dimensions to put in a foundry and larger fitting shop for castings later on as the extension of the business demands it. The illustration shows the assembling department. On the right are over one hundred bins (a portion of which are in sight), in which are kept different kinds of pipe fittings, bolts, cap screws, steel bolts, brake cylinder, and pump fittings of all kinds, for repair parts or for new work as needed. One of the company's oscillating pumps, run by belting from main shafting, is seen close by. This pump is used for testing purposes, compressing air as high as 125 lbs. per square inch. This air is stored in a large tank of about 40,000 cu. ins., placed in the cellar. From this tank, pipes are run to the testing bench, which is seen on the right below the pump. The main pipe runs along the back of the bench for twelve feet, and has eight openings or outlets, so that a number of workmen can test different parts at the same time, without being in each other's way. A special feature of this testing bench is that pressure of any desired amount can be forced into auxiliary tanks, for testing parts where a certain pressure per square inch is necessary, as in the case of setting and adjusting the automatic pressure valves or adjusting springs for the switch cut-outs, without interfering with workmen testing brake cylinders or other parts, where so high a pressure is not required.



ASSEMBLING DEPARTMENT, HUNT AIR BRAKE WORKS.

In front of the engine will be placed a dynamo of the Westinghouse make, to be used in testing motors and pumps, and for lighting purposes. This machine has a capacity of fifteen amperes and 500 volts.

Towards the rear, and near the center, is the boring mill, which is used for boring brake cylinders, pump and housings. It has a special clamping device by which the four jaws are moved together, by one handle, and will place automatically any style of casting central with the boring bar, after the first one is adjusted. This machine has ten speeds and the same number of feeds, and will bore accurately a brake cylinder 7 ins. diameter × 14 ins. long, including facing ends and putting in and taking out of machine, in forty-five minutes. It is a vertical mill and is much easier and convenient to operate than any horizontal mill built at the present time. Another feature is that the chips fall out below and the operator has a clear and unobstructed view of his work at all times. By using the adjustable table, the machine can be changed to a drill press for light or heavy work, in a very short time.

At the left of the boring mill is a common type of drill press of the Prentiss make. The only feature of note over any ordinary drill press is the tapping attachment, whereby all pieces requiring to have the holes tapped are done by power. The spindle is so arranged that a tapping head can be attached, being so arranged that after a hole is tapped to the desired depth the tap slips on a friction socket and remains at a standstill, while the drill press spindle continues to revolve. By a friction clutch and backing belt, the tap can be reversed and removed. The advantage of this is twofold; first, all holes are tapped centrally, and second, all holes are tapped alike, so that one bolt does not fit loosely and another tight, all fitting properly and alike.

In the row of machines on the extreme left, beginning with the rear, is a special lathe for drilling small holes and grinding valves. Next is a No. 24 Brown & Sharpe milling machine, used for facing, cutting gears and any other parts of our work requiring facing or milling. Next in line is a twenty-four inch shaper, used for all planing and facing that cannot be done on the milling machine. Next is the latest and most improved style of brass turret lathe. The last two machines are lathes for making tools and turning up pistons, cranks and work of like nature.

All parts of the brake are built from case hardened steel templates; every machine which does a particular part being equipped with the necessary jigs, so that there is no time lost in fitting up for any given part.

In the rear, partitioned off from the main building, is an eighty horse power, horizontal tubular boiler, fired by natural gas, and back of this is a large stationary forge, with all the necessary tools for making and dressing machine tools and small forgings used in the brake. The plant is supplied with power from a forty horse power, automatic Brownell engine.

The works are adjacent to those of the Pittsburgh Reduction

Company, at whose foundry all brass castings for the work are supplied. A foundry for furnishing castings of iron is also located conveniently near the Hunt Air Brake Company, and the largest pipe works of the country are easy of access, within the suburbs of Pittsburgh, so that the factory is conveniently located in the matter of securing supplies, as well as in the equipment of its plant.

The company is organized under the laws of the state of Pennsylvania. Its president is Alfred E. Hunt, secretary and general manager, Geo. E. Pratt, and treasurer, D. L. Gillespie. Among its stockholders are some of the leading and wealthiest business men of Pittsburgh. The capital stock of the company is $50,000, and its offices are at the works and in Ferguson Block, Pittsburgh.

Duncan Trolley Base and Wheel.

The Duncan trolley base, herewith illustrated, and built under patents granted Apr. 18, 1893, is now in service on several prominent railways throughout the country and is giving good results. Malleable iron and wrought forgings are the materials used in its construction, each piece being carefully fitted. The tension, which is secured by the cam on the lower end of the pole socket, can be adjusted to suit any weight of trolley wheel. When the springs have been set to the required tension, the end plugs are screwed in place, forming a complete covering for the spring, and protecting it from the snow and sleet of winter. The trolley is but twenty inches long, and weighs only sixty pounds, making it easy for one man to handle. It is specially adapted for low bridges and tunnels, as the pole can be brought down to seven inches above the car roof. The patents cover the use of the cam for securing tension in a trolley.

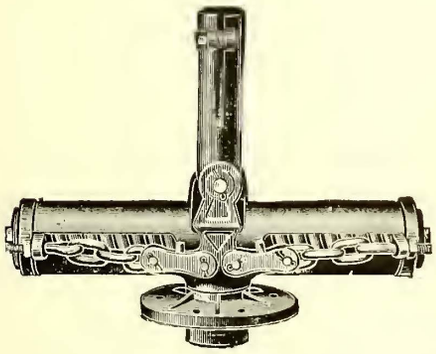


FIG. 1. TROLLEY BASE.

FIG. 2. WHEEL.

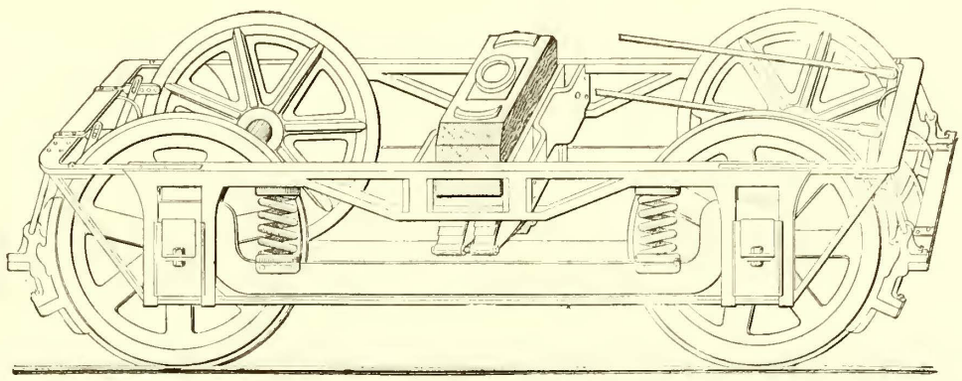
The Duncan self oiling trolley wheel is also said to be meeting with great success. Wheels put in service last December are running to-day, and show very little wear. This is a ten months' run and will bear investigation by railway managers who wish to reduce operating expenses. The wheel is made of bronze, cored out in the center to hold sufficient oil for about eight days' run. The bushings are of hardened tool steel, while the pin is also of hardened steel. The oil in the reservoir keeps both pin and bush well lubricated, making wear almost impossible.

The patents of the above trolley base and wheel are owned by the Simonds Manufacturing Company.

Imperial Swivel Truck.

The accompanying engraving represents the Imperial 999 truck of the Fulton Truck & Foundry Company, built especially for interurban railway work. As will be seen the whole construction of the truck is substantial, and such as to best withstand the heavy service to which in interurban work the truck is subjected.

The Imperial 999, it is claimed, is composed of less parts than any truck on the market. The side frame to which is attached the oil box jaws, is a steel casting in one piece. In this way the use of many bolts and rivets so often employed in truck constuction is avoided. The carrying bars are made fast to the journal boxes and in such a manner as to hold them in their proper position when the brakes are set and there is no tendency for them to lose their alignment. This, the manufacturers of this truck claim, is an important point especially where power brakes are used, as the strains to which the connections between the carrying bars and journal boxes are subjected during emergency stops, are such as to tend to part the two.



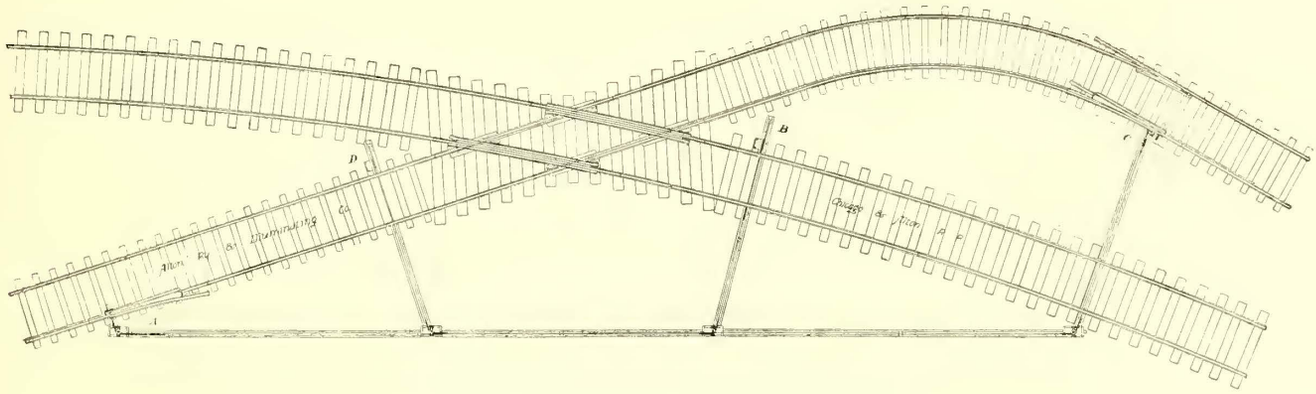
IMPERIAL SWIVEL TRUCK.

The truck is equipped with a simple and effective brake. The spring adjustments are of such a nature as to save the rail joints, the journals and wheels and make the car easy riding, a very desirable feature, as a large part of the travel on interurban cars is that of pleasure seekers.

Protective Device for Grade Crossings.

The illustration below shows a device manufactured and sold by the Paige Iron Works, to avoid accidents at the crossings of steam railways by electric roads.

This particular derailing device was put in recently at Alton, Ill., where some protection of the kind was deemed essential. A derailing switch is placed at either side of the crossing and approximately fifty feet distant from the same. The normal condition of the switch is to derail the electric car and in order that the car may safely pass the switch the conductor of the electric car is obliged to cross over the railroad track and by raising the lever open his line. The object of placing this throwing lever at the crossing is obvious, as the conductor in crossing the track to the lever has a full view of the steam track each way. In this particular case, advantage was taken of the curves in both electric and steam tracks as will be seen by the above illustration. In case of derailment, the electric car will not approach the steam track, but move parallel with it. The derailing switch, A, is thrown by lever B, as is also the switch C thrown by switch lever D. When a car has passed the crossing and is trailing through the second switch, each wheel flange closes the switch point which is again opened automatically by a spring.



PROTECTIVE DEVICE FOR GRADE CROSSINGS.

New Air Brake System.

The Christensen air brake system, which was put on the market some time ago has recently been improved by the Seamless Construction Company, by whom it is now exploited. The brake equipment with pump on the axle is illustrated diagrammatically in Fig. 1. The pump, which is enclosed and self-contained, is hung upon one of the axles of the car and simply suspended by its rear end from an elastic suspension, secured to the truck frame. All working parts are protected from dust by the casing, which also answers as a receptacle for the lubricant. The pump is worked by an eccentric and strap inside the casing. The plunger is single acting

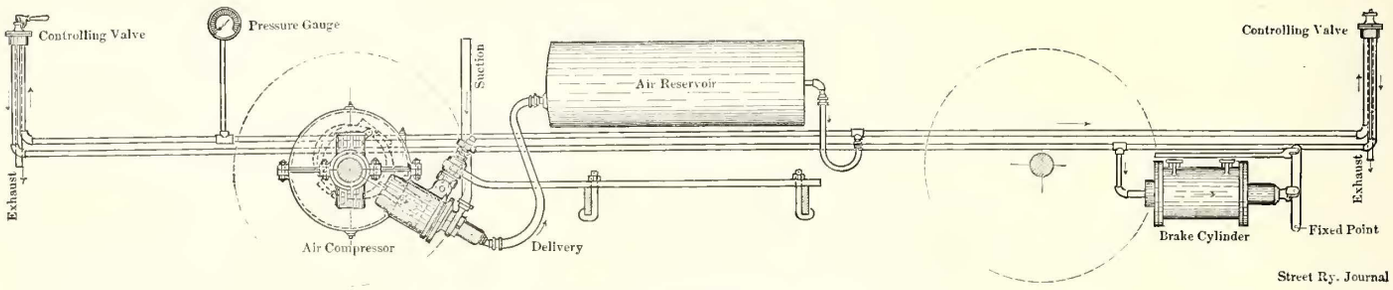


FIG. 1.—AIR BRAKE EQUIPMENT FOR SINGLE CAR.

and is connected to the eccentric strap by an extra large case hardened steel pin, working in a phosphor bronze bushing. A grease box on the outside of the casing, feeds oil to the side bearings of the latter upon the axle. They are also lubricated by an oil chamber on the side of the casing beneath the bearings which, by means of a felt wiper, supplies oil in the same manner as on the main journals of the truck axles.

The pump is readily accessible and can be mounted on the axle or dismounted in less than twenty minutes. On the back head a combination consisting of three moving parts performs the function of suction valve, discharge valve and regulator. The latter is for the purpose of letting the air escape back through the suction to the atmosphere as soon as the maximum pressure is reached. To the inlet spout is attached a rubber hose which is connected either with the inside of the car or with a dustproof casing so that no impurities or grit can enter the pump. The air reservoir is a seamless, cold drawn steel shell made by a new process and tested at 500 lbs. per square inch It is fitted with a check valve to prevent the air from escaping back through a possible leak in the combination on the pump when the car is out of use for some time.

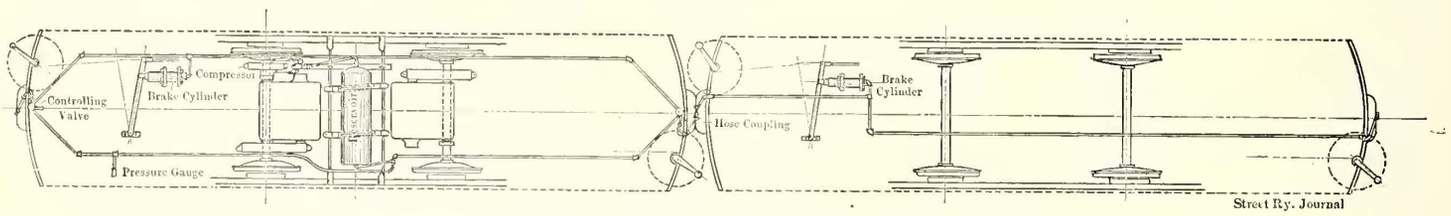


FIG. 2.—AIR BRAKE EQUIPMENT FOR MOTOR AND TRAIL CAR.

The pressure gauge is of the ordinary approved pattern. The controlling valve is a special feature and is so arranged that a man, even with the most primitive ideas, cannot misuse the brake. The handle is about five inches long and is turned an angle of about 90 degs. to effect an emergency stop. The service stop is a separate notch and by moving the handle to this notch, a pleasant, easy stop, without jar, is obtained. There is absolutely no excuse for the motorman making any other kind of stop, unless in emergencies, when he must move the handle as far as it will go. This arrangement also avoids flat wheels because the application is even and if the wheels should skid on a bad rail, the brakes can be instantly slackened. The wheels will then revolve with the brakes still partly set.

This air brake is applicable to trail cars as well as motor cars. When trailers are used the brakes are set from the motor car and the air is conveyed to the trailer through an ordinary hose coupling. The equipment of a trailer simply consists of a brake cylinder and piping.

When starting out with an empty reservoir a run of some three or four blocks is required to give enough air pressure for making a stop, but experience has shown that on all the brakes so far in use, the air pressure when once gained, is retained, not only over night, but for several days. The power required to run the pump is said not to exceed an average of ¼ h. p. and in distances with few stops it is considerably less.

The air brakes on the single and double truck cars on the Milwaukee Street Railway equipped with the brake have now been in continuous and uninterrupted service for about fourteen months, during which time there have been no accidents or collisions of any kind. The repairs to the brake, it is said, have been merely nominal. Only one car wheel (defective in casting) has been replaced during this period, in which the car has run about 60,000 miles.

The Christensen independent motor compressor is shown in Fig. 3. Some of the most important objects sought in its design were as follows: all the parts must be easily accessible for removal and repairs; the motor and pump must be so constructed as to require no attention by the motorman, while in service, and should be able to remain in continual service for at least four months, without repairs or overhauling of any kind; in operation the equipment should be nearly noiseless; the current for operating the motor should be automatically controlled by the maximum and minimum air pressures; the limit between these pressures should not exceed fifteen pounds, the automatic switch for this purpose should also be arranged to be operated manually.

With these requirements in view, the apparatus illustrated has been constructed and has been operated for several months, with, it is said, satisfactory results.

The combined motor and pump, of which an illustration is given in Fig. 3, has two cylinders with single acting plunger pistons fitted with an improved form of packing and with steel case hardened and ground wrist pins. The connecting rods are operated by a steel crank shaft, with cranks at 180 degs. apart. The crank shaft is extended at one end beyond the main bearing for receiving a gear wheel, meshing with a pinion on the armature shaft directly above. The base of the motor forms a top cover for the pump base. The gears are also enclosed by a suitable casing. At the gear end the armature shaft revolves in an extra long bronze bearing, provided with a stuffing box of improved construction. It will thus be seen that the interior of the pump is completely enclosed. The gear case is partly separated from the rest of the space inside the pump base in which the crank shaft revolves. The space in the pump base is partly filled with oil, say two or three gallons, and the gear case is partly filled with the regular gear grease. Experience has shown that with one supply of oil a pump will be lubricated for five or six months without replenishment.

The suction and discharge valves are conveniently arranged in the cylinder back cover in such a way that each is independent of the other and the pump may be run as a single cylinder pump by removing one of the suction valves. Furthermore, the suction valves and discharge valves are alike in every respect and are formed of a seamless, cold drawn steel cup, each valve weighing some two or three ounces. The motor is so constructed that by unscrewing a few bolts, the armature or fields can be removed and exchanged without disturbing any other part of the apparatus. The whole may be done in ten or fifteen minutes. The gear, as well as the pinion, can also be removed and exchanged, without disturbing any other part of the machine, and in like manner, the valves and cylinder cover may be removed without disturbing any other part of the machine.

The capacity of this pump is thirty-four cubic feet of free air per minute, which, at sixty pounds air pressure and 550 volts requires about nine amperes in actual running. In other words, it will charge an air tank, 18 ins. × 9 ft., from atmospheric pressure to sixty pounds per square inch in 2½ minutes. As the application of the brake for three cars requires three or four pounds, the pump is large enough to restore the pressure within a very small fraction of a minute.

The automatic switch controller is shown in Fig. 3. The maximum and minimum pressures are regulated by a small screw for each. This adjustment can be performed at any time by removing the top cover of the switch controller.

The resistance coils are arranged in the base of the controller, immediately below the operating mechanism and are so constructed that any defective coil may be removed and renewed without any trouble. The connection between the contact strip and buttons is formed with a brush as shown and so arranged as to be renewed or cleaned in a few seconds. The handle carrying this contact brush is arranged to be engaged or disengaged from the automatic machine, worked by the air pressures by simply pulling a small knob. This disengages the automatic part entirely and the switch may then be operated by hand, in the same manner as any other ordinary rheostat switch.

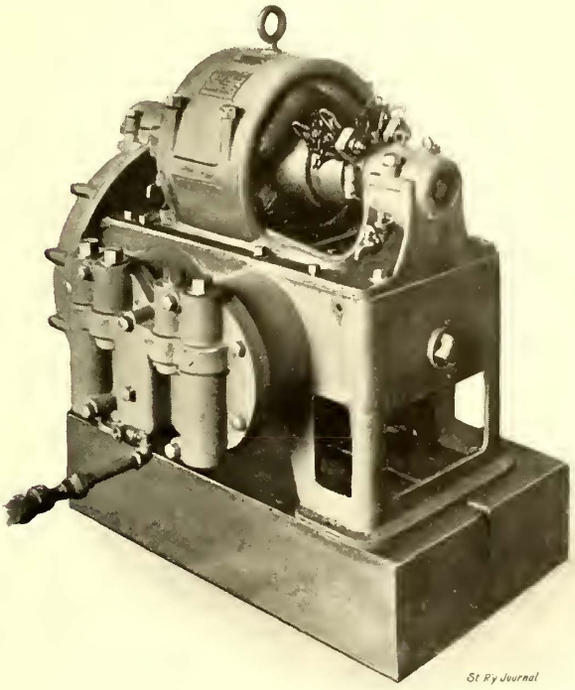


FIG. 3.—INDEPENDENT MOTOR COMPRESSOR.

The controlling valve consists of a main casting, suitable for receiving the reservoir pipe, brake pipe and exhaust pipe and has a balanced disk valve for controlling the admission or exhaust of air pressures from the brakes. This disk is perfectly balanced and has an improved method of lubrication so that sufficient oil can be charged into it to keep all parts lubricated for several months.

By turning the controller handle beyond the notches for admission and exhaust, which can be done immediately after leaving the station on an elevated road, the motor will be put in service, even if the air pressure has not fallen to the predetermined minimum. The pump is of sufficient capacity to restore the full air pressure to

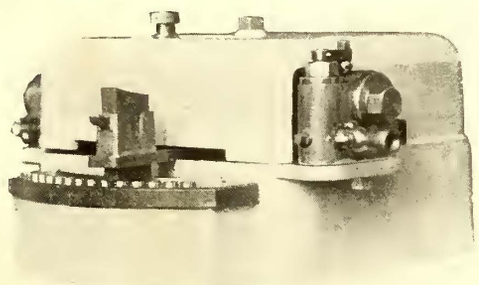


FIG. 4.—ADJUSTABLE RHEOSTAT.

its maximum between any two stations, at which time the automatic switch controller cuts off the current. This will occur long before the train has reached the next station. If the motorman, through carelessness, should forget to move the controlling valve handle past the regular release position, then by three or more applications of the brakes, the air pressure will drop to the minimum at which the automatic switch controller is set and the motor and pump are started by the controller, independent of the motorman's controlling valve.

This motor pump, as well as switch controller, may, of course, be used for either system of straight or automatic air brakes. The company is prepared to furnish both, having designed and patented a triple valve for use with the latter system. This triple valve has only two moving parts including a quick action attachment, as against five or six now in use on the ordinary triple valves. It has, furthermore, several advantages over other triple valves, the principal one being that with it the brakes in a train of one or two cars are released in practically the same time as when straight air is used.

A New Rail Bond for 50 to 500 Amperes.

Thomas A. Edison and Harold P. Brown have designed a new form of the plastic bond for electric roads where the full conductivity of the rail is not required. One inch from the end of each rail a shallow hole is drilled diagonally downwards into the junction of the base and the web. This hole is amalgamated by the Edison process and filled with the plastic alloy.

A U-shaped loop of amalgamated copper is inserted into a pair of these holes at each joint and is held upright by the angle plate. The copper is not clamped or riveted and is therefore free to adjust itself to every movement of the rails, since the plastic alloy adheres tightly to the amalgamated surfaces and forms a pair of flexible socket joints.

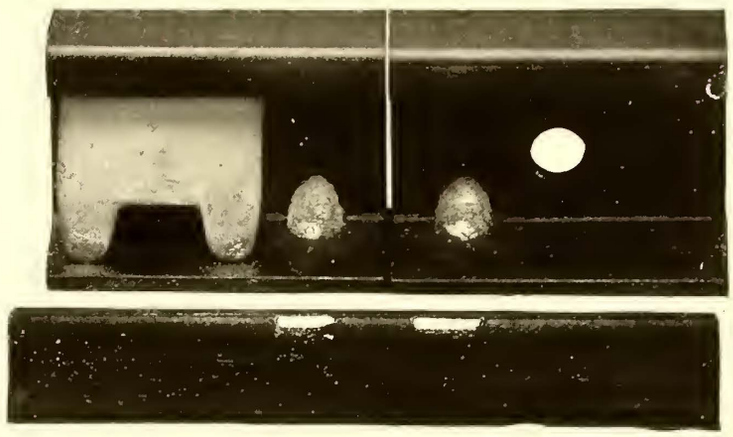


FIG 1.—SOCKET BEFORE APPLYING BOND.

FIG. 2.—BOND COMPLETE

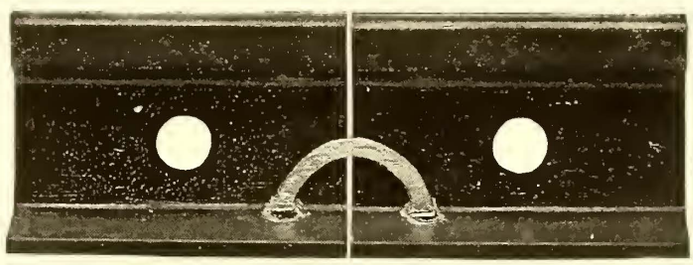


FIG. 3.—BOND APPLIED TO T RAIL.

These joints will allow the rails to move ¼ in. in any direction without disturbing the electrical contact. There is no mechanical stress on the copper and it cannot break or crystallize, and since it is amalgamated by the Edison process, it cannot rust or be injured by electrolysis. The electrical loss at the contacts is said to be very much less than that of any other form of copper bond.

As an example of the short life of ordinary copper contacts, some tests were made, Sept. 11, by Robert Dunning, master mechanic of the Buffalo Railway Company. The nine inch girder rails on the Niagara Street line were found to be carrying but twenty-five amperes each, instead of their proper load of 500 amperes. These rails were laid about two years ago and had at each joint two No. 000 copper bonds eight inches long. Examination showed that these were mechanically tight, but on removal, the contact surfaces were found covered with a black, greasy oxide.

Fig. 1 herewith shows the plastic socket bond before applying to rail. The copper strip shown is equal in carrying capacity to two No. 0000 wires.

Fig. 2 shows the bond complete. The girder rail has a hole one inch in diameter penetrating the web so that a copper strip can be used on each side to transmit heavy current. When necessary a small piece of flexible cork is placed on each side of the holes to prevent any of the plastic alloy from jarring out, but with ordinary sections this is not needed.

Fig. 3 shows a T rail and a No. 0000 copper bond inserted into one of the holes. This wire is flattened so as to fit behind the angle plate and has its ends bent forward to prevent it from being jarred out of the hole.

Air Brakes on Nantasket Beach Railway.

At the time the STREET RAILWAY JOURNAL published a description of the electrically operated railroad between Pemberton and East Weymouth on the Old Colony division of the New York, New Haven & Hartford system, particulars regarding the method of braking and contact were not obtainable. These have now been communicated to us.

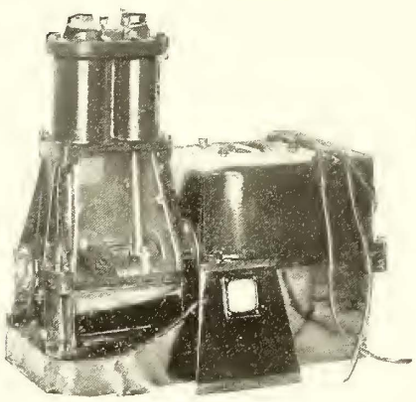


FIG. 1.—AIR COMPRESSOR.

It will be remembered that on the line from Pemberton at the extreme end of Nantasket Beach to Nantasket Junction, a distance of 6.91 miles, the cars are operated by overhead trolley contact. From Nantasket Junction to East Weymouth the electricity is taken by means of the sliding contact shoes from a third rail laid in the center of each track. When the cars start from the Junction station, momentum is given to the car by electricity taken from the overhead wire and it is carried over the third rail. The trolley then slips from the termination of the overhead wire, is pulled down and hooked and the shoes come into contact with the surface rail. A knife switch under the hood of

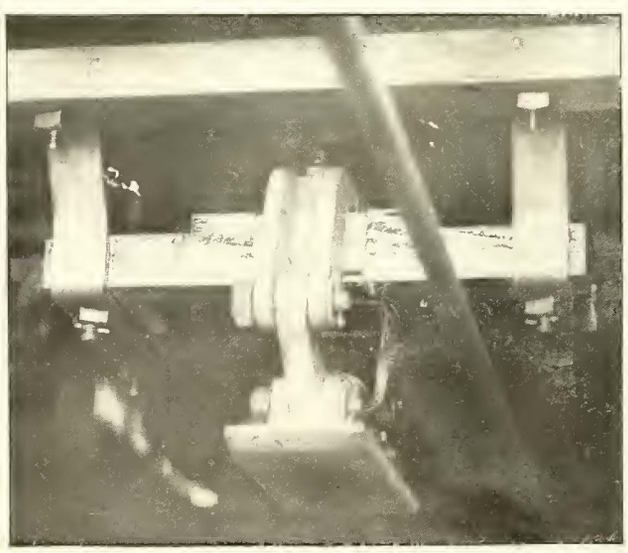


FIG. 2.—SHOE FOR THIRD RAIL.

the car being closed, the current from the rail is thrown into the motors and the operation of the train is continued without interruption.

One shoe is placed between the axles of each truck, immediately under the king pin. It is suspended by two links, and thus hangs loosely. This allows it to slide over the surface of the third rail without difficulty and to make perfect and continuous contact. The distance between each of the shoes on the car is thirty-three feet; thus at crossings, where no third rail is laid less than thirty feet wide, one shoe is always in contact with the end of one section or the beginning of the next; at wider crossings the impetus of the moving car brings the shoes into contact again before the car can come to rest. Each shoe is a cast iron plate twelve inches long, and five inches wide. It weighs about twenty pounds. It is connected to the motor by a flexible cable.

The air for the brakes is supplied by an electrically driven air compressor automatically controlled by the air pressure itself. The apparatus consists of a double vertical air pump with single acting cylinders, 5¾ ins. × 7 ins. stroke, directly connected to a series motor, the lower field of which is extended to form the base of the air pump. The connection between the two is thus rendered very rigid. The capacity of the pump is 52½ cu. ft. of free air per minute working against ninety pounds pressure per square inch. At this pressure the speed is 250 revolutions at 600 volts.

The air compressor is piped directly to the main reservoir, and is controlled automatically by a pneumatic governor consisting of a cylinder containing a piston working against a spring. The action of this automatic control is as follows: the pipe running from the main reservoir enters the cylinder below the piston. As the pressure rises the piston is forced upward against the spring. The other end of the piston rod carries the contacts through which the pump motor circuit is made and broken. Any arcs that may be made when the contact is broken are blown out in a magnetic field, the coils of which are connected directly in series with the motor.

As the pressure in the reservoir falls five or seven pounds, the piston is forced back into its normal position by the spring. The contacts are pushed down to their seat, the circuit is closed, current flows to the motor and the compressor starts. The circuit remains closed until the pressure reaches normal, when it overcomes the force of the spring, forces the piston upward, separates the contact, breaks the circuit and the motor stops. This operation is repeated automatically, the combination of motor and pump requiring practically no attention. These automatic governors can

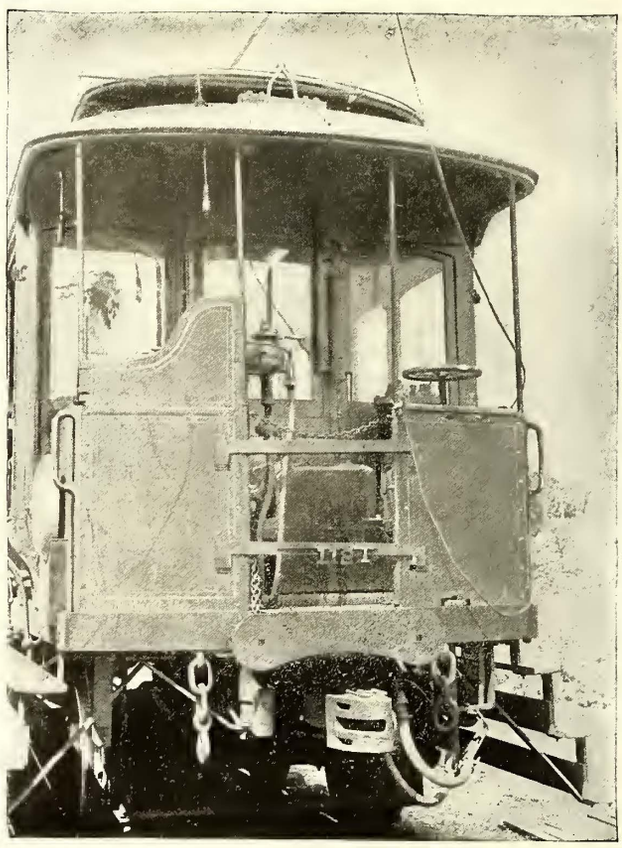


FIG. 3.—PLATFORM OF NANTASKET BEACH CAR.

be adjusted to any pressure from 45 to 100 lbs. and work on a difference of from five to seven pounds in pressure.

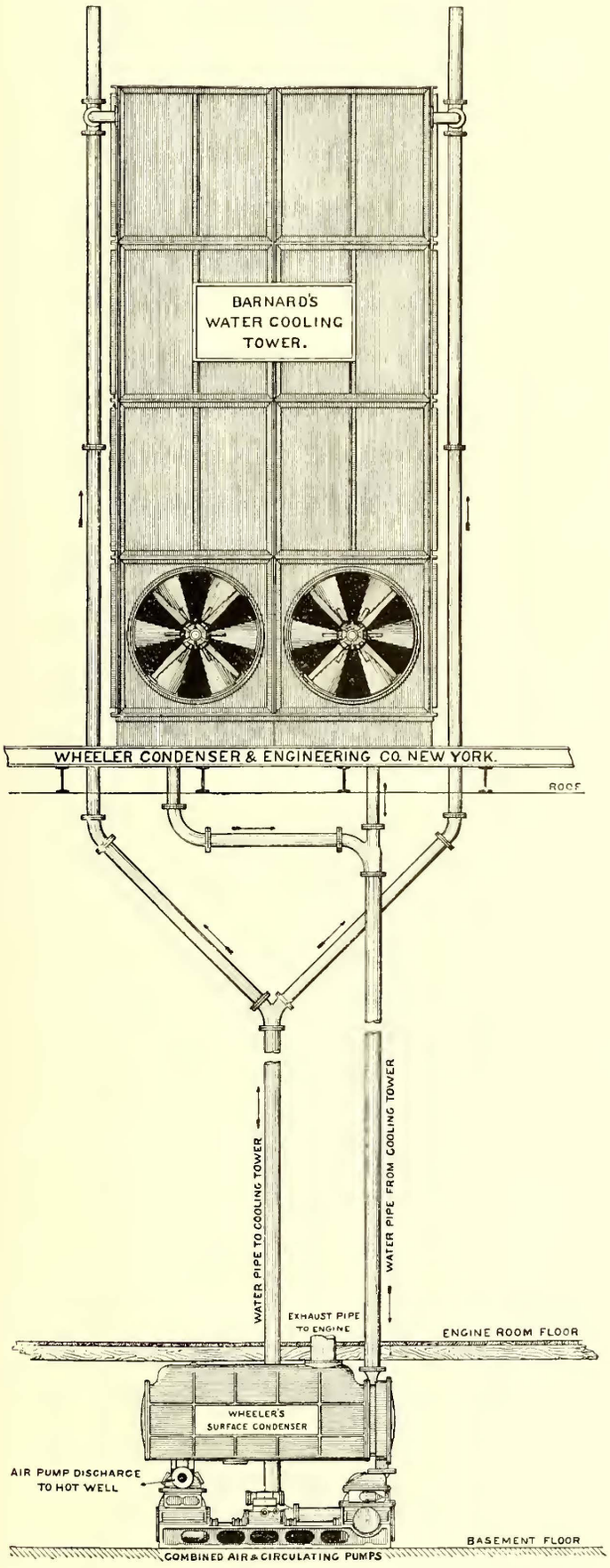
The development of the combined air pump, motor and automatic governor is due to the General Electric Company. It is of recent design and takes the place of the oscillating cylinder type of air pump with which the motor cars were originally equipped.

MESSRS HOWE & BEARD of Canandaigua have recently brought out a new air brake which is giving excellent results, it is claimed, in practice. Patents have been allowed to this firm for certain novel features of construction and it is said that the brake will soon be placed on a car in this vicinity, and one in the western part of the state for trial.

THE Selectmen of South Framingham, Mass., have granted the Framingham Union Street Railway Company permission to equip its Union Avenue line with electricity and the company will begin work at once. It is probable that the line will be extended to Marlboro.

Barnard Water Cooling Tower.

The use of multiple cylinder condensing engines, requiring from 1¼ to two pounds of coal per indicated horse power per hour, according to size, has, until recently, been prohibitory, except in localities affording abundant water for condensing purposes. The successful installation of several Barnard water cooling towers, under widely different conditions of use and in different localities, seems to offer evidence that these towers will enable a good condenser to maintain a degree of vacuum fully equal to that obtained by using water from natural sources; consequently, all steam power plants may be operated condensing. An electric station recently equipped with this apparatus is the Twelfth Street station of the Edison Electric Illuminating Company, of New York. The contract for the condensing apparatus was awarded to the Wheeler Condenser & Engineering Company. It included one of that company's standard surface condensers, mounted upon the air and circulating pumps placed in the basement, and a Barnard water cooling tower located on the roof, which is some seventy feet above the condenser. The up discharge pipe from the top of the condenser conveys the hot water to the top of the tower, and the pipe from the bottom of the tower conducts the cooled water down to and through the circulating pump and condenser to the up pipe. This water is kept in continuous circulation through the channels above described, and, sufficiently cooled in its transit through the tower to enable the condenser to maintain twenty-five inches vacuum, or better.



WATER COOLING TOWER.

The apparatus works smoothly and quietly. To see it in operation and the work it accomplishes, one would be more inclined to believe the injection water came from a river ten feet below the condenser, rather than from a small tank seventy feet above, and on the roof of the station.

On Apr. 2, 1896, a continuous six hour test of a De La Valle steam turbine was made, with an average load of 1402 amperes. Throughout the test the vacuum gauge ranged from 25 ins. to 26 ins., averaging 25.6 ins.; and on Sept. 2 a full load was carried for five hours, with an average load of 3628 amperes (about 732 i. h. p.); the vacuum averaged over 25 ins. It will also be of interest to state that the exhaust steam averaged 13,535 lbs. per hour, and that the losses by evaporation, etc., were only three per cent. of the circulating water, and did not exceed eighty per cent of the boiler feed-water when the engines were working condensing.

The combination arrangement of the Wheeler condenser, with its air and water circulating pumps, is particularly well adapted for use in connection with water cooling towers, as the air pump operates under the same conditions and maintains the same degree of vacuum as would result from an abundant supply of condensing water from the most convenient natural source. The water circulating pump also operates under ordinary conditions, with a comparatively small additional duty imposed upon it, to lift the circulating water possibly twenty-five per cent of the height of the building. The greater part of the lift is balanced by the down column of water from the cooling tower, which is circulated down one pipe and up the other, passing through the pump and condenser. There is not a building so high that this combination of the surface condenser in the basement, and the cooling tower on the roof, is not usable, as the apparatus is wholly independent of distance, either horizontally or vertically. Roof structures are largely a necessity in cities, but where ground room is available, the cooling tower may be situated at any convenient point.

The Barnard cooling towers are continuously efficient, as they are subjected to no wear or oxidation, the superficial surfaces being steel wire cloth (galvanized after weaving), made in mats and suspended in a vertical position, properly placed. The hot water from the condenser is evenly subdivided and distributed over the upper edges of the mats, uniformly flowing over and through them, compelling every square foot of the mats to do a proportionate amount of work. The space occupied by the tower is small, and the power required to operate is estimated at from two per cent to psosibly five per cent of the main engines, according to conditions.

Electric Locomotive Service.

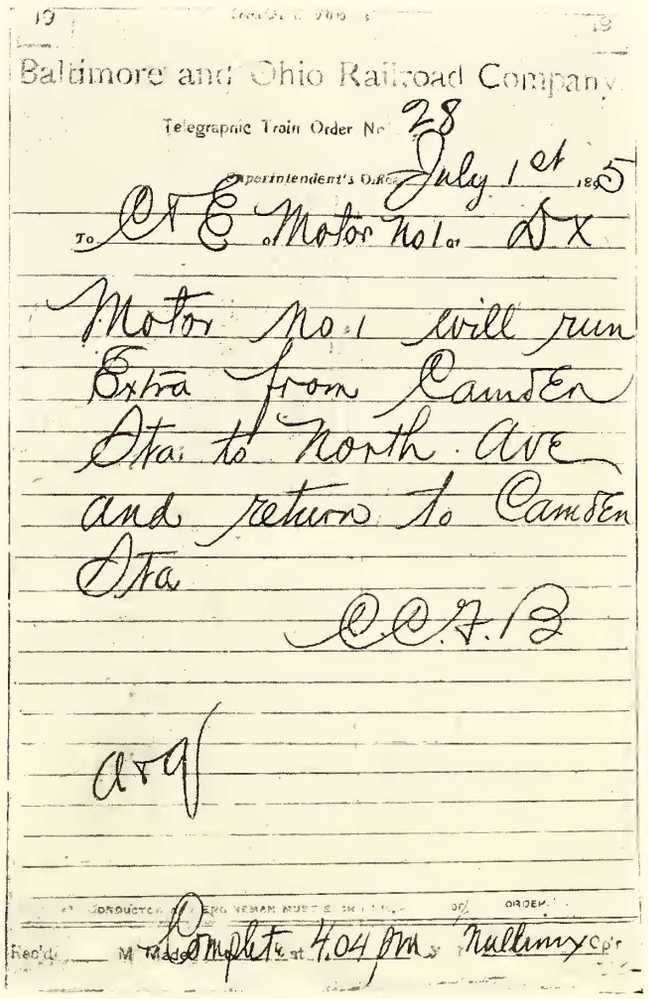
It is now more than a year since the electric locomotive service was inaugurated through the Baltimore Belt Line tunnel. On Aug, 4, 1895, the Locust Point-Canton Ferry was discontinued. Since then all the northbound freight service of the Baltimore & Ohio road has been carried on through the tunnel by electricity. For four months locomotive No. 1 handled this, being held ready for duty for twenty-four hours a day. With a single exception only, no delay in the train service can be charged against motor No. 1. This exception occurred three months after the service was started, and was due to a loose wheel.

Since its inauguration the train service has been handled entirely by Baltimore & Ohio enginemen, who were assigned to duty on the electric locomotive. These men experienced but little trouble in acquiring the requisite amount of skill to handle the locomotive satisfactorily, without the assistance or presence of an electric expert. They are now able to handle a freight train under all conditions with far greater dexterity than with a steam locomotive. On one occasion a freight train weighing nearly 2000 tons, was started on a grade of eight per cent and brought to a speed of twelve miles per hour in less than two minutes. The drawbar pull exerted during acceleration was over 60,000 lbs. A dynamometer car used in heavy steam railroad work was put behind the electric locomotive and the drawbar pull for various weights of train and different currents was noted. From this data, curves, which are fairly accurate, showing the pull for any current, were obtained. It was found necessary to unconple a portion of the train, as the dynamometer car was unable to register the highest drawbar pull during the acceleration of the "ruling" freight train.

No. 2 locomotive was put into service Dec. 1, of last year, and No. 3 about May 1 of this year. Following the suggestion of General Superintendent Fitzgerald, of the Baltimore & Ohio Railroad, both are fitted with a controller operated by a lever directly connected to a system of movable vertical contacts. This lever is arranged very similar to the throttle of a steam locomotive. The experience of the motor engineers shows this to be a very satisfactory arrangement.

No. 1 locomotive, however, is fitted with a controller which operates by a wheel through a system of levers and gearing to a horizontal system of contacts which connect in multiple the resistance for the different steps on the controller.

One of the more striking performances of No. 2 locomotive consisted in the acceleration of a freight train weighing 1300 tons, on the eight per cent grade, to twenty-three miles an hour in about one minute and thirty seconds. The start was made without an inch of slack in the entire train. A current of 3600 to 4200 amperes was used during the greater portion of this acceleration. The greatest current used indicated a drawbar pull of over 60,000 lbs. at an estimated speed of eighteen miles per hour, which effort is, in mechanical horse power, about 1800 h. p. It is interesting to note that these


Baltimore and Ohio Railroad Company

Telegraphic Train Order No. 28

Superintendent's Office, July 1st, 1895

To C & E Motor No 1 at D X

Motor No 1 will run Extra from Camden Sta to North Ave and return to Camden Sta

C.C.F. 12

Rec'd ___ M Complete at 4.04 PM Mullinix Op'r

FIRST TELEGRAPHIC TRAIN ORDER EVER ISSUED TO AN ELECTRIC LOCOMOTIVE ON A TRUNK LINE.

very heavy currents were handled at a line potential of 725 volts. This test was made to show the extreme range of the locomotive. The controller is thoroughly protected by the well-known Thomson magnetic blow-out. It was only from the ammeter which is in circuit, that the heavy currents which were handled were apparent.

The passenger service has not yet been undertaken, on account of the non-completion of the uptown passenger station, and because the overhead work as at present erected, is not adapted to handle the passenger service with the proper dispatch. The Baltimore & Ohio Company is extending the overhead work and upon the completion of Mt. Royal station, in the course of a few weeks, expects to take all passenger trains through the tunnel by the electric locomotives.

The original contract with the Baltimore & Ohio Company calls for sufficient generating capacity to operate two electric locomotives on the grade at the same time, each pulling a freight train. As the freight service does not at present call for this heavy duty, the Baltimore & Ohio Railroad, under the supervision of Dr. Louis Duncan, its consulting engineer, has contracted with a street railway company of Baltimore to sell to it the surplus power that has resulted. This street railway service is performed at no increased expense for labor and but a slightly increased expense for fuel. The revenue from this service now amounts to enough to pay all expenses of the power station, the wages of the motor engineers, and to furnish a considerable surplus. The advantages accruing from this course are so apparent that a fifth power unit is to be installed as a reserve. A motor booster will also be installed, so that the generators can be run continuously on the street railway circuit, and the current necessary for the locomotive service taken from the same machines and at the increased potential due to the booster.

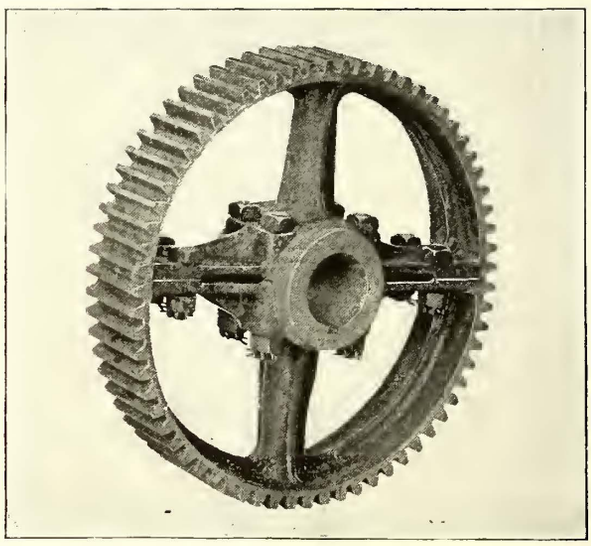
In addition to the apparatus for the electric locomotive service, the power station includes a lighting plant of 400 arc lights capacity, and when the present alternations are completed, an alternating current output of 450 k. w. The Baltimore & Ohio Company is using this to light its various stations and shops in the vicinity of Baltimore. The saving on this account amounts to quite a large item. A small locomotive has recently been ordered to be used for switching purposes on some of the streets of Baltimore. The cars are at present switched by horses, and the saving with the new power will be considerable.

The successful operation of electricity for the train services has caused the heads of the various departments of the Baltimore & Ohio road to consider where electricity can elsewhere be used to supplant existing apparatus. They already have in mind the replacement of engines by electric motors in their elevators and in the shops of the company.

Steel Gears and Pinions.

The greater economy of steel gears compared with cast iron gears in street railway practice, has long ago been demonstrated by the experience of street railway managers. A careful investigation recently carried on extending over sixty-six railways in forty-nine cities, using not less than 7000 railway motors, revealed the fact that whereas the life of cast iron gears is somewhat over 30,000 miles, that of steel gears is nearly twice as great.

Apart from the advantages of longer life and higher efficiency it was also found that with steel gears the danger of their breaking was much less than with iron gears and consequent springing and breaking of shafts and frames much less liable to occur.



STEEL GEAR.

The metal selected by the General Electric Company for its gears is a strong, close, homogeneous steel, especially free from blow holes and possessing excellent working qualities. The teeth are cut out of the solid stock by finely made cutters of a shape determined by a great number of exhaustive experiments. The gear cutting machines used are both elaborate and expensive and are of unusually heavy design and accurate workmanship to turn out uniform gears. Each gear is rigidly inspected and subjected to severe test before leaving the factory.

The railway motor pinions are made from best hammered steel forgings, the teeth being cut with machinery giving the same accuracy as with the gears. Tests of similar rigidity are applied to them.

The State Board of Railroad Commissioners, of New York, has decided to grant the franchise to the Third Avenue Railroad Company, permitting it to build an electric railway on the Kingsbridge Road, to be operated by the overhead trolley system.

The Springfield & Southwestern Street Railway Company, of Springfield, Msss., has been incorporated by John B. Conklin, of Catskill, N. Y.; G. A. J. Milair and Jesse W. Starr, of New York; E. P. Bartholomew, J. L. Worthy and George A. Hill, of West Springfield, and W. H. Dexter, of Springfield, to build an electric railway from Springfield to West Springfield, Agawam and Suffield, Conn. Capital stock, $300,000.

Direct Connected Units.

The engraving on this page illustrates the type of direct connected apparatus which has become familiarly known as the "Kodak," and differs from other direct connected generating outfits in that the engine and generator have each their own separate shafts and bearings, while the connection between them is flexible and elastic.

This form of apparatus was brought out by Westinghouse, Church, Kerr & Company, while the merits of the application of engines by direct connection to dynamos was still being discussed, and a large number of such outfits were furnished and put in operation before other builders were furnishing direct connected apparatus of any kind.

This form of connection is the only one that takes into consideration an important engineering factor, the value of which increases with age. An armature is an electrical element which must be held central in its field and is supported by a shaft, subject to but little distorting strain, running in bearings which are practically free from wear. On the other hand an engine shaft is subject to severe strains, due to steam pressure on the pistons, giving rise to more or less flexure, under the best of conditions, and subject—even with the most generous bearings and lubrication—to considerably more wear than is incident to electric machinery. In fact all engines are provided with some means for compensating for such wear. Therefore the revolving shafts of engines and generators are under such different conditions as to cause their connection to be best made, it is claimdd, by a mechanism which shall not require close alignment, and be independent of wear upon either. In addition to this a certain amount of elasticity is manifestly desirable in the presence of the shocks incident to electrical service, as has been frequently demonstrated through the use of the Westinghouse spring coupling. The patents on such couplings have caused this application to be confined almost entirely to Westinghouse apparatus.

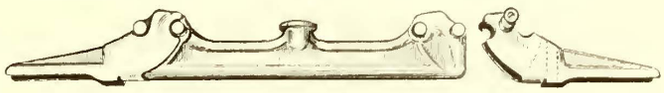
The Westinghouse interests also furnish the engine type generator fitted to the Westinghouse engine shafts where desired, though maintaining the engineering superiority of the "Kodak" type of apparatus.

The Westinghouse compound engine is so well known that it scarcely needs specific description. As a high speed engine it has been furnished in large numbers and its special features in street railway work are its high average economy under widely varying loads due to the peculiar steam distribution, which holds the economy practically constant through wide ranges of cut-off, which is effected on both cylinders by a single valve; its quick regulation, by which is meant the ability to meet the conditions of the change of load within a short space of time, quite independent of the mere matter of regulation within a given percentage in revolutions per minute, and also the running qualities, which adapt it to long continued operation under severe conditions, have always been characteristic of Westinghouse engine designs, whether compound or otherwise. It may be said regarding this form of engine that it stands quite alone in its design. The Westinghouse units most commonly employed in street railway service are 200 h. p., 330 h. p. and 600 h. p.

Automatic Live Wire Cut-Out.

Whatever danger is supposed to lie in the 500 volt current is harmless, so far as the public is concerned, so long as the trolley wire remains insulated and suspended at a height of eighteen feet or more above the street. Should, however, the trolley wire be broken by the falling limbs of trees or by other bodies or should it be pulled down by the trolley pole of the car, there is a great advantage in being able to disconnect the broken ends of the trolley wire. It would be still more advantageous to arrange the trolley wire so that it would disconnect itself automatically in case of break.

It is this result which the cut-out, illustrated in the accompanying engraving and which is manufactured by the Live Wire Cut-Out Company, accomplishes. The construction of the device is clearly shown in the engraving. It is similar in general appearance to an ordinary line cut-out or hanger ear, except that the ear is in three pieces. The end pieces lock into the central piece so long as the tension of the trolley wire keeps their lower edges horizontal. As soon as the tension on one side is relieved, however, the end piece tends to drop down, and this immediately disengages it from the lugs on the central part from which it drops, breaking the circuit.

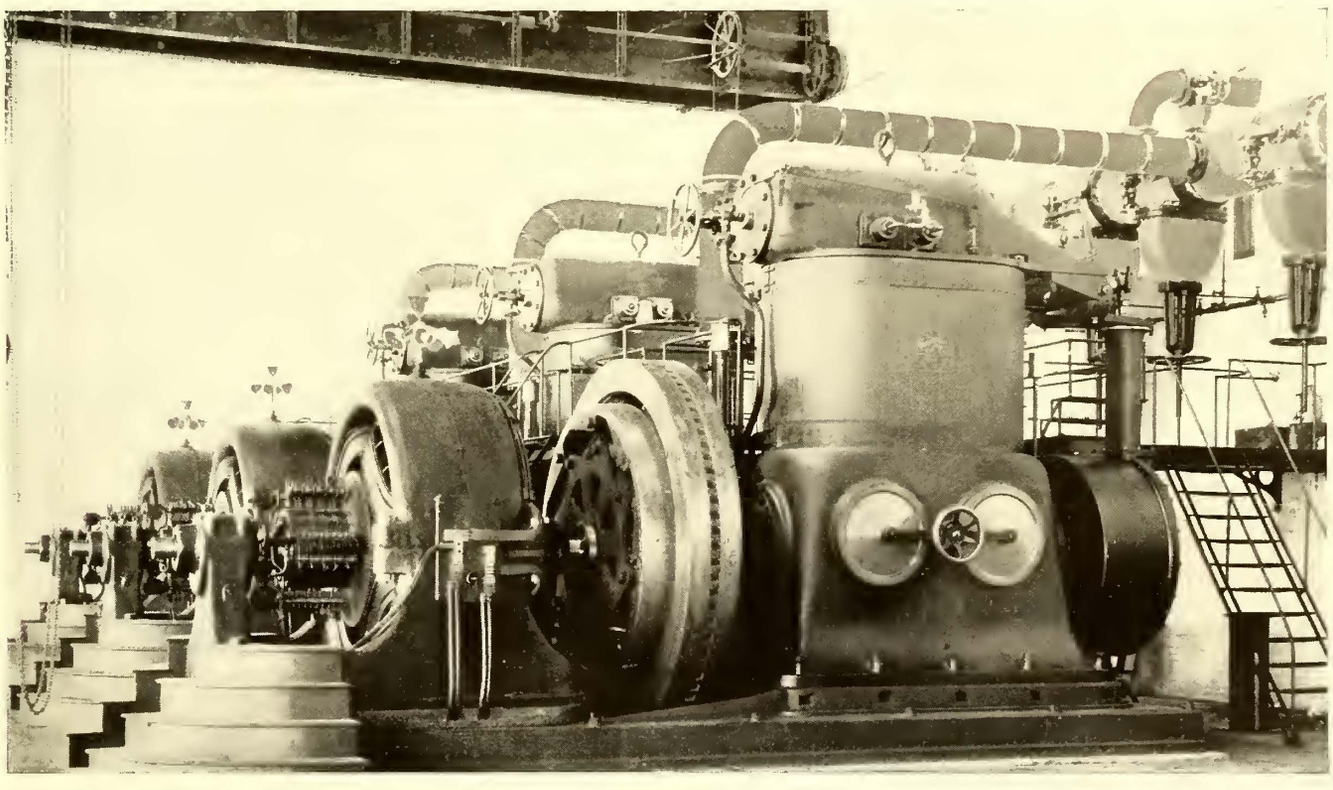


AUTOMATIC LIVE WIRE CUT-OUT.

Handsome Rail Catalogue.

Dick, Kerr & Company, Limited, of London and Glasgow, have recently brought out one of the handsomest catalogues which has ever come to this office. This company is known throughout the world wherever street railways are in operation. It has enjoyed a particularly large business in England, on the continent of Europe and in the English colonies where its rails and construction have come to be regarded as standard.

Dick, Kerr & Company were prompt to recognize the advantages of electricity as a motive power for street railways, and roll a complete line of rails suitable for electric roads and of the deep patterns, seven to ten inches, adopted in this country. That the company does not confine itself to the manufacture and sale of rails is clearly shown in the catalogue in question. Much of the best work in tramway building in Great Britain during the past few years has been performed by the company which has taken contracts for the complete equipment of different railways, including track construction and power station. A number of very handsome views are given of the Edinburgh Northern Cable Tramway being built by the company, of the Brixton Cable Tramway, the Douglas Cable Tramway, the Douglas & Laxey Electric Railway, the Snaefell Mountain Electric Railway, the Bessbrook Electric Railway and others.

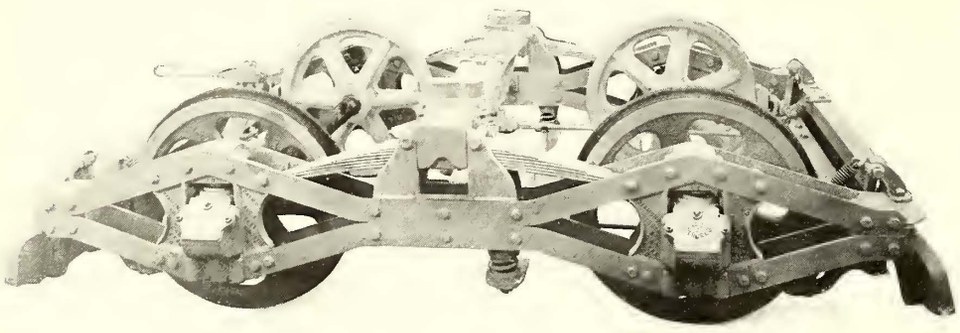


AN EQUIPMENT OF KODAK UNITS.

Diamond Swivel Truck.

The Diamond Truck & Car Gear Company has recently made a new addition to its different styles of electric and cable trucks, by the manufacture of a new double or swivel truck for use under long cars. The design of the truck is similar to that of the standard "Diamond" single truck, manufactured by this company. The side frame members after leaving the angle of the diamond, run parallel with each other, until the angle of the adjacent diamond is reached.

By this parallel-center construction of the side frame members an opportunity is secured of locating advantageously the side steady



DIAMOND SWIVEL TRUCK.

guides for the bolster, which are firmly riveted to each member. This accomplishes two results, that of firmly bracing the truck frame members, and that of providing a guide and draught-plate for the bolster. Situated between these two guides and resting on a shelf, on the inner surface of the plates, are the spring pockets, which support the motor suspension bars.

The bolster is of heavy channel steel, with an under truss support or reinforcing girder of heavy flat steel bar, which is firmly riveted at each end of the bolster channel bar. This tie is also augmented by a steel casting which is bolted to these members and also acts as a vertical guide for the bolster in the jaw of the side steady plates.

Immediately at the center of the truck and within the area of the steel channel bolster and truss, the maximum width of which is midway between its ends, is located a separating casting, through which the king bolt passes. This casting, with its two fellow members, form a truss, from which each end of the bolster is tensioned, or sprung together and riveted.

Surmounting the channel bolster, and vertical with the king bolt casting, is riveted the female center or swivel plate, through the center of which, the main swivel or king bolt passes.

The load of the car body is received and carried by two extra long half elliptic springs, one on either side of the truck and located between the steady plates and the side frame members. These springs are seated at either end upon steel wearing pieces, which rest upon the solid shelves which are a part of the pedestal, and located nearly over the journal bearings. On account of the extreme length of these springs, it is claimed, a very easy riding and resilient service is secured by their use.

At either end of the steel channel bolster, and surmounting it, are the improved spring friction bearings, which receive the side movements of the car body first, thus assisting the main half elliptics, and modifying the thrust of the car load upon them. These side yielding bearings impart also a very easy riding quality to the truck. The brake equipment is of a unique swinging design and in its application is very powerful.

The truck side frame members are securely held together at their ends by steel angle bars, which are firmly bolted to the end piece of each frame. These angle braces are also augmented by heavy life guards, which are also firmly bolted below the angle bars to the frames.

The first impression upon looking over the truck is one of exceptional strength combined with easy riding qualities. Upon a thorough examination of construction, it is found that the manufacturers have spared neither pains nor expense in their endeavor to place upon the market a swivel truck, within which are combined the essential features and improvements, suggested by experience.

Compressed Air Motors in New York.

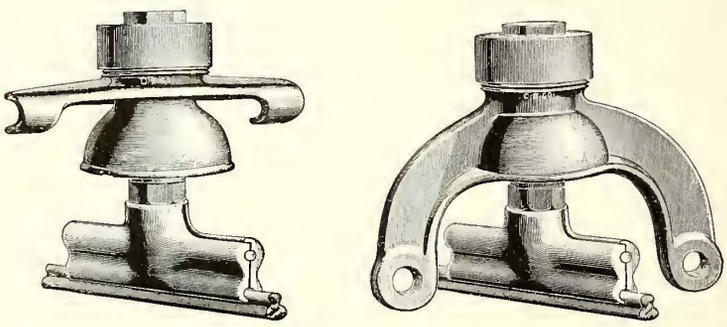
Several of the compressed air motor cars recently built at the Worcester works of the Wheelock Engine Company were received in New York last month. They were built under the superintendence of Joseph Hoadley, of Hoadley Brothers, and Walter Knight, formerly of the General Electric Company. A trial trip was made on Sept. 26, on the lines of the Metropolitan Street Railway Company with satisfactory results.

Figure 8 Trolley Wire Appliances.

The favor with which the figure 8 trolley wire has been received has been so general that the Ohio Brass Company has brought out a full line of overhead parts for use with it, as its peculiar and novel shape would not permit employment of those devices which had been used heretofore, without making radical changes in their form and detailed construction. Two of the principal factors which had to be considered in this connection were the increased weight of the trolley wire, and the application of the various devices, so that the contact surface of the wire would present a free and uninterrupted passage for the trolley wheel. To fill these conditions the improved designs of trolley wire devices herewith illustrated were placed on the market. They have been adopted by the following among other roads:

Cleveland, Painesville & Eastern Railroad Company, Cleveland, O.; Interurban Railway Company, Saginaw, Mich.; Santa Barbara Consolidated Electric Company, Santa Barbara, Cal.; Toledo, Bowling Green & Fremont Railway Company, and Toledo Traction Company, both of Toledo, O.

The insulated bolts are in two styles, designated as D and D-W, the duplicates of each other except that the ends of the metal bolts are made differently, being of such a design as to permit attaching different ears and clamps. One is threaded externally on the end, the other is cone shaped and threaded internally to receive the stud bolt with which the type D-W trolley clamp is equipped. Both of these styles of bolts are provided with a hexagonal nut at the bottom of the insulation, which is for the purpose of using a wrench to tighten them with. They are interchangeable with all the different forms of type D hangers.



FIGS. 1 AND 2. HANGER AND DOUBLE PULL-OFF.

FIG. 3.

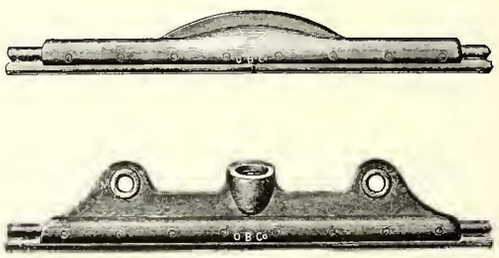


FIG 4 EARS.

The hangers are made in the various forms required for the different styles of suspensions. The bodies, which are of malleable iron, are constructed as light as is consistent with the strength required, but ample allowance has been made in their design so that they will support with perfect safety the heaviest trolley wire now in use. The castings being machined to a standard size admit using the types D and D-W bolts interchangeably. The hanger cap is made with a hexagonal nut, for tightening it on the body. This nut is of the same diameter as that on the insulated bolts, so that only one wrench is required for all.

The D-W trolley clamp varies but slightly from the type W, which has been on the market for the past several years. Its design and detailed construction are similar, but the shape of that part of the jaws that clamp the trolley wire has been modified to conform to the contour of the Figure 8 wire and its strength has also been made relatively greater to compensate for the increase in the weight of this style of wire. It has a stud bolt of the proper length to allow the type D-W bolt to thread onto it sufficiently far to force the co-acting jaws of the clamp firmly on the wire and also to hold it rigidly in suspension. The position of the clamp on the wire is such that the trolley wheel does not touch it in passing under.

The type D-W feeder clamp is an exact duplicate of the regular type D-W clamp with the addition of a lug and set screws for attaching the feeder wire to it. The standard size of lug is made large enough to take a No. 00 B. & S. wire.

The type D double strain ear is of a similar design to the usual type of ear used for the same purpose, but the lips are so constructed that it can be securely fastened to the wire without the use of solder, and of such a shape that they will offer no obstruction to the trolley wheel in passing. In practice the lips are cast open so that the ear can be seated properly on the wire, after which they are closed over it by a few light blows of a hammer. A special forming tool is used to facilitate doing this, also to insure the lips being bent evenly and smoothly. The ear is secured to the wire by means of eight ⅛ in. steel rivets, which are placed in as many holes provided for them, by drilling through both of the lips and the intervening wire.

The splicing ear is of a somewhat novel design, made necessary by the conditions under which it is used, and is of such a shape as to give the requisite strength to stand the great strain to which it is subjected in practice. The inside of the lips is cast the exact shape and size to fit snugly over the trolley wire, the abutting ends of which meet in the center of the ear, being placed there by entering them from the ends of the ear. The wires are fastened in place by means of ten steel rivets which are exactly like those used with the double strain ear, and which are handled in the same way. This device makes a perfect electrical and mechanical splice in the trolley wire, leaving the under side of it free for the trolley wheel to make contact with when passing over.

New Heater Panel.

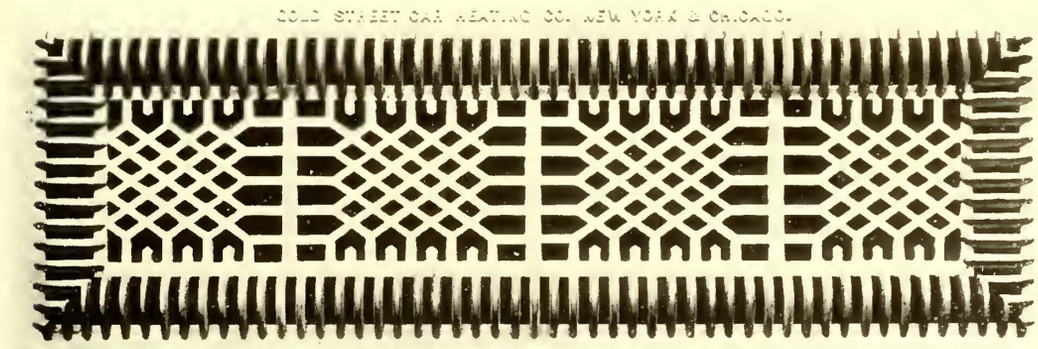
The different manufacturers of electric heaters, now that the advantages of electric heating are so generally recognized, are devoting much attention to the mechanical details of construction and the tasteful design of panels, and the accompanying engraving shows a new style recently brought out by the Gold Car Heating Company.

As will be seen the object sought in the design was to secure at once something tasteful, with a panel which would afford the least obstruction to the passage of air over the hot resistance wires. This, it is thought, is accomplished in the design shown.

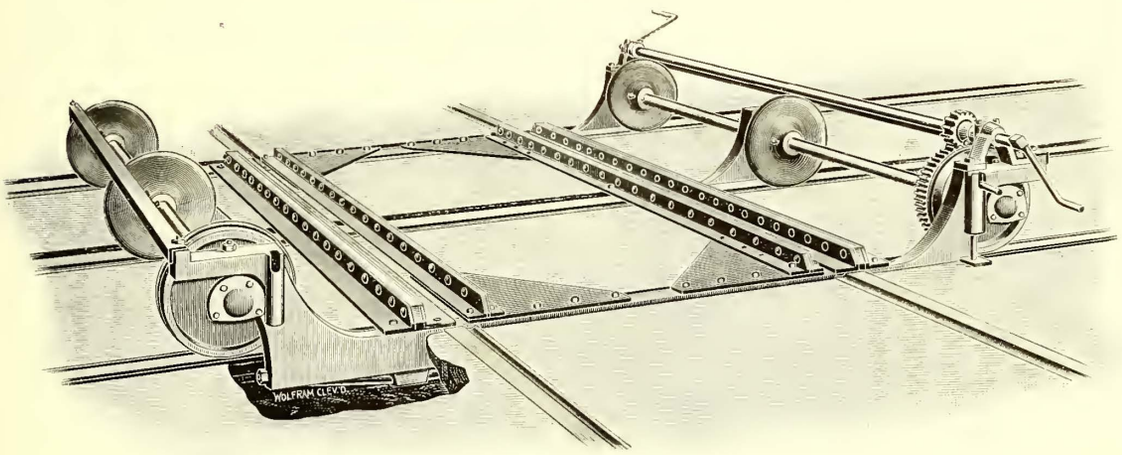
An Adjustable Hand Strap.

The accompanying engraving shows an improved form of hand strap, which is adjustable to the height of the person using it, and is so constructed that by drawing the lever down by means of a pendant attached, the strap can be lowered to any desired point within a distance of fifteen inches. On releasing pendant the strap is automatically checked, and remains at such point until released, when it returns to its original position, which is the usual length of the straps now in use. It then works as an ordinary strap until the pendant is drawn down again.

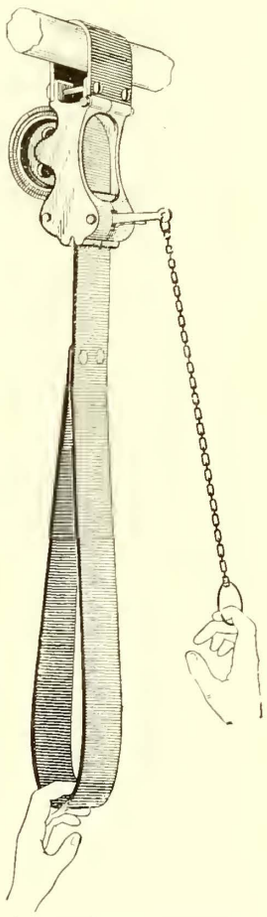
The strap is of leather, and the frame of metal and finished in either nickel, bronze or japan. The frame will last indefinitely, and straps can readily be replaced at any time by any one, so that so far as renewals go, it is as cheap as the ordinary strap. If desired advertising cards can be placed on the holder. The strap was invented by Henry A. Hartman.



PANEL FOR ELECTRIC HEATER.



TRANSFER TABLE.



ADJUSTABLE HAND STRAP.

New Transfer Table.

The accompanying engraving shows the latest transfer table manufactured by A. G. Hathaway, the well known manufacturer of transfer and turntables, hydraulic wheel presses, etc. The table is made in different sizes, twelve, fifteen and twenty feet long, and is mounted on wheels eighteen inches in diameter. The carrying capacity is twenty tons. The table is equipped with a geared end starter by the help of which one man can easily transfer a twenty ton car. This device is a very convenient one, as by it the night watchman does not need a helper in putting his cars away at night or in taking them out in the morning.

The New Orleans City & Lake Railroad Company has ordered several of these tables, and Mr. Hathaway numbers among his other customers the J. G. Brill Company and the Cincinnati Street Railway Company.

DURING the recent storm the car sheds of two of the electric railway companies in Savannah, Ga., were demolished and the cars in them were severely damaged. The loss to each companyis estimated at $25,000.

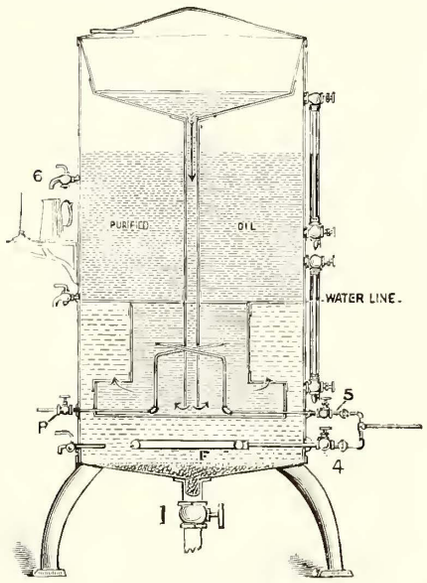
THE certificate of incorporation of the Twenty-eighth & Twenty-ninth Streets Crosstown Railroad Company, of New York City, the successor of the Twenty-eighth & Twenty-ninth Streets Railroad Company has been filed with the County Clerk. The capital stock is $1,500,000. The directors are B. Franklin de Frece, Edgar H. Rosenstock. Lewis C. Hunt, Mark J. Katz, James V. Falvey, Francis W. Elder, Joseph T. Schieffelin, Albert H. Walker and Robert W. M. Guinn.

Oil Purifier.

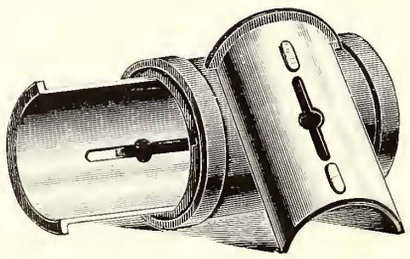
The method of purification of machine and lubricating oil after it has performed its work and has been collected in the drip pans, is essentially different from that of filtration. Oil filters have been on the market for a number of years. Various filtering mediums have been used which passed the dirty oil through cotton waste, felt, sawdust, etc., letting the waste oil pass down through filtering mediums, and other methods that permitted the oil to rise. Filtration, it is asserted, causes the larger particles of oil, and the paraffine which give it body and viscosity to become filtered with the impurities, and the product is a light rarified oil rather than a purified oil to be used again.

The purification of waste oil does not employ any filtering medium, but only warmth and water as its agents. The oil purifiers that are on the market do not compete in output with filters.

The purifier illustrated herewith is now put on the market by the McClelland Oil Purifier Company. It is constructed on strictly scientific principles, the purification being mechanical and automatic, requiring no skill or attention. This purifier is made in six sizes. As the company guarantees that all the dirty oil placed in the purifier will be made as good as the original, the saving depends entirely upon the amount of oil that can be caught in the drip pans, which ought to be at least seventy-five per cent, and in some cases as high as ninety per cent



OIL PURIFIER.



REVERSIBLE ARMATURE BEARING LINING.

Referring to the accompanying diagram of the purifier, connection should be made at valve 1 with the sewer, if practicable. At 4 and 5 with the exhaust steam. The purifier is then filled one-third with water, which is gently warmed by turning on the steam The best results are obtained by the use of distilled water from the condenser, and the water should never be more than warm. One hundred and twenty degrees F. is about right, as too much heat thickens the oil and spoils it. The impure oil is thrown in the top chamber and, passing by gravity through a strainer, very gradually finds its way into a vertical pipe as shown by the arrow in the center of the tank, and mixes with the water at the bottom. The dirty oil and water are prevented from rising to the surface by means of an inverted bell, while the heat from the steam coil forms fine oil globules from the mass which gently rise, and the sediment, grit, dirt and all impurities are readily precipitated and drop to the bottom, and the purified oil passes out from under the bell through the perforations, as shown by the small arrows at the side. It is washed as it rises through the water into the reservoir of purified oil. Impurities of the same specific gravity as the oil, are prevented from rising with it, by means of a wire gauze screen that is around the outside and flush with the top of the bell.

A great advantage of the purifier illustrated is the facility with which it can be cleaned. The purified oil should be drawn off first, and the water drawn off from one faucet till the oil remaining in the lower chamber appears, which can be saved and purified later. F. is a perforated circular pipe into which steam is turned at 4. The steam jets stir up the sediments and impurities in the bottom, and when valve 1 is opened, causes it to be washed down the waste pipe, with the escaping liquid. The interior can easily be taken out.

If desired the purifier can be partially cleaned without disturbing the purified oil, by turning steam in the perforated pipe F, slightly opening valve 1, at the same time pouring water in at top at A. With ordinary dirty oil the purifier should be cleansed every six weeks; with very dirty oil every three weeks.

Columbia Machine Works.

The Columbia Machine Works is doing an excellent business in the manufacture of commutators, other motor parts, trolley parts, controller parts, car fittings, etc. A visit to their factory shows a very busy scene. The works extend along Doughty Street from Columbia Heights to Furman Street. The company has a number of patented specialties, which have given good satisfaction and which recommend themselves to users of electric railway apparatus.

The engraving on this page shows the company's interchangable and reversible motor armature bearing lining. These are of babbitt or brass with oil grooves and are so arranged as to fit into the bearing shells so that they can be changed readily when worn out or their position reversed.

The adjustable controller handle is another important improvement made by the company and is designed to keep the controller handle close fitting on the controller spindle. The company's self-oiling trolley wheel is another ingenious invention which has met with great success. In addition to the ordinary graphite bushing there is a pocket around the hub of the wheel in which is placed felt. This felt is soaked with oil, giving better lubrication than if the graphite alone was depended upon. A hole at the side allows the introduction of further oil when necessary. One of these trolley wheels has run 10,000 miles on the Brooklyn City & Newtown Railway in Brooklyn.

The commutator trade enjoyed by the company is a large one. It not only supplies drop forged commutator bars separately, but complete commutators and does a large business in refilling commutators. The commutator bars are produced from the best Lake copper, which is received in rods at the company's works.

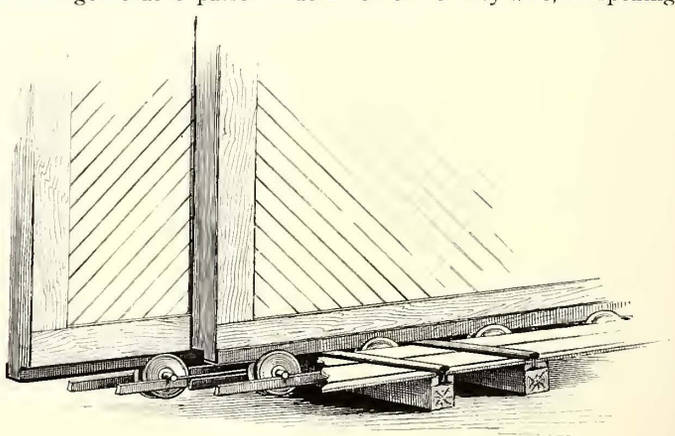
The commutator department of the company is particularly complete and to it the managers of the Columbia Machine Works devote a great deal of care and attention. Assembling, as it does, its own commutator bars into commutators enables the company to make sure of detecting if any single bar is not uniform with the rest. Commutators of all kinds to fit Westinghouse, General Electric and Steel motors are made.

The insulation between each bar is tested by a 550 volt current by means of a special dynamo. A trip through the factory presents a very busy scene. One floor is devoted entirely to the assembling and machining of the commutators; another to the car trimming department in which are located buffing wheels and emery grinders. Near these machines is a nickel plating bath, capable of plating a piece of metal seven feet long and four feet in diameter. This is said to be the largest plating tank in the city of Brooklyn. The drop forging department, containing two drop hammers and the brass foundry are in a separate building adjoining the main works. Sixty-five men are employed.

The company numbers about 100 railroad companies among its regular customers, among whom are: Nassau Electric Railway Company, Brooklyn; Steinway Electric Railway Company; Coney Island & Brooklyn Railway Company; Wilmington City Railway Company; Yonkers Railway Company; Paterson Railway Company; Union Railway Company, of New York; Wissahickon Railway Company; Hestonville, Mantua & Fairmount Park Railway Company; Bridgeport, Bellaire & Martin's Ferry Railway Company and others.

Roller for Car House Doors.

The accompanying engraving shows an ingenious method of supporting car house doors. No posts whatever are needed. The top of the door being suitably guided by rollers not shown in the cut, is so arranged that it passes underneath the trolley wire, an opening



ROLLER FOR CAR HOUSE DOORB.

only large enough for the trolley wheel to pass through being left overhead.

This device is especially adapted for the doors of freight stations and similar buildings and must commend itself to engineers and architects engaged in the designing of such buildings. The inventor, J. A. McElroy, of New York, has equipped several very large car house doors with it.

It is understood that the Hagerstown Railway Company, Hagerstown, Md, is preparing to build a bridge across the Potomac River, at Williamsport, with a view of reaching a beautiful grove on a hill in West Virginia, where it is proposed to establish a park.

Hollow Forged Steel Shafts.

In order to fully appreciate the advantages claimed for making large shafts of steel and "hollow forged," it will be necessary, first, to consider in detail the requirements which such shafts have to meet and then to determine upon the best material and apply it in the best manner to satisfy them. Shafts have various duties to perform. Sometimes they are subjected to torsional or twisting stresses only, as when a force is applied to a lever arm at one end and this force is resisted by the work which has to be performed at the other end. Occasionally shafts are subjected to bending stresses only, as when a heavy weight is carried in the center while bearings at the ends serve as supports. But most frequently we find them subjected to a combination of both twisting and bending stresses, as when an engine applies its power to a crank at one end to turn a shaft which supports at its approximate center a heavy electric generator or a heavy belted flywheel.

A shaft heavily weighted between its bearings has the fibres of its metal that are above the center constantly in compression while those below the center are under tension. As the shaft revolves, each fibre is submitted to stresses alternating from one extreme to the other. A parallel case, though greatly exaggerated, is where the two ends of a wire are taken, one in each hand, and bend it rapidly first one way and then the other. It will eventually break, and if there is a nick in its surface or a flaw in its interior the bend will confine itself to that point as its weakest section, and the break will eventually take place there. It is so also with a shaft. Each has its life, although it may be infinitely long with some that are sound and not heavily strained. With ordinary shafts however where commercial requirements have reduced the size to the smallest dimensions that will be accepted and initial cost has had consideration above quality of material and workmanship, the chances are that it is defective and that the life will be short. The severe torsional shocks to which heavily weighted engine shafts are put when subjected to varying loads increases the liability to break at a weak point. A slight flaw worked upon constantly will eventually extend itself until it results in weakening the entire section containing it to such an extent that it cannot longer resist the stress for which it was calculated.

Authorities on machine design state that when considering shafts up to ten inches in diameter a constant of 9000 lbs. per square inch must be used in determining the strength of wrought iron and 12,000 lbs. for steel. When considering shafts above ten inches in diameter, iron shafts must not be subjected to more than 8,000 lbs. per square inch and steel shafts to not more than 10,000 lbs. These figures are taken as one half the elastic limit of the respective metals. We thus find that it is necessary to use a larger shaft if wrought iron is selected as the material to use than if steel is decided upon. A larger shaft means greater weight where weight is not wanted and larger bearings to support it, together with the necessarily increased size of foundations.

Let us consider the reasons given for placing a higher factor of safety on wrought iron than on steel and especially for increasing it in shafts above ten inches in diameter. It is first necessary to compare the two materials in their respective processes of manufacture. The following is taken with some abbreviation from a paper by W. F. Durfee on "Fibrous Wrought Iron and Crystalline Steel" read recently before the Franklin Institute and reprinted in the *Iron Age*. He says:

"The term 'wrought iron' is popularly supposed to designate a metal, but it is really the name of a mechanical admixture which, at its best, consists of clusters of crystals (which may with propriety be regarded as compound crystals) of practically pure iron, separated from one another, as the result of the manipulative processes employed, by films or threads of an unavoidable impurity, called 'cinder.' "When a properly heated bloom or other similarly constituted mass of wrought iron is subjected to the action of the hammer or rolls the contained cinder endeavors to escape from its entangled mechanical alliance with the crystals of the iron and in so doing each particle thereof is driven into some line of least resistance which is always finally located in a plane at right angles to the direction of the force acting upon the metal. The direct consequence of the elongation of its compound crystals, and the effort of the intervening cinder to escape in the direction of least resistance while the wrought iron bloom is being forged or rolled, as before described, is the establishment of that structural peculiarity in the resulting bar known as 'fibre' which is one of the most conspicuous features of wrought iron and one not found in any any other variety of ferruginous materials. Steel is iron freed from mechanically mixed impurities, such as cinder, etc., by a melting process during which there is combined with it chemically a small percentage (not large enough to prevent the metal being forged or rolled) of other impurities, introduced for the purpose of modifying its strength, hardness, elasticity or ductility in such a way and degree as to adapt it to the particular use to which it is to be applied. In short, while wrought iron is having (as the unavoidable result of the methods employed in its manufacture) its impurities *mechanically* mixed therewith, steel is iron having (as the result of the adoption of appropriate manufacturing processes) its impurities *chemically* combined. All steel in our day, save the comparatively unimportant product called 'blister steel' is made by some process involving melting and casting; and although the various methods employed all practically free the metal from an admixture of cinder, and in consequence tend, so far as elimination of cinder is concerned, to produce a homogeneous crystalline structure, still, owing to defects inherent in the methods of casting, and oftentimes in the chemical constitution of the metal itself the ingots of steel are too often far from homogeneous. In fact, their structure may be such that when hammered or rolled the resulting bar, although destitute of cinder, they may nevertheless show evidence of fibre."

Thus it will be seen that when iron or steel is produced which shows a fibrous structure it is a material which is weakened by impurities in one case or imperfections in its constitution in the other. From the nature of its manufacture it is impossible to eliminate cinder from wrought iron. It is, however, possible to free steel from blow holes by a process invented and perfected by Sir Joseph Whitworth & Company, of Manchester, England, and introduced into and controlled in this country by the Bethlehem Iron Company. This has become generally known as "the Whitworth Process of Fluid Compression." It consists in subjecting the fluid metal to hydraulic pressure up to 7000 tons if necessary, until it has solidified. (Fig. 1.) Under this enormous pressure gases are prevented from generating in the mass and the air, entrained while pouring, is forged out in the direction of least resistance, where it escapes through vents in the mould provided for that purpose. There are, however, other defects which are apt to occur in steel ingots which are required for making large shafts and it must be understood that ingots should be twice the diameter of the finished forging in order to have sufficient work put into the metal by the forging process, to properly develop the physical properties of the metal. For instance, best practice requires that shafts twenty-four inches or thirty inches in diameter should be worked down from ingots forty-eight inches and sixty inches in diameter respectively.

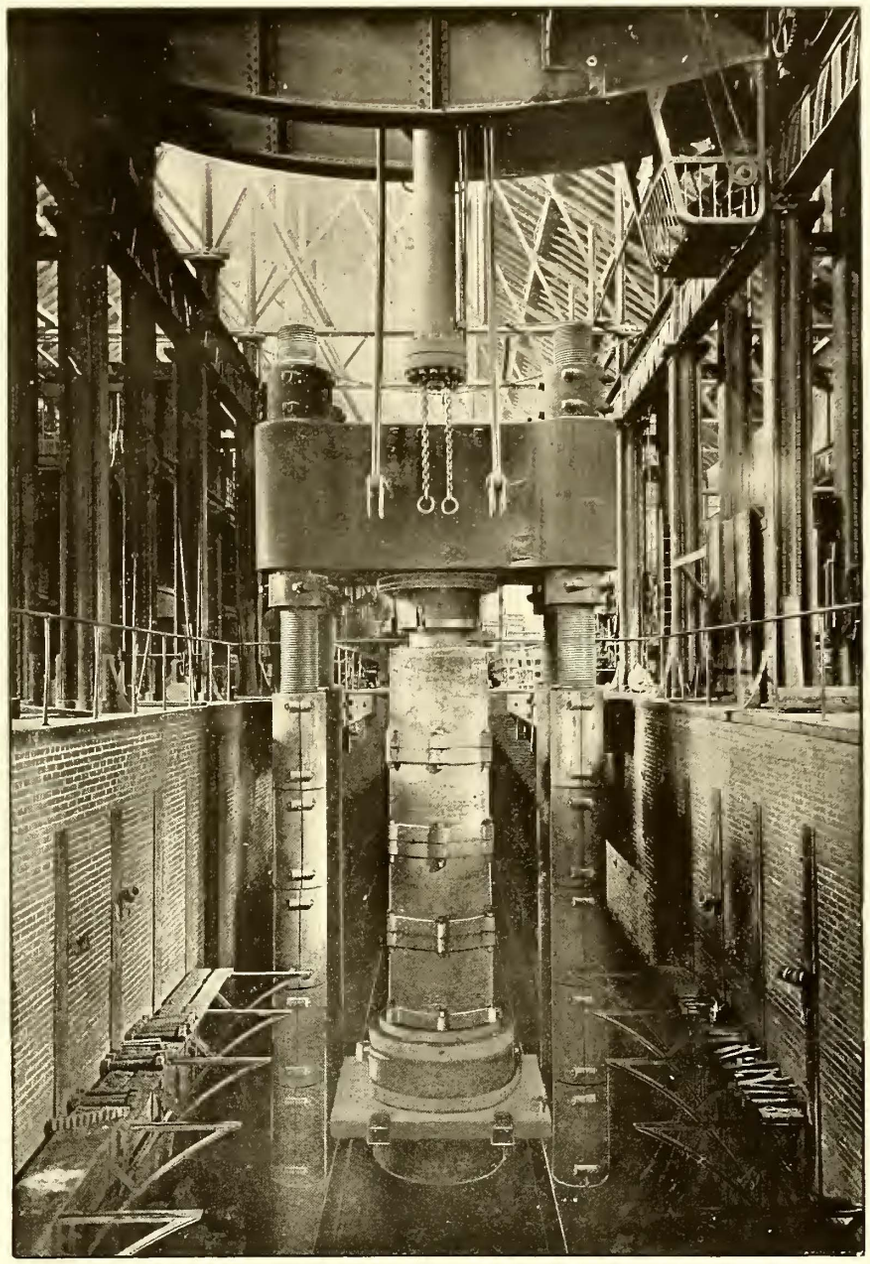


FIG. 1.—WHITWORTH PROCESS OF COMPRESSING FLUID STEEL.

Ingots of these sizes are liable to defects called "piping" and "segregation." When a mould is filled with molten steel the metal cools first at the surface of the mould and, in large ingots, will become absolutely solid at the surface while the center is still liquid. Subsequently, as the metal solidifies from the outside inwards, its tendency is to draw on the metal in the center and upper part to supply shrinkage at the sides and bottom; and thus cavities, or "pipes," are apt to be formed in the upper part and along the central axis or line of last cooling. Even if the ingot when cooled is solid throughout, the metal is necessarily under stress. It is as if a quantity of metal were put into a rigid shell too large for it and was stretched out in all directions to fill it. In order to prevent "piping," ingots are made twenty-five per cent to fifty per cent longer than the forging would otherwise require and are then subjected to the Whitworth process of fluid compression. Under this latter influence the "pipes" are filled by fluid metal from the upper portion where it cools last.

"Segregation" is a separation of the various ingredients of steel such as carbon, sulphur, phosphorus and, to a less degree, silicon and manganese, according to their respective temperatures of solidification. These tend to concentrate at the center and upper portion of the ingots where the metal last solidifies. Fluid compression tends to prevent segregation and produces ingots which are more homogeneous than can otherwise be made.

As "piping" and "segregation" tend to affect the center of ingots and consequently of the shafts made from them, in order to free the latter from any ill effect that might occur from these causes, it is customary to make them hollow by boring. The removal of

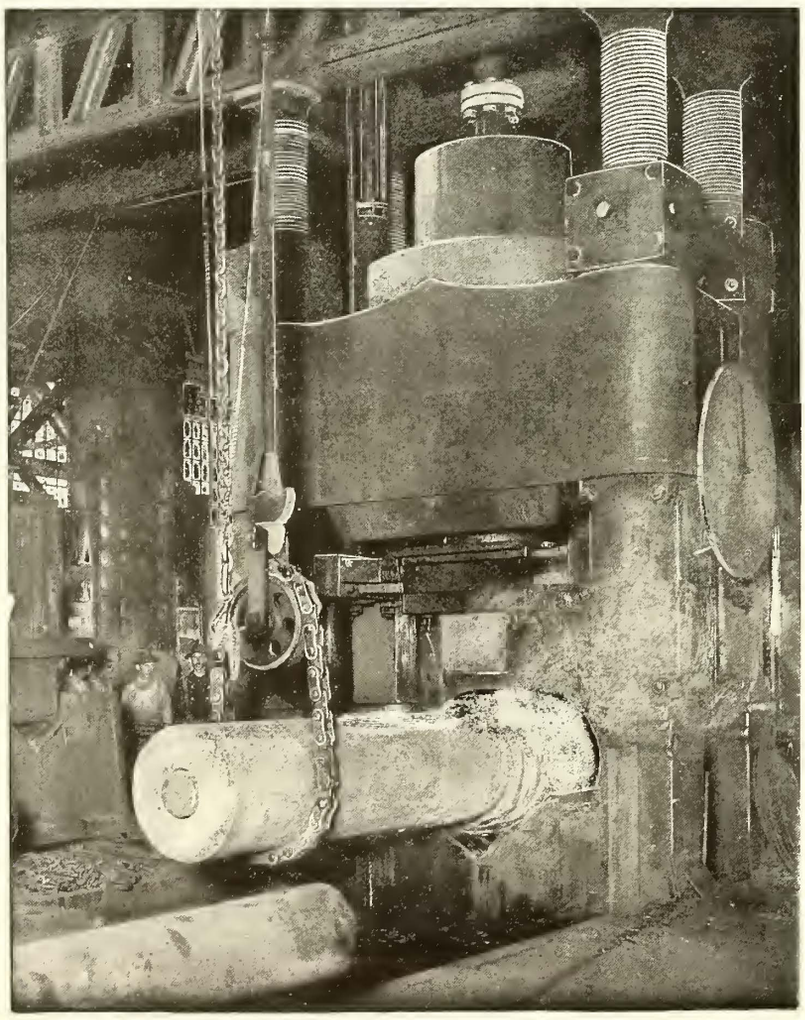


FIG. 2.—SHAFT UNDER HYDRAULIC PRESS.

this probably imperfect portion improves steel shafts greatly, provided they are treated subsequently so as to increase the elastic strength of the remaining metal.

The first hollow shafts of this character were supplied to this country by Fried. Krupp, of Germany, but his were made of crucible steel and after boring were oil tempered to restore the strength that was taken from them by boring. The most satisfactory method however of accomplishing the result sought for is that known as 'hollow forging," which was introduced into this country from England by the Bethlehem Iron Company when it built its present forging plant. As the walls of hollow shafts are comparatively thin and yet must do the work originally intended to be performed by the solid forging, the metal must be without flaw or defect of any kind, homogeneous throughout, and thoroughly worked to give it strength. For this purpose, therefore, only fluid compressed open hearth steel is used and of a grade that will best insure satisfactory working.

As before stated, in order that the metal should be sufficiently worked to give it strength and toughness, the best practice requires that the ingot should be at least twice the diameter of the finished forging. It is also made from twenty-five per cent to fifty per cent longer than otherwise would be necessary to take care of "piping" and "segregation."

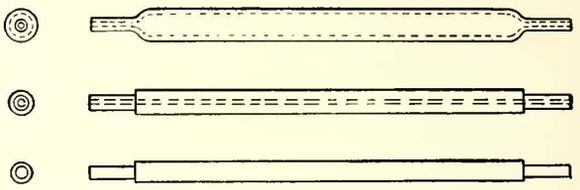


FIG. 3.—SOLID AND HOLLOW SHAFTS WITH SECTIONS.

The ingot is subjected to hydraulic pressure which is continued until the metal is solid throughout, great care being taken to cool it slowly and equally on all sides. The upper twenty-five per cent or fifty per cent of extra length is then cut off and a hole nearly the size required in the finished forging is bored through the remaining piece (Fig. 4). It is then ready for the forging process.

First it must be reheated and as much care has to be taken in this operation as was taken in its cooling, one process being evidently the reverse of the other. For, as has been already shown, the metal in the interior of the ingot is already under stress, and heating it, if it were solid, is apt to increase that stress to such an extent as to expand the surface metal away from the center and leave cracks in the interior. The heat must, therefore, penetrate it slowly and uniformly from all sides. After being reheated, a steel mandrel of the proper size to fit loosely is inserted into the hole and the piece is placed under a hydraulic press where the metal is drawn out over the mandrel to the required dimensions (Fig. 2). The hydraulic press instead of the hammer is used to work it into shape. Under its action the forging is slowly operated upon and the pressure distributes itself evenly throughout the mass, whereas, under the high velocity of impact of the hammer the metal does not have time to flow, thus causing internal strains and possibly cracks. The varying impact of the hammer would also work the metal so evenly that the mandrel would be apt to stick fast to the forging.

With hollow forgings manufactured under the processes here described these objections are met by taking out the possibly defective center altogether. By substituting for it, during the process of forging, a mandrel, the latter acts as an internal anvil and thus even in the largest hollow shafts the thickness of metal worked upon would be within the limits above mentioned. The use of hydraulic presses having a capacity of from 2000 to 14,000 tons, selected according to the size of the forging under treatment, can leave no doubt in the most incredulous minds that the metal has been thoroughly worked.

During this process of working down and drawing out the metal it is probable that the entire piece or at least the end of it which is being worked upon will have to be reheated from time to time. Operating on metal which has become too cold to flow would injure it by disturbing the continuity of its structure and thus establishing lines and planes of weakness. After the process of shaping to the proposed design has been accomplished, the piece must be subjected to a final treatment of "annealing." This consists in heating the forging slowly in a furnace and then allowing the latter to cool down slowly with the forging in it. Annealing not only relieves these strains, but gives a finer grain to the metal and increases toughness.

On the treatment of steel after forging depend to a great extent its physical qualities, and it will vary in strength accordingly from that of the best wrought iron to between three and four times its strength. Annealing generally lowers the elastic limit slightly in well made forgings, annealed forgings showing it to be about forty-seven per cent of the ultimate strength. It considerably increases, however, the "elongation" and "contraction." To develop these qualities to their fullest extent in any grade of steel, "tempering" is resorted to. This consists in heating the forging to a temperature which experience has shown to be right according to the purpose to which the forging is to be put and then plunging it into a bath of oil or other suitable liquid. It is then carefully annealed. This double treatment tends to harden it, breaks up the crystalline structure due to forging, and modifies the physical properties by increasing the elastic limit and adding toughness.

Forgings must be hollow to be tempered successfully, otherwise strains would be introduced by the sudden shrinkage of the surface metal on the hotter interior when the piece is dropped into the cold bath which would, instead of strengthening the piece, result in weakening it and possibly in bursting it into pieces. The thin walls of hollow forgings allow the heat to be extracted rapidly from both the inner and outer surfaces.

For the general run of engine forgings, a steel should be used in which a tensile strength of about 75,000 lbs. and an elastic limit of 35,000 lbs. per square inch can be obtained with an average elongation of twenty per cent in four diameters.

When proper precautions are employed, forgings can be made with perfect safety of a still higher grade of steel, and this is especially recommended for crank and cross-head pins and for all parts subjected to severe alternating strains and wearing action. In this grade of steel a tensile strength of about 85,000 lbs. and an

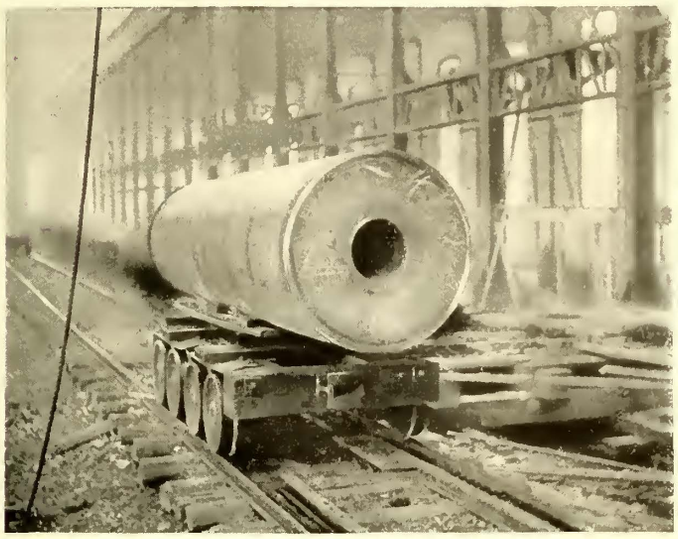


FIG. 4.—TRANSPORTING A HOLLOW FORGING.

elastic limit of about 40,000 lbs. per square inch can be obtained with an elongation of fifteen per cent in four diameters.

If steel forgings are tempered they will possess still higher qualities than those above mentioned and can be furnished with a tensile strength of 85,000 to 90,000 lbs. and an elastic limit of 45,000 to 55,000 lbs. per square inch and an elongation of fifteen to twenty per cent in four diameters. By introducing about three per cent of nickel into the composition of steel, a finely granular or amorphous condition is obtained in forgings and the very highest quality of steel is attained. By the combination of hollow forging and tempering this nickel steel a material is obtained excelling all others shown in elastic strength and toughness.

According to the formulæ for strength of shafts we find that hollow forged shafts are as strong or stronger than solid shafts of the same outside diameter. The shaft for the Ferris wheel, for instance, which is the largest shaft ever made, is 45 ft. long, 32 ins. outside diameter with a 16 in. hole through it. The walls of this shaft are only 8 ins. thick. Compared with a solid shaft of the same outside diameter, this shaft has lost twenty-five per cent in weight and gained twelve per cent in strength.

The ability to produce forgings of this hollow variety has led to their adoption in many places where castings, both of iron and steel, have previously been used. This substitution has resulted in considerably lightening the weights of such pieces and also the parts in which they rest and move.

Conspicuous among hollow forged shafts are the Ferris wheel shaft, already mentioned and shafts for the steamers, "Puritan," "Plymouth," and "Pilgrim," of the Old Colony Steam Ship Company, 20½ ins. outside diameter, 9 ins. inside diameter, weighing 65,832 lbs. each. The shafts for the engines of the Cicero & Proviso electric road, Chicago, are 24 ins. diameter with an 8 in. hole through them. The shafts for the engines of the North Shore electric road, Chicago, are 22 ins. outside diameter, 7½ ins. inside diameter. The shafts for the engines of the Northwestern Elevated Railway and also for the Union Loop Railroad, Chicago, are 28 ins. outside diameter with an 11 in. hole through them. The shafts for the engines of the Chicago City Railway Company, Chicago, are 26 ins. outside diameter with a 10 in. hole through them. Many more prominent examples of this type of shaft might be mentioned but the above will give an idea of their character.

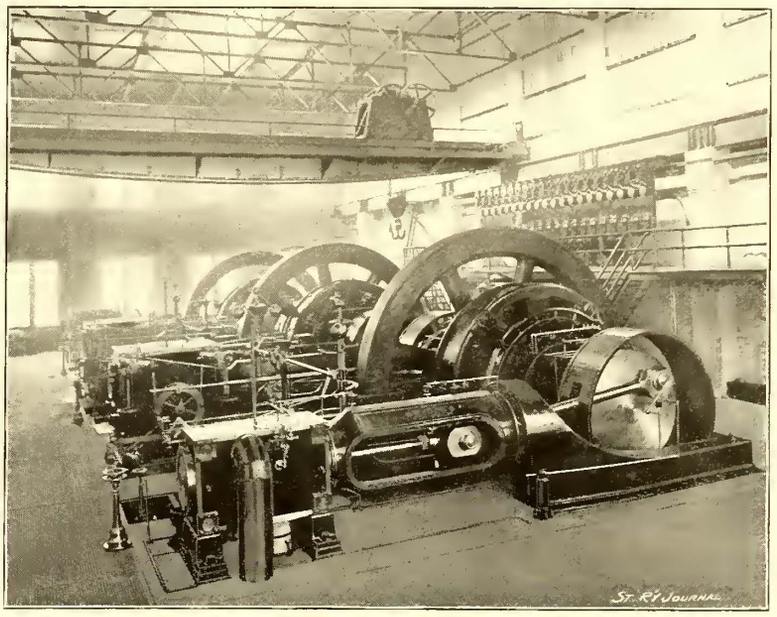
ELECTRICITY performs a very large part in the new steel plant of the Apollo Iron & Steel Works, at Vandergrift, Pa. The electrical power plant consists of three 400 h. p., side crank, medium speed engines of the latest type, recently brought out by the Ball Engine Company, which are direct connected to Westinghouse generators. These generators furnish power to thirty-six different power motors operating various machinery, including the electrical centrifugal pumps furnishing the water supply of the steel works, which comes from the river, 1200 ft. away.

North Chicago Street Railway Company's Hawthorne Avenue Power Station.

This is one of the large power stations built for the Yerkes system of roads and put in commission during the past year. While not differing radically from the other stations installed by the same management it contains much to interest street railway managers. The station is located between Hawthorne Avenue and the north branch of the Chicago River, at Hobbie Street. The building, of brick, is of substantial construction and designed with a view to facilitate the economical and convenient operation of the plant. The boiler room contains 4000 h. p. of "Standard" boilers. The boilers, ten in number, of 400 h. p. each, are set in five batteries, and are so connected with the main header that any one or more of their number can be run in connection. These boilers are fitted with Murphy furnaces, and the boiler room is equipped with conveying machinery for handling coal and ashes. The boiler room also contains a plant of Jewell filters which purify the feed-water before it goes to the boilers. In the boiler room are also placed two large size Berryman heaters which utilize the exhaust from the boiler feed and other steam pumps used in the station.

The engine room, separated from the boiler room by a substantial brick wall, contains at present three large direct connected units, room being left for a fourth unit whenever it is needed. Each unit consists of a cross compound, condensing Reynolds-Corliss engine, direct connected to an 800 k. w. General Electric generator. The engines were built by the Edward P. Allis Company, and are of its heavy "1890" pattern, so well known from its installation in so many of the leading street railway power stations in this country. Each engine has cylinders 24 ins. and 46 ins. × 48 ins. The frames, slides, crossheads, connecting rods, pins, etc., are exceptionally heavy, being the same as used in the Allis "1890" 32 in. engines; the crank and crosshead pins are 8 ins. × 8 ins; the main bearings 20 ins. × 36 ins.; and the diameter of main shaft 22 ins. The flywheel of each engine is 20 ft. diameter, and weighs fifty tons. With 140 lbs. initial steam pressure and 80 r. p. m. each engine has a range of from 800 to 1500 i. h. p. The machine as a whole is massive in its proportions and calculated to withstand the severest strains incident to street railway service.

The condensing apparatus is of the Blake vertical Admiralty pattern, and while each unit is complete in itself, the condensers are arranged, by means of a common vacuum pipe, so that any desired combination of engines and condensers may be had. Between each engine and its condenser is placed a Berryman feedwater heater, with suitable arrangement of piping.



HAWTHORNE AVENUE POWER STATION, CHICAGO.

The engine room has a twenty-five ton traveling crane, covering engines and generators; also with a complete gravity oiling system as well as all other necessary appliances.

New Railway Magazine.

The first number of *Baker's Railway Magazine* has been issued and its appearance indicates that the publication will find a place in the steam railroad field, which it is designed to reach.

The leading article is on "Good and Bad Money" and is an excellent presentation of the Silver Question in its relation to railroad employes.

New Vertical Engine for Steinway, N. Y.

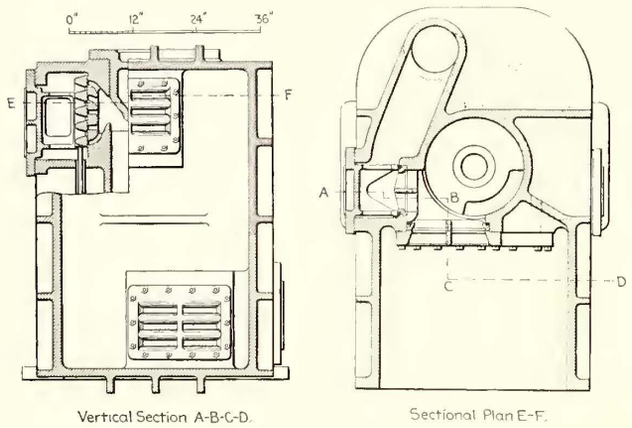
The subjects of the accompanying illustrations are two Williams improved engines, adapted to general specifications by J. H. Bickford, engineer for the purchasers, the Electric Illuminating & Power Company, of Long Island City. Wm. Tod & Company are the builders.

The engines are of the compound condensing type, are speeded 150 r. p. m. and are direct connected to two phase generators of 300 k. w. and 500 k. w. and are to be employed in lighting and power service.

The general specifications called for gridiron valves for both high pressure and low pressure cylinders, the exhaust to be independent of the steam (a four valve system) and the governor to control the cut-offs on both high and low in order to secure the most direct governing control. Unusually heavy wheels were also called for to neutralize sudden fluctuations in the load.

Economy in the use of steam is provided for by steam jacketing the cylinders top and bottom, the use of reheating coils in the receiver, small clearances, absolutely tight valves and free steam passages. Durability is insured by ample shafts and bearings throughout and the cranks are properly counterweighted to prevent vibrations.

The cylinders for the smaller engine are 14½ ins. and 28 ins. 30 ins. stroke. Those for the larger are 18¾ ins. and 37½ ins. × 30 ins. stroke. As stated both engines are speeded 150 r. p. m., the piston speed is therefore 750 ft. p. m. The cylinder ratios are a little more than 4 : 1. The steam pressure is 125 lbs.



Vertical Section A-B-C-D. Sectional Plan E-F.

FIGS. 1 AND 2.

Fig. 3 is a general view of the smaller engine from which an idea may be had of the outlines of the framing and the arrangement of the stairs, railings, platforms, pipes, etc. It will be observed that the columns widen at bottom giving a secure longitudinal bracing. In addition to this the cylinders are bolted together, forming a receiver between them and still further bracing the engine. Engines so constructed stand perfectly rigid while under heaviest loads.

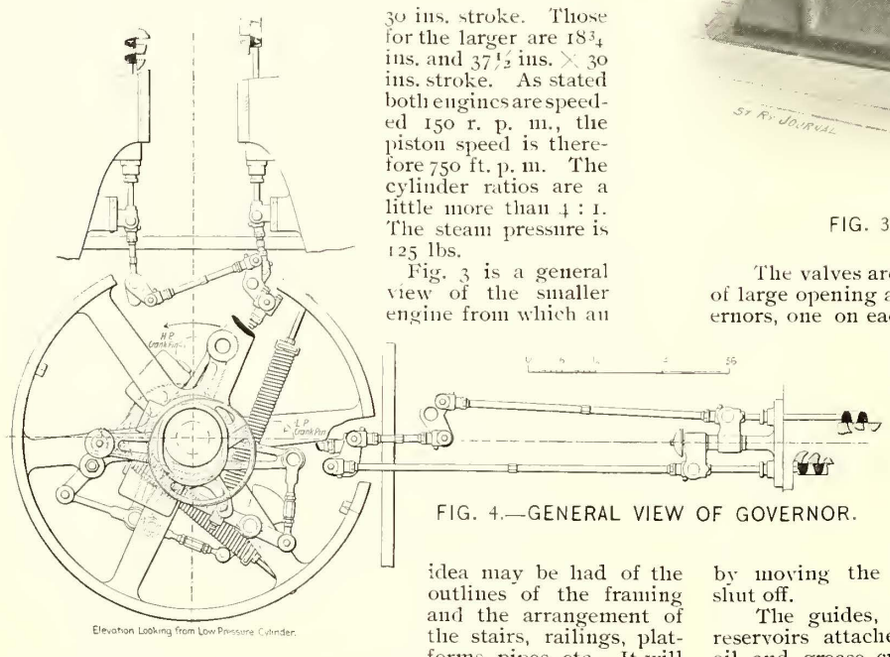


FIG. 4.—GENERAL VIEW OF GOVERNOR.

A short description of the details may be of interest. For the high pressure cylinder Fig. 1 shows one steam valve in section to the left and Fig. 2 shows both valves in section. By this arrangement one part is made to serve for both steam and exhaust and the clearance is reduced to a minimum for direct driven valves. It does not exceed six per cent by actual measurement. Mr. Williams, the designer, believes that five or six per cent is as low as the clearance should run in an engine at 150 r. p. m. and that the very small loss to economy occasioned in steam by this clearance is much more than made up for in the smoothness of running rendered possible by a longer compression curve and by the decrease in the internal condensing surface due to a shorter stroke and higher rotative speed.

Fig. 4 is a general view of the governor looking from the low pressure cylinder. The low pressure valve gear is in fact vertical, but in this cut is shown horizontal in order to avoid complicating the drawing and to show the valve gear for each cylinder in their true position at beginning of downward strokes of both pistons.

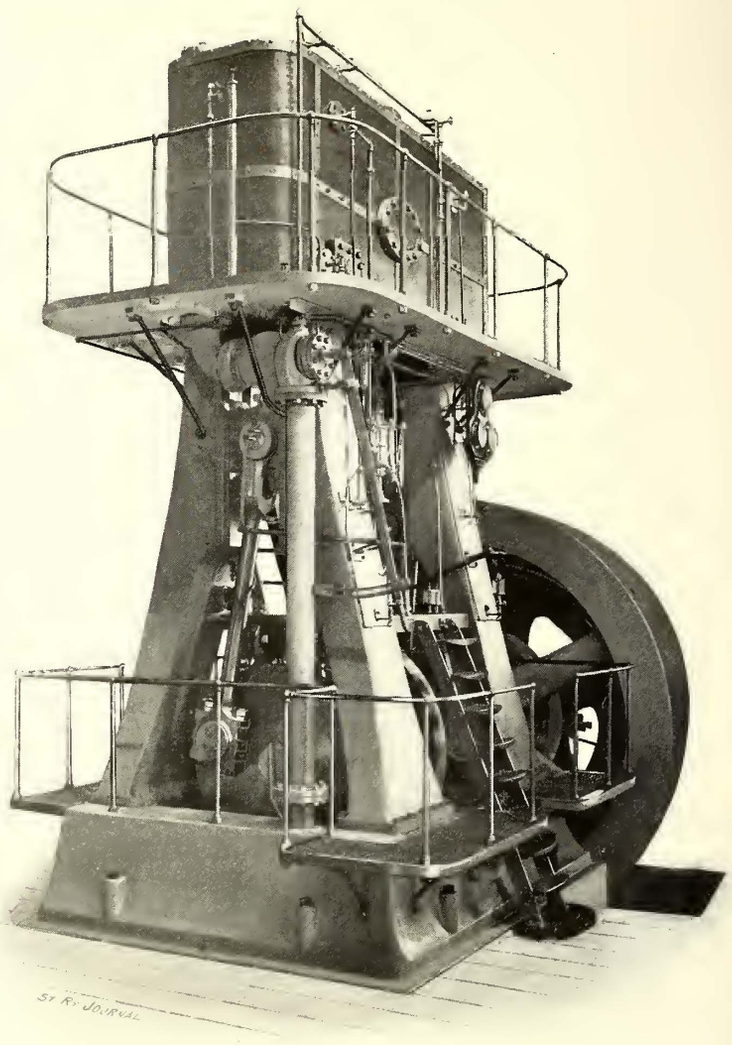


FIG. 3.—VERTICAL ENGINE FOR STEINWAY.

The valves are driven through quarter crank rockers admitting of large opening and small travel. There are in fact two shaft governors, one on each side of the governor casing or driver, connected together so as to act in unison. It is not intended however to maintain an equal admission in each cylinder at all points of cut-off, and the low pressure side is made in a manner adjustable to suit the conditions of service.

The throttle valve is of the lever type, having a piston valve and disk valve on the same stem, controlled directly by hand from the starting platform. It is so arranged that the piston valve closes first and the engine is handled with it. The disk valve may be closed by moving the lever a little further. The steam is then all shut off.

The guides, crossheads and crank pins are lubricated from reservoirs attached to the cylinders. The main bearings form oil and grease cups and other joints in valve gear are supplied with automatic grease cups.

All drips of oil go in the crank pits and are conveyed away through a 1½ in. pipe to a tank in the basement from which it is taken and filtered and used again.

The cylinders are to run on very light lubrication from a cylinder oil cup.

The Clodfelter Gas Belt Electric Railway enterprise, Anderson, Ind., which was abandoned six weeks ago after fourteen miles of grading had been completed between this city and Marion, has been taken up by B. F. Arnold, president of the Arnold Electric Power Company, of Chicago, and J. W. Angel, of Chicago. They will have the line between Anderson and Marion running this winter and connect all gas belt cities and Indianapolis next spring.

The Electric Equipment of Brooklyn Bridge Cars.

The switching of the Brooklyn Bridge cars by electricity will shortly become an accomplished fact. The cars are being rapidly finished, and as they reach the yards of the Brooklyn Bridge Railroad, will be fitted as fast as possible with the electric apparatus. The twenty car equipments forming the order are now ready in the shops of the General Electric Company, waiting for the cars to reach Brooklyn.

The first car, a handsome piece of car work, reached Schenectady from the shops of the Pullman Palace Car Company a few weeks ago, was fitted with the electrical apparatus, and is now in Brooklyn. The balance of the cars will be equipped at their destination.

The electrical equipment of each car consists of four G. E. 50 motors and two K 14 controllers, both especially designed for this work. The motors are completely encased, and are water tight and dust tight. The armatures are slotted, each coil lying in its own slot, and the method of winding followed allows of the removal of any coil with very little disturbance to the others. Each motor is provided with a roller which will come directly over the cable and prevent it from abrading the motor or injuring it in any way and from being injured itself.

The K 14 controller is the standard K type of controller adapted for four motors of the capacity of those which will be used in this case. It embodies all the qualities of the K type, and, of course, has the magnetic blow-out. Two circuit breakers, a magnetic fuse box and twelve resistances complete the electrical motive equipment.

The only portion of the electrical apparatus which will be apparent to the public, will be the controllers at the extreme edge of the platform and an upright iron post with a small handle to operate the circuit breakers. Motors, resistances, circuit breakers, etc., will all be out of sight beneath the car. The circuit breakers are closed and opened from the platform, but are so placed that inspection can readily be carried out.

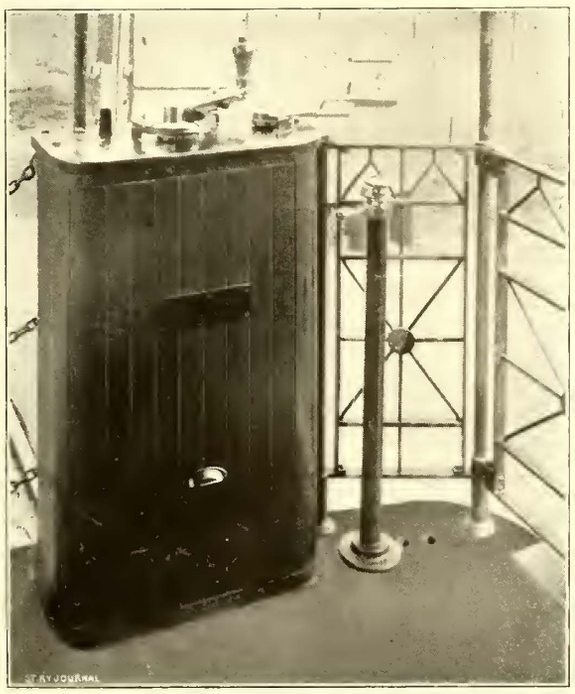


FIG. 2.—PLATFORM OF BRIDGE CAR.

The duty which these motors will be called upon to perform will be to switch the four-car trains from the incoming to the outgoing platforms. When the trains are loaded the motors will push them forward over the tilting sheaves, where the cable will be taken up by the grips on the other three cars of the train. The conditions of the contract between the electrical company and the Brooklyn Bridge trustees, require that in case of any failure on the part of the cable plant the four motors together shall be powerful enough to propel the fully loaded train, weighing 120 tons, across the Bridge at the speed of the cable, i. e., 11.3 miles per hour. The capacity of the motors, is such that they will be able to haul the heaviest bridge trains up a 3.78 per cent grade not only for the short thousand feet —the length of that grade on the bridge structure—but the whole length of Manhattan Island if necessary. The trucks of the new cars are from the shops of the McGuire Manufacturing Company which has recently constructed the trucks of the electric cars used on the Lake Street elevated in Chicago.

The third rail method of contact will be adopted, and current will be taken by four shoes to each motor car, two on each side. These are suspended from a support set between the journal boxes of each truck, and will be so hung as to give a perfect contact with the third rail.

FIG. 1.—ELECTRIC CAR FOR BROOKLYN BRIDGE.

As soon as the full number of motor cars is equipped and in service the steam locomotives will be taken off. This will not only mean a relief to the passengers on the trains, but an actual source of economy to the Bridge itself, the gases from the locomotives proving an actively destructive agent to the ironwork of the terminal stations.

The question of the abandonment of the cable for the complete operation of the Bridge trains by electricity is one which will probably be settled in favor of the cable. The uniform speed given to the cars by the cable, and the fact that the cars, while attached to it, are spaced at regular intervals, eliminate from the operation of the trains a personal factor, which might tend to accident, while by balancing up grade trains against those running down grade, the consumption of power is reduced to a minimum.

Flexible Brackets in Overhead Construction.

The popularity of the flexible brackets in overhead construction is made manifest by the numerous orders for them which have been placed during the past year. With a very few exceptions, all of the high speed suburban and interurban lines that have been constructed this year have adopted the flexible bracket as the best method of supporting trolley wires. Many of the roads that were originally built with rigid brackets are changing these brackets to the flexible type and thereby making a very great saving in the cost of maintenance of the bracket lines. The Creaghead Engineering Company, which is the sole manufacturer of the Creaghead flexible bracket, has enjoyed, consequently, an excellent business in this line during the past year, not only for complete brackets, but also for flexible attachments for rigid brackets.

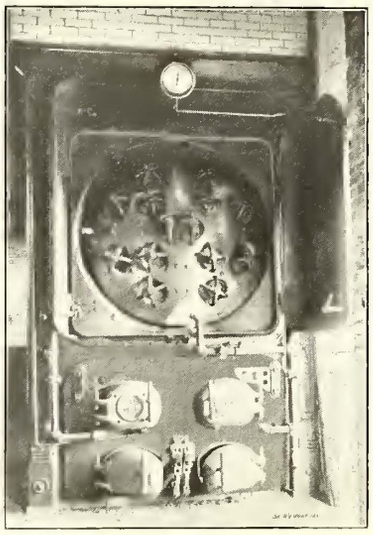
During the construction season, the Creaghead Engineering Company has sold brackets to the Corning & Painted Post (N. Y.) Electric Railway, the Youngstown (N. Y.) & Lewiston Electric Railway, the Holyoke (Mass.) Street Railway Company, the Schuylkill Valley Traction Company (Norristown, Pa.), the Oil City (Pa.) Street Railway, the Washington, Mt. Vernon & Alexandria Electric Railway, the Calumet Electric Street Railway, Chicago, the Moundville, Benwood & Wheeling (W. Va.) Electric Railway, the Fort Wayne (Ind.) Consolidated Railway, the Metropolitan Street Railway, Kansas City Mo., the Citizens' Street Railroad, Memphis, Tenn., Aurora (Ill.) & Geneva Electric Railway, Rutland (Vt.) Street Railway, Fox River Railway, Green Bay, Wis., Union Railroad Company, Providence; R. I., Syracuse Rapid Transit Railway Company, Youngstown & Mahoning Valley Railway Company and many others.

The Lindell Railway Company, of St. Louis, has about completed the work of changing its bracket lines on Washington and Page Avenues to the Creaghead flexible type. Members of the Street Railway Association visiting St. Louis, will have an opportunity to see there the brackets in position.

The full line of electric railway appliances as manufactured by the Creaghead Engineering Company will be exhibited in an attractive manner at the St. Louis convention. This company has made a study of overhead construction, and will have an interesting display in charge of Thos. J. Creaghead, general manager, and George R. Scrugham, superintendent, from the Cincinnati office.

Wood's Water Tube Boiler.

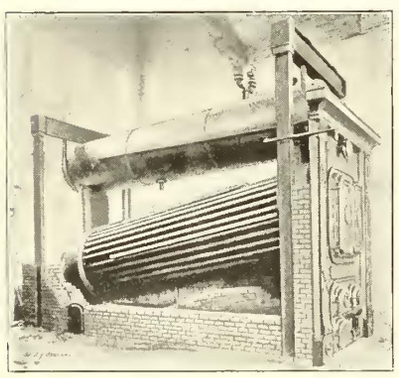
The accompanying engravings show a water tube boiler manufactured by the New Haven Boiler Works and in use in a number of railway power stations including the Lebanon & Annville Electric Railway and Calumet Street Railway Company, of Chicago. The boiler has had a large use also in other industries. The advantages claimed for these boilers are: a large amount of efficient heating surface, the small space occupied for the power required, rapid and economical steam generation, accessibility to all parts, external and internal, for cleaning, great strength and durability, freedom from cast iron headers, manifolds and numerous joints, the use throughout of the best soft open hearth wrought steel, more water and steam space than possessed by any other boiler, perfect circulation of water, the production of remarkably dry steam.



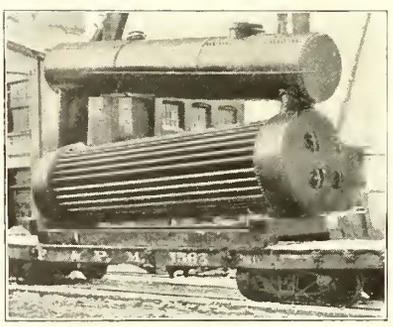
BOILER WITH FRONT OPEN.

This boiler is constructed, as will be seen by the illustrations, of two end tube cylinders varying in diameter according to power required, but in no case to exceed twenty inches long and connected by tubes. The outer ends of these cylinders are convex and in the center is placed a manhole, also six or more hand holes for removing tubes and cleaning.

The tubes are from 4 to 4½ ins. in diameter, and all are expanded and flared over on the inside of each tube head. Each tube acts as a brace or stay. The shells of the tube cylinders are made of plates ⅜ in. to ½ in. thick and double riveted, and each connected on top by a 14 in. neck, to a steam drum. The drum being 30 to 48 ins. diameter and same length as the boiler, ample storage room for water and steam is provided. The drum is accessible at the front head by means of a manhole, allowing every part to be explored, a feature that no other water tube boiler possesses. This boiler can be supported by side brackets, riveted to the shell of the tube cylinders, or it can be suspended from the top by means of side columns and girders, or saddles, to yokes riveted to top of steam drum directly under saddles and thus be entirely free from the brickwork. In fact the means for setting and hanging can be adopted as with any other boiler.



BOILER IN SETTING.



BOILER WITH SETTING REMOVED.

The fire is made under the front and higher end of the boiler, and the products of combustion pass up and around the entire length of the tubes and tube cylinders, thence back and around the rear tube cylinder and up into a combustion chamber under the steam and water drum, thence up side flues provided on each side of the front end of the drum in the brickwork, and thence along the top of the drum through a flue formed with covering bars and brick, and to the chimney. As will be seen, every foot of surface of both boiler and drum is utilized as a heating surface.

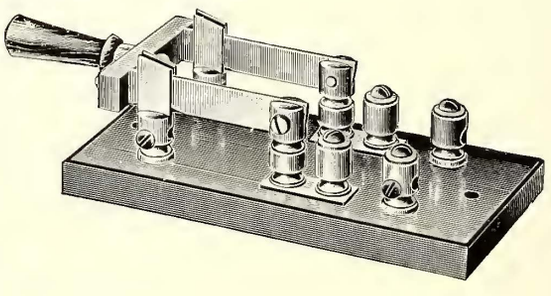
The water inside the tubes, as it is heated, tends to rise towards the higher end, and as it is converted into steam, the mingled column of steam and water being of less specific gravity than the solid water at the back end of the boiler, rises through the large vertical necks into the drum above the tubes. Here the steam separates from the water and the latter flows back to the rear and down again through the tubes in a continuous circulation. As the necks are large and free, this circulation is very rapid. The steam is taken out, after being thoroughly separated from the water, at the top of the steam drum near the back end through a dry pipe provided on the inside of the drum. The feed is taken up through the center of the steam drum at or about the water level and carried by a pipe of sufficient capacity through the steam to and down the rear neck to within about fifteen inches of the bottom of the back tube cylinder. By this means the water is delivered into the boiler at the same temperature as the steam.

Medbery Insulation and Improved Overhead Equipment.

The selection of overhead apparatus in the construction of an electric railway forms a most important problem to every builder of an electric road. At best overhead wires can hardly be considered as an ornament to any street. If a railway company wishes to win and keep the good will of the public it must pay special attention to this portion of the equipment. The overhead system should not only be as tasteful and unobtrusive as possible, but it should be also so strong and durable that under no conditions of the weather will any accident to it be possible. Not only is the public interested in having a strong and substantial overhead system, but the railway company as well, for any breakdown in the overhead wire means delay to traffic and possible injury to passers by, with indefinite damage suits.

During the last year or two important improvements have been made by the manufacturers of overhead line appliances in the line of greater strength, durability and finish of overhead parts. To no company engaged in the manufacture of overhead material is more credit due for these improvements than to the Fiberite Company. H. J. Medbery, the president of this company and inventor of the insulating material bearing his name, has always taken a leading position in this movement toward high class overhead material. He early determined to let no material leave his works which would develop defects in service, and he has given his personal attention to the design and manufacture of the Medbery overhead parts. As a result the material of this company has achieved a deserved reputation for its strength and wearing qualities in service.

The overhead line parts of the Fiberite Company are made in all the different styles which have become popular in street railway service. Straight line hangers are made in both "Standard" and "West End" and "Empire" forms, in all of which metal parts protect the insulation from any blow of the trolley wheel. The Globe strain insulator is made in three sizes. According to tests made at the Stevens Institute of Technology, this insulator shows an insulation resistance of 350,000 megohms and a breaking strain of 65,000 lbs. Strain insulators which will stand a pull of 12,000 to 18,000 lbs. are also manufactured by the Fiberite Company.



STANDARD SWITCH.

The quick and slow break switches made by the company have had an excellent sale during the past year. They are manufactured in different sizes, from fifteen amperes up, and have already achieved an excellent reputation. The company is up to the times in both its material and methods, and has always enjoyed an excellent popularity.

Starting with the benefit of the experience of some of the oldest and most practical men in the business, whose experience covered the erecting and operating of trolley roads, with a determination to make the very highest class of equipment possible, and with excellent manufacturing facilities, it is not surprising that the Medbery insulation at once took a high rank.

During all this time, the material has been subjected to the most severe tests on some of the largest roads in the country, and in all cases the reputation of the company for furnishing material fully meeting all the severe requirements has been sustained.

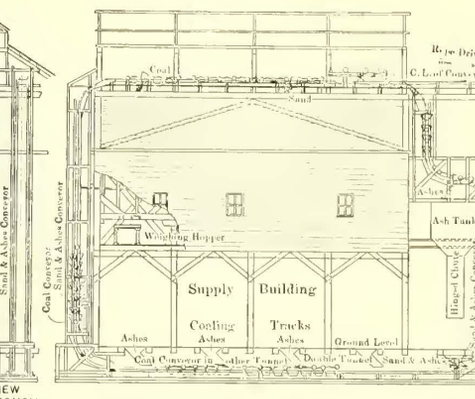
The company has superior facilities for making special work, and is called upon very frequently to decide upon and perfect new devices, its advice being very valuable in such cases.

The company will have an extensive exhibit at the convention, and as a matter of course, it will be inspected with interest by everyone present who is interested in electric roads.

The "Hercules" Trolley Wire Clamp.

The demand for a clamp or mechanical ear for suspending the trolley wire from the hanger is increasing. The ease and rapidity with which a mechanical ear is applied, and detached in case of repairs or for adjustment of the line, and also its moderate price, have always been strong points of reasoning for its adoption. A good mechanical ear can usually be obtained for from nineteen to twenty-one cents, depending upon its length, weight and quality of the metal, while it is alleged that it costs from two to three or more times as much to solder an ear to the wire, and attach it to the hanger. This item of cost, the time required and the necessity for unsoldering and resoldering occasionally, have led many to express a preference for a mechanical clamp. This has led to the invention of a variety of forms.

A successful mechanical clip, besides holding the wire, must permit a reasonably smooth runway for the trolley wheel; it must also be strong and simple in construction, cheap in price, and reliable until actually worn out. The improved "Hercules" clip, sold by the H. W. Johns Manufacturing Company, is claimed to fulfill these conditions. As will be seen from the illustration, the device consists of two simple castings, comprising the jaws, automatically locked throughout their length by the nut screwed down from above. One of the principal weaknesses generally found in clamps of this character is the spreading of the jaws at the ends, thus permitting the trolley wire to tear out. This defect is remedied in the "Hercules". The ends grip the wires strongly at the center, and tests made in comparison with the soldered ear prove it to be twice as strong in this respect. In one case a strain of 500 lbs. led to the destruction of a soldered ear, while the "Hercules" clip, under the strain of 1000 lbs., still held the wire securely without injury to itself. The runway for the passage of the trolley wheel is uninterrupted, so as not to cause objectionable jumping and sparking of the wheel. The "Hercules" clip should prove exceptionally valuable for hanging the new figure 8 and clover leaf shaped wires which are coming into use. It is very easily put in place, and will still support the wire when the jaws are slightly loosened to permit adjustment.



THE HERCULES TROLLEY CLAMP.

Coal Handling Plant.

The use of coal handling machinery in electric railway stations is increasing as electric railway managers are devoting more attention to securing economies in various details of practice. The coal handling machinery of the John A. Mead Manufacturing Company has been adopted in a number of electric railway stations, and its advantages have commended its use.

The accompanying engraving shows sectional views, vertical and cross, of a recently built coal pocket equipped with the coal handling machinery of this company and built for the Long Island Railroad Company.

COAL HANDLING PLANT, LONG ISLAND CITY.

The coal that is received in barges from the river is hoisted by an automatic steam shovel to a hopper which discharges into a weighing hopper and this into the McCaslin conveyor. The latter is an endless chain supported on track wheels with overlapping buckets pivotally mounted in the chain. These buckets form, while on a horizontal track, a continuous receptacle, and while passing from a horizontal to an inclined or vertical track, maintain their normal upright position by gravity. There are two systems of this conveyor. One surrounds both the storage and supply buildings, and the other surrounds the supply building like a belt, passing up and down either end, along on top of the building and through tunnels under the buildings and railroad tracks.

The engines are coaled on the tracks under the supply building and when the bins in the supply building need replenishing the coal is reconveyed from the tunnel under the storage building and is discharged into the supply building. In case navigation is suspended the plant is so arranged as to receive coal from cars which discharge the coal into the hoppers under the tracks at either end of the storage building. The coal passes from the hoppers into the conveyor and is carried up and discharged into either the storage or supply buildings in the same manner as if received from a vessel.

The conveyor system, which surrounds the supply building, is utilized to convey the ashes from the several ash hoppers under the coaling tracks up to and discharge the same into the elevated ash hopper, from which the ashes are loaded into cars. The ash conveyor is also arranged to receive sand discharged from cars into the hopper under the track between the storage and supply buildings and convey it up to and discharge it on to a shaking screen. the screened sand passing from the screen into the sand bins in the supply building. In this plant the engines discharge their ashes, receive coal, sand and water on the same tracks.

The coal consumed on this road is "run of the mine" bituminous coal and the automatic steam shovel and conveyor is especially adapted and arranged for the purpose for which it is used.

Ladies as Conductors.

A method of raising money for charity was employed last month in London, Can., by the officers of the Young Women's Christian Association in that city and the London Street Railway Company. The ladies connected with the former organization upon an appointed day assumed charge of the electric cars of the London Street Railway Company and received the fares, the railway company donating one third of the receipts to charity. Of course a great many passengers rode who would otherwise not have patronized the cars, and the result was a large fund for the charity.

The railway company received many encomiums for its liberality and while it could not afford to give this proportion of its receipts to charity every day in the year, it probably received a *quid pro quo* in the way of free advertising and increased popularity for its liberal policy.

Compression Shaft Coupling.

The accompanying engravings show a new compression shaft coupling, recently put on the market by Patterson, Gottfried & Hunter, of New York.

Fig. 1 represents the coupling fitted to a shaft. Fig. 2 represents the outer shell, and Fig. 3 the sleeve.

The sleeve is tapered from the middle down to each end, has six slots running nearly its entire length, three from one end and three from the other end, in alternation, and holds the ends of the shafts by compression. The outer shell has a bore tapering from the middle outward, the taper corresponding with the taper on the sleeve, the diameter of the bore being slightly less than the diameter of the sleeve. It is divided in two, the halves being drawn together with four bolts and nuts, one half having two pin holes in it.

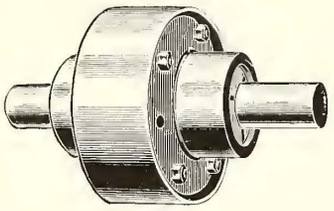


FIG. 1.

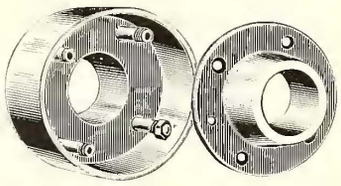


FIG. 2.

FIG. 3.

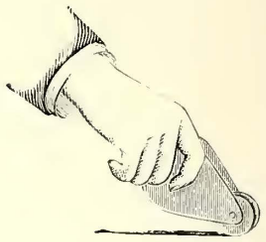
When the halves of the shell are drawn together by tightening the nuts on the bolts the pressure of the tapering bore on the tapering sleeve, which is compressible on account of the slots in it, causes the sleeve to grip the shaft. When in place, the flanges extend beyond the nuts and the heads of the bolts. When the coupling is to be taken down, after the nuts are taken off of the bolts, the halves of the shell can be easily driven apart by driving a pin through the pin holes.

The chief advantages claimed for the device are: keys and key seating are done away with, the shafts do not need to be centered, even if there be a slight variation in diameters, and couplings do not need to be faced, a gripping power is obtained that will break the shaft before slippage takes place, there is an equally distributed bearing over the entire surface covered by the coupling, clothing and belting are not liable to be caught, and shafts of different diameters may be united (with reduction couplings) without any cutting down.

The clutch is built by the manufacturers in different sizes for different diameters of shafts, from $1\frac{3}{16}$ ins. diameter to $5\frac{15}{16}$ ins. diameter.

Gilding Wheel.

A novel and ingenious method of applying gilding to cars is manufactured by the W. H. Coe Manufacturing Company and is shown in the accompanying engraving. The method of using the device is so clearly illustrated by the engraving that no further description seems necessary. The device is employed by such concerns as Jackson & Sharp Company, Wagner Palace Car Company, Pullman Palace Car Company, St. Louis Car Company, American Car Company and many others.

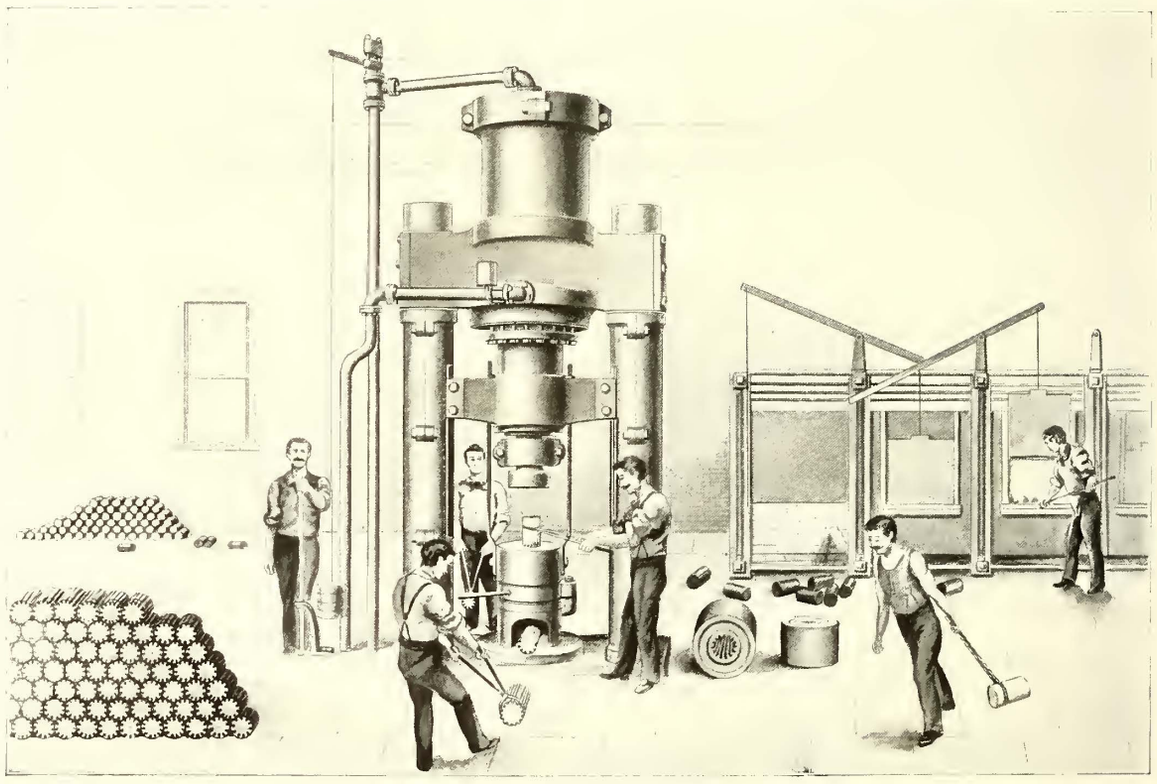


GILDING WHEEL.

Manufacture of Hot Pressed Pinions.

Many who have seen or heard about hot pressed pinions are unacquainted with the method of their manufacture.

In the engraving below the process employed at the works of the United States Projectile Company is clearly shown. It is certainly a radical departure from the old method of cutting teeth on a gear cutter. The steel is cut into solid billets of various sizes, as may be required for the different styles of pinions. The billets are then placed in a furnace and when the proper heat has been obtained they are carried to the press, and forced through a suitable die under a hydraulic pressure of over one million pounds. Thus the finished pinion is made and no machining of teeth is necessary. It is claimed, that in this way the metal is solidified and toughened far more than by any other process, and that the pinions are very durable.



THE MANUFACTURE OF HOT PRESSED PINIONS.

Many thousands of these pinions have been used by various street railway companies throughout this country and Canada since they have been placed on the market, and the United States Projectile Company has some very complimentary testimonials as to their efficiency.

A COMPANY of Philadelphia capitalists headed by George S. Gandy, president of the Fairmount Park Transportation Company, has obtained a controlling interest in the stock of the Bucks County Railway Company, of Doylestown, Pa., and will build an electric railway from Philadelphia to Willow Grove as soon as the line from Willow Grove to Doylestown is completed. The distance from Doylestown to Philadelphia is twenty-five miles and from Doylestown to Willow Grove twelve miles. Edward B. Ives and Axel H. Engstrom are the constructing engineers employed by the company.

THE Central Railway Company, Baltimore, Md., in connection with the extensions which it is now building, will erect a power house and purchase forty new cars.

THE Kingston City Railroad Company, Kingston, N. Y., will extend its lines in the city as soon as it can secure the necessary franchises.

Casualty Insurance.

The subject of insurance against losses resulting from accidents is attracting much attention, especially from smaller companies, whose ability to raise large and unexpected sums of money in emergencies is limited.

The average of a period of ten years for most roads shows that the losses for casualties are not very serious. The trouble is, they may nearly all come in close succession. It is this element of chance which forms, probably, the most undesirable element in the financial side of street railway operation. In the case of steam railroad corporations the question is not such a vital one, as, owing to the extent of their lines and operation, the losses will average themselves fairly well.

Now that street railway securities are furnishing so large a field for the investment of funds of those who are more or less dependent upon the income from such investments, the prudent manager is he who adopts all reasonable means to make certain the payment of his coupons and the declaring of regular dividends. While this is so, all realize that nothing is more uncertain than the amount which will be required any year to cover accidents.

There are two ways in which, therefore, some united action would be desirable. First, in applying the theory of averages over all parts of the country, so that the chance of a single accident would not bear too heavily on one road. Second, by affording the experience of all to each participating road, in securing all the protection afforded by law and in detecting any bogus claims which may be made by persons who make a practice of bringing fraudulent claims of this character against transportation companies.

It was through a realization of these conditions that the Electric Mutual Casualty Association was established by street railway managers to provide protection to those who may associate themselves with them as policy holders, at what might fairly be called actual cost. For mutual insurance, when the business is fairly, honestly and prudently conducted, must be, in the end, the cheapest and best protection possible.

The Association has certainly been well received since it has been established and has among its members some of the most conservatively managed roads in the country.

The Association has now over fifty members and assets of over $100,000 with no liabilities. The members speak of the work of the Association in the highest terms, and the latter has letters from different prominent members expressing the greatest satisfaction about its work. Among these are letters from the president or general manager of the following companies, members of the Association: the Chester (Pa.) Traction Company; the Schuylkill Valley Traction Company, of Norristown, Pa.; the Norwalk (Conn.) Tramway Company, and the Belt Electric Line Company, of Lexington, Ky. The officers of the Association are: president, Horace E. Hand, of the Ithaca Street Railway Company and the Cortland & Homer Traction Company; vice-president, W. B. Rockwell, of the Staten Island Midland Railway Company and Middletown-Goshen Traction Company; treasurer, George M. Hallstead, of the Delaware, Lackawanna & Western Railroad, and secretary, Newton Jackson.

Electric Launches for Pleasure Resorts.

The electric launch as an adjunct to parks and resorts provided with lakes or situated on river banks, is an attraction which has proved in almost every case a profitable investment. The steadily gliding boat, propelled by an unseen power appeals strongly to the public which frequents these places and wherever an electric launch has been installed, it has rarely been allowed to rest unpatronized during the day and evening except for purposes of charging.

Street railways owning parks with navigable lakes have in several instances found electric launches a cheap and profitable investment to add to the others provided to allure the paying public.

Underground Conduit Construction on Lenox Avenue, New York.

One of the chief points of interest in New York to a visiting street railway manager, whether a resident of this country or from abroad is the electric railway conduit system on Lenox Avenue. This line, as is well known, forms part of the extensive surface system of the Metropolitan Street Railway Company and connects with the terminal of the Columbus Avenue Cable Railway.

The difference in ease of riding is very noticeable as a passenger transfers from a cable to an electric car. The cars start up easily and soon acquire full speed. The line crosses one cable line at 125 Street and Lenox Avenue. The engraving on this page gives a good idea of the appearance of the roadway.

VIEW ON LENOX AVENUE, NEW YORK.

Automatic Circuit Breakers for Cars.

The motors and other appliances of street car equipments have hitherto depended for protection against injury from excessive currents on the common safety fuse in its box placed beneath the car platform and more or less inaccessible. The blowing of the fuse entails delay until the motorman replaces it, and as a certain time is taken by a safety fuse to blow considerable injury may be done to the motors and other car apparatus in the interval in which it is reaching the melting point.

To avoid this delay the General Electric Company conceived the idea of making the main motor switch an automatic circuit breaker instantaneously operating and easily reset. This device has been perfected and the automatic circuit breaker for street railway car equipments, known as the "M" circuit breaker is now being manufactured. In appearance it resembles the main motor switch and in every way answers the purpose of one. It is intended to be placed in the same position under the car hood. The handle is so arranged that the breaker may be opened and closed by hand in the same way as the standard main motor switch. The device is provided with magnetic blow-out and can thus break the severest short circuits without injury to itself. It opens the circuit instantaneously and the ability to close the circuit immediately after it has opened, thereby avoiding delay to the car, will be at once appreciated.

The M circuit breaker is so constructed that an automatic counter may, when desired, be introduced into it, in such manner as to preclude any tampering with it by the motorman. This registers every time the circuit breaker opens automatically, and affords an excellent method of detecting the improper handling of the cars. It gives to the inspector a means of discovering those motormen who have turned on the current too suddenly, calling for an excessive amount of current.

The M circuit breaker is adjustable. By a simple movement of the calibrating spring the breaker may be adjusted to open at any predetermined amount of current within a certain range. The device is manufactured for 75-150 amperes and 150-250 amperes, the first figure representing the lowest tripping point, the second the maximum carrying capacity for steady loads. The adjustment may, however, be made to break the circuit at currents considerably higher than the maximum carrying capacity. This device will be exhibited at the St. Louis convention.

PERSONAL AND BIOGRAPHICAL

Mr. Richard Emory has been appointed general manager of the Baltimore Traction Company.

Mr. Frank R. Henry, secretary and treasurer of the Missouri Railroad Company, is a native of the city of St. Louis, and is now thirty years of age. He entered the employ of the company with

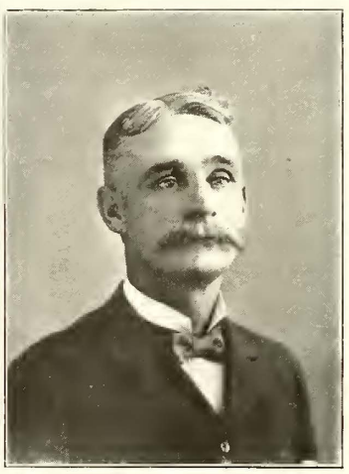
RICHARD McCULLOCH,
ELECTRICIAN, CASS AVE. & FAIR GROUNDS RY. CO.

C. NESBITT DUFFY,
SECY. & TREAS., CASS AVE. & FAIR GROUNDS RY. CO.

which he is now connected, when sixteen years of age, and has been consequently associated with it for fourteen years, during the last five of which he has acted as secretary and treasurer of the company.

Mr. E. R. McDowell, who has acted for the last eight years as superintendent of the Fifth Avenue cable and the Duquesne electric divisions of the Pittsburgh & Duquesne Traction Company, of Pittsburgh, Pa., was presented last month, on the occasion of his retirement from the company, a handsome gold watch and chain, with horseshoe charm. The gift was made by the employes of the company on the night of Sept. 3, who, headed by a band of music, marched in a body to his residence.

JAS. ADKINS,
SECY. & TREAS., LINDELL RAILWAY CO.



WINTHROP BARTLETT,
CHIEF ENGINEER, MISSOURI RAILROAD CO.

Mr. W. A. McGuire, of the McGuire Manufacturing Company, who recently returned from a European trip, reports a rapidly growing interest in electric power among the street railway companies of Europe, especially those located in Germany and France. Mr. McGuire believes that a large amount of electric railway construction will be undertaken in these two countries during the next year or two, and that he will secure a good share of the orders placed in this country for apparatus manufactured by his company, those who are acquainted with Mr. McGuire's push and enterprise will not doubt.

Mr. R. B. Jennings, secretary and treasurer of the St. Louis Railroad Company, came to St. Louis in 1866 from Fauquier County, Virginia. An entire stranger, he accepted the first employment that presented itself, a conductorship with the St. Louis Railroad Company, and served in that capacity until Oct., 1866, in which month he was appointed to a clerkship in the company's office. In April 1871 he was elected secretary and treasurer and holds that position at the present time, having been in the service of the company continuously for a little over twenty years.

Mr. John C. Allen, superintendent of the Southern Electric Railway Company, has had experience in all of the various motive powers in use on the Southern Electric Railway, and is regarded as one of the veterans in the street railway business in that city. He commenced his street railroad career in 1879, when twenty years of age as driver on the Broadway line in St. Louis. He entered the employ of the Southern Electric Railway Company in 1883, as driver, was then appointed conductor, then roadmaster, then in 1892 was given the office of superintendent of the company. He is a native of Canada.

Mr. R. S. Wakefield, who was superintendent of the Queen City Railway Company, of Dallas, Tex., resigned that position on Sept. 1, to accept that of manager of the railway lines of the San Antonio Edison Company. This company is now operating the

R. B. JENNINGS,
SECY. & TREAS., ST. LOUIS RAILROAD CO.

FRANK R. HENRY,
SECY. & TREAS., MISSOURI RAILROAD CO.

lines formerly belonging to the Citizens' Street Railway Company, and has greatly improved both the line and equipment during the last year. Mr. Wakefield is a farmer boy, or was nine years ago, when he went from central Illinois to the metropolis of that state. Here he acquired the groundwork of his business education, and has steadily advanced to his present position, which he reaches at the age of twenty-five.

Mr. H. O. Rockwell, electrical superintendent of the St. Louis & Suburban and Meramec River Railways, is a native of Connecticut, having been born at Bloomfield in that state in July 1868. Mr. Rockwell, like many other railway engineers, began his electrical career with the old Thomson-Houston Electric Company, having entered the works of that company at Lynn, in 1887. He had previously taken a technical course. Mr. Rockwell remained with the Thomson-Houston Company until December, 1890, making a specialty of power transmission. In the year last mentioned he became associated with the St. Louis & Suburban Railway Company with which he has since remained.

Mr. T. L. Hanley, engineer in charge of the manufacture and installation of special work for the Lindell Railway has had a long experience as engineer of track construction and in civil engineering. In 1889, Mr. Hanley was appointed assistant engineer to the City Surveyor of St. Louis, and in 1891 took up track construction for the Lindell Railway Company. In the following year he became connected with the Frog & Switch Company, of Chicago, and engaged in the manufacture of special work. In the following year he severed his connection with this company and entered the employ of the St. Louis, Chicago & St. Paul Railroad as chief engineer and roadmaster. In 1895, he was appointed chief engineer of the St. Louis, Peoria & Chicago Railroad.

Mr. A. C. Thompson, electrical engineer of the Missouri Railroad Company, was born in Ohio in 1857, and received a common school education. At the age of eighteen he was appointed to take charge of a pumping station for the Coal Creek Mining Company, at Coal Creek, Ind. When twenty-one years of age he entered the employment of a flouring mill, at Waterman, Ind., and a few years later engaged in bridge work with the Howe Truss Bridge Company, of Toledo, O. Mr. Thompson left the employ of the company to enter the lead mining business in southwestern Missouri, and went out of this business to install some compressed air mining machinery in Weir City, Kan. He began his electrical career in 1884 with the study of telegraphy, and branched from that into arc lighting station work with the Thomson-Houston Electric Company. He severed his connection with this company to help install a plant for the Missouri Street Railway Company in 1890, and has had charge of the electrical department of this railway ever since. His mechanical and electrical knowledge has been obtained through study and practice, and his work has been marked by its thorough practicability.

Mr. Richard McCulloch, electrical engineer of the St. Louis, Citizens' and Cass Avenue & Fair Grounds Railways, is a son of Robert McCulloch, vice-president and general manager of these systems, and is generaly regarded as one of the leading electric railway engineers of the country. He was born in St. Louis County, Mo., in 1869. He attended the public schools and Washington University in St. Louis, and was graduated from Washington University in 1891 with the degree of mining engineer. While attending college he worked in every branch of the street railway business during the vacation and before and after the college lectures. He also took part in the United States geological survey in Missouri, Arkansas, Indian Territory, Colorado and Montana.

In 1891-92 Mr. McCulloch spent a year in Mexico in the service the of Mexican National Smelting Company. Returning from

H. O. ROCKWELL,
ELECTRICAL SUPERINTENDENT,
ST. LOUIS & SUBURBAN RY. CO.

T. L. HANLEY,
TRACK SUPERINTENDENT,
LINDELL RY. CO.

Mexico he decided to engage in electric railway work, and in 1892-93 took the expert course in the shops of the General Electric Company, in Schenectady and Lynn. In 1893 he was appointed engineer for the Cass Avenue & Fair Grounds Railway, and since that time has been civil and electrical engineer for the consolidated management of the St. Louis, Citizens' and Cass Avenue & Fair Grounds Railways, of St. Louis. He has also had charge of the electrical reconstruction of the Baden Railway, Southwestern Railway and Citizens' Railway.

Mr. C. Nesbitt Duffy, secretary and treasurer of the Citizens' and Cass Avenue & Fair Grounds systems was born in St. Louis, Aug. 14, 1859, and received his education at the St. Louis University, where he remained for three years. At the age of fourteen, he began earning his own living as shipping clerk and general utility boy in a grain shipping and commission house. After twelve years' service in mercantile business, filling different positions of trust and responsibility, he entered the street railway business in May, 1886, as secretary and treasurer of the Union Railroad Company.

The Union Railroad Company was then an eight mile road, operating bobtail cars by mule power. Julius S. Walsh, president of the American Street Railway Association in 1886, was president of the Union Railroad Company at that time, as well as president of the Citizens', Northern Central and Cass Avenue Companies, each company being then operated separately and independently of the other. In April, 1888, Mr. Duffy was elected secretary and treasurer of the Citizens' Railway Company.

In January, 1889, Mr. Walsh and his associates sold the Citizens', Cass Avenue, Northern Central and Union lines to the National Railway Company, of Chicago. The management of the four lines was then consolidated, with Robert McCulloch, vice-president and general manager, Mr. Duffy having been elected secretary and treasurer of the four companies. Mr. Duffy was married in May, 1895, to Miss Alice Cunningham, of St. Louis.

Mr. Winthrop Bartlett, one of the most prominent civil and electrical engineers, was born in Springfield, Mass. He was graduated from the St. Louis High School in 1871, and from the Washington University in 1874, with the degree of C. E.

During the two years following his graduation from the univer-

J. F. DAVIDSON,
SUPERINTENDENT, MISSOURI
RAILROAD CO.

JOHN C. ALLEN,
SUPERINTENDENT, SOUTHERN
ELEC. RY. CO.

sity he was mechanical draughtsman in the locomotive department of the Wabash Railway Company, at Springfield, Ill.; during the next seven years he was resident engineer of the St. Louis division of the St. Louis, Iron Mountain & Southern Railway. From 1883 to 1885 he was a member of the contracting firm of S. W. Crawford & Company, and in 1886 and 1887 was superintendent of the Allen Gold Mining Company.

Since June, 1887, Mr. Bartlett has been almost exclusively in the street railway business, having been connected with the constructing and operating departments of various roads, among the most important in St. Louis are: the Olive Street Cable, the Broadway Cable, the Market Street electric line, the Forest Park, Laclede & Fourth Street, the Cass Avenue & Fair Grounds, the St. Louis & Suburban, the Southern Railroad, the Benton & Bellefontaine, the

A. C. THOMPSON,
ELECTRICIAN, MISSOURI
RAILROAD CO.

T. F. SNEED,
SUPERINTENDENT, ST. LOUIS
& SUBURBAN RAILWAY CO.

Grand Avenue Railway, the Midland electric, and the St. Louis and Meremec River.

Mr. Bartlett is at present chief engineer of the St. Louis & Suburban and of the Meremec River Railway Companies. He also has a good practice as consulting engineer.

Portable Rail Saws for Electric Railways.

The use of portable rail saws, according to the Q. & C. Company, the manufacturer of the Bryant metal sawing machine, is increasing rapidly, and there are now 129 different roads using this machine. One company, which had previously made its frogs, crossings, switches, etc., in its own shops without the aid of a metal saw, installed one of these No. 10 saws last spring and is able to report, it is said, an actual saving of about $5 per day, obtaining this result with one-half the number of men previously employed to do this work.

Owing to the availibility of electric power on electric roads, the

manufacturers of this metal saw have adapted their tool to its operation by an electric motor, when this attachment is desired. The efficiency of the machine when so equipped has made it a very popular tool, as it dispenses entirely with the noise and danger depending upon using a friction saw running at high speed, and accomplishes the result desired without interfering in any way with the temper of the metal cut and without necessitating hand trimming to remove burrs resulting from the use of the friction saw.

The machines to be run by electric motors are manufactured by this company in as large sizes as thirty-six inches in diameter of saw blades.

The Q. & C. Company has recently installed a No. 10 power sawing machine in the shops of the Citizens' Railway Company, of St. Louis, and has a number of others in use among the steam railroads terminating in that city. The roadmaster of the St. Louis Terminal Railroad Association speaks in the highest terms of its performance both in the way of efficiency and economy.

Some Notes on the Cast Weld Rail Joint.

A number of street railway companies who have had an extended experience with the cast-weld joint report that it is giving eminent satisfaction. The work of putting in this joint has not been confined, it seems, to new rail, but a large amount of old track on various roads throughout the country has been practically reclaimed by this process. Where the cars run in one direction only over the rail a low spot often forms on the receiving rail a few inches from its end, providing the joint is at all defective. As the balance of the rail is generally in as good condition as when first laid, some managers have adopted the plan of taking up the rails when badly pounded, cutting off the battered end, and then repunching and relaying the rails.

The cast-weld joint has been successfully applied during the last year or two to track in the condition as above mentioned. In cast-welding the joint where the track is in this condition the method adopted is to raise the end of the receiving rail above the end of the other rail to the extent of the depression that has become pounded in the receiving rail. This will vary from $\frac{1}{32}$ in. to $\frac{1}{8}$ in. and after the joint is cast the surface of the raised rail is ground perfectly smooth and even with the other rail by the use of an emery wheel attached to a flexible shaft and driven by an electric motor. This plan of dealing with old battered rail has been very extensively adopted in Chicago and in Milwaukee, also Providence, on what is known as the Providence rail, and in Newark, N. J., DeKalb Avenue line, New York City, New Haven, St. Louis and other cities, and is understood to be giving universal satisfaction. The track thus overhauled has been of all kinds and weights of rail.

The Chicago City Railway Company has practically cast-welded its whole system both cable and electric. The Citizens' Street Railroad Company, of Memphis, is welding its entire system. The Twin City Rapid Transit Company, of Minneapolis, has been using two machines for the past year and expects to eventually weld its entire system. In St. Louis, the Easton Avenue line of the National system has been welded its entire length, 2000 joints have been put in on the Suburban line, 2000 on the Lindell and about 4500 on the Missouri road. At Washington 2000 joints have just been put in for the Capital Traction Company and a machine has just been started on six inch T rail at Sioux City, Ia. Thus far there have been about 100,000 of these joints put in.

AMONG THE MANUFACTURERS.

J. Holt Gates, of Chicago, has removed his office from 311 Dearborn Street, to suite 1143 Marquette Building, where the agencies of the Walker Company and the C. & C. Company will henceforth be.

Max Osterberg, E. E., M. A., consulting engineer, has become associated with the Correspondence School of Technology, Cleveland, O., in the capacity of instructor and representative for Greater New York.

The Fiberite Company, of Mechanicville, N. Y., manufacturer of the Medbery insulation for electric railways, has appointed S. F. B. Morse, of Marquette Building, Chicago, Ill., as its Western representative.

The Standard Air Brake Company, of New York, supplied the air brake equipment for the new parlor car recently built for the Springfield (Mass.) Street Railway Company by the Wason Manufacturing Company and described in our August issue.

Messrs. Mayer & Englund, of Philadelphia, are doing an excellent business in general electric railway supplies. The firm will be represented at St. Louis, but will make no individual exhibit, as the exhibits of the Nuttall Company and of the International Register Company will include most of its specialties.

The Ohio Brass Company, of Mansfield, O., will have a display at the convention in connection with the Western Electrical Supply Company, of St. Louis. The company will be represented by the president, C. K. King, and probably also by Jas. H. McGill, its Chicago agent, and A. L. Wilkinson, special agent.

The Steel Motor Company, of Johnstown, Pa., has recently published a new catalogue descriptive of its series multiple controllers, motors, and other apparatus for street railways. The motors of this company, which are doing excellent work on a number of lines in this country, are illustrated and described.

The O. J. Gude Company, of New York, has secured all of the street railway advertising interests belonging to Mr. Ferrie, except those in Philadelphia and some other towns in Pennsylvania, and now are placing advertisements in about 3000 cars. C. H. Chisholm has charge of the company's street railway department.

A. G. Hathaway, of Cleveland, O., whose new transfer table is illustrated in this issue, has installed a number of these transfer tables in the car houses of the St. Louis Railway Company, Lindell Railway Company, Missouri Railway Company and National Railway Company. The Missouri Railway Company has equipped some of its cars with the Murrey anti-friction brake.

The Stever Rail Joint Company, the well known manufacturer of the Stever rail joint, has recently received an order for fifty joints from Capt. Robt. McCulloch, of the National Railway Company, of St. Louis. The order was given so that this joint could be thoroughly tested on the lines owned by the National Railway Company.

The Kisinger-Ison Company, of Cincinnati, is well represented in St. Louis, so far as its apparatus is concerned, as many thousands of the Kisinger wire connectors are employed in that city. The company is also doing a good business in the manufacture of snow-sweepers and is now engaged on several for the Cass Avenue line in St. Louis.

The Stanwood Manufacturing Company, of Chicago, has a large number of its steps in St. Louis, so visitors to the convention will be able to see them and examine their workings. The Stanwood steel steps are used by the following companies in St. Louis: Citizens' Railway Company, Cass Avenue & Fair Grounds Railway, St. Louis Railroad Company, Southern Electric Railroad Company.

The Westinghouse Machine Company, of Pittsburgh, has recently published an attractive pamphlet descriptive of Westinghouse gas engines. Gas engines have not been exploited in this country as extensively, it would seem, as their merits for certain classes of work deserve. For driving small generators they have a higher economy, it is claimed, than steam engines and at the same time require less attendance.

J. H. Fay & Company, of Cincinnati, O., have recently published a pamphlet entitled "Wood Workers, Variety and Universal." The pamphlet is of course descriptive of the well known wood working machinery manufactured by this company for car shops. It is well worth reading by any person interested in wood working machinery, and we understand to such J. A. Fay & Company will be glad to send a copy.

A. Jackson Reynolds & Company, of Montreal, Can., whose electric street cleaning and self-loading cars were described in a recent issue of the STREET RAILWAY JOURNAL, have organized a company with a capital of $200,000 for the manufacture of these cars for use in Lower Canada. The firm will have on exhibition at St Louis a new car which, it is expected, will be able to clean one hundred miles of street in a day.

The J. T. Schaffer Manufacturing Company, of Rochester, N. Y., has sent among other orders five of its wheel presses to St. Louis where they are in use by the Citizens' Railway Company, Cass Avenue & Fair Grounds Railway Company, St. Louis Bridge Terminal Railway Company, Benton-Bellefontaine Railway Company, and Wiggins Ferry Railway. They can be examined here by any person interested in this apparatus.

The Consolidated Car Fender Company, of Providence, R. I., has recently published a card pocket folder showing in tabular form the presidential vote from 1824 to 1892. One page of the folder is printed with the names of the different states and their electoral vote with blanks in which guessers on the coming election can fill in their own figures. The folder is decorated by handsomely engraved steel portraits of the two leading candidates for the presidency.

The American Stoker Company, of Dayton, O., has recently perfected a steam motor which is applied to each stoker, thus making each machine independent. This renders the work of installation very simple. It also renders the stoker practicable for use under marine boilers. This company is desirous of a general representation through engineering firms handling pumps, heaters and boiler room supplies and invites correspondence from interested parties.

E. F. deWitt & Company, of Lansingburgh, N. Y., have issued a notice to street railway companies, car builders and to all whom it may concern that they have commenced suit against the J. G. Brill Company, of Philadelphia, for infringement of their letters patent No. 491,191 dated Feb. 7, 1893, for sand boxes for street railways. The firm warns street railway companies and all others that all infringments of their sand box will be prosecuted to the full extent of the law.

T. Shriver & Company, of New York, have been for many years manufacturers of traveling cranes, and have made a specialty of equipments for power houses and central stations. These cranes are compact and require but little head room. The working mechanism is entirely enclosed and free from dirt and dust. The hoisting mechanism runs in a bath of oil, securing perfect lubrication, without the necessity of frequent attention for oiling. Persons wanting anything of the kind would do well to address them.

Thomas and Wm. Smith, wire rope manufacturers of Newcastle-upon-Tyne, England, have recently published a handsome catalogue descriptive of their wire ropes for mining work, cable railways and other purposes for which they are adapted. The ropes of this company have given very good results on cable railways both in this country and in Australia where they have been extensively used. Among the engravings in the book, which is handsomely illustrated, are several showing method of shipping cables to Australia and America.

Richard Dudgeon, of New York, is well known as a large manufacturer of hydraulic jacks for all purposes. Mr. Dudgeon's business was established in 1850, so that he has been for forty-six years in this line of work. He was the original inventor of hydraulic jacks and has taken out a large number of patents dating from 1851 down, for different improvements in jacks. He is also the inventor of the roller-tube expander and hydraulic punch, and manufactures, besides jacks and punches, wheel presses, steel hammers, die presses, etc.

The Edward P. Allis Company, of Milwaukee, Wis., has published a reproduction of the record of speed regulation as recorded by a Mosscrop recording gauge, attached to one of the Allis engines, in the Green Street power house of the People's Traction Company, Philadelphia. The speed of this engine, under the varying conditions of street railway work, is shown to remain practically constant. The engine is of the twin tandem compound type with cylinder dimensions 24 ins and 48 ins. × 60 ins. stroke and is direct connected to a G. E. M. P. generator.

A. O. Schoonmaker, of New York, deals exclusively in mica for electrical purposes. Carrying a large stock of India and Amber mica he is able to fill all orders promptly and at lowest prices. He makes a specialty of solid sheet mica segments for all railway motors, washers, bushings, etc., built up and gauged to required thickness, and is prepared to cut mica to any design or pattern wanted. His exhibit at St. Louis, in the booth of the Commercial Electric Supply Company, his St. Louis representative, should be visited as showing what can be done with mica.

The Brussels Tapestry Company, of New York, manufacturer of textile fabrics for car window and berth curtains, printed ducks, self adjustable curtain fixtures, etc., has brought out a new material for car curtains, entitled "Brusselette." This material is a close imitation of leather, is waterproof, does not scratch, is pliable, odorless and of fast color. The company fully guarantees these qualities in Brusselette. The material is made in all the well known Brussels patterns and is specially adapted for curtains for open cars. The company will send samples on application.

The American Rattan & Reed Company, of Brooklyn, N. Y., has lately added a full line of cane weaving machiney, which gives it ample facilities for furnishing promptly woven cane for seating purposes and straight cane for sweepers. A large supply of these materials is always carried in stock. The business of the company has grown so large that the company finds it pays to keep a buyer constantly in East India to select and purchase its stock. This not only assures the company its cane at a very low figure, but also the finest goods in the market. The factory in Brooklyn is easily accessible by any Brooklyn ferry.

The Washburn & Moen Manufacturing Company, of Worcester, Mass., reports that its business for the past year has been unusually satisfactory and far in excess of its expectations. Especially has this been true of the company's electrical wire trade. The company has obtained many important contracts for electric railway equipment and electric light installations, and the continued sales of the Chicago rail bond, to many of the largest railway systems of the country, testify to its superiority. The company's works are probably the most extensive of their kind in the country and comprise factories at Worcester, Mass., Waukegan, Ill., and San Francisco, Cal.

The Steel Motor Company, of Johnstown, Pa., writes us that its exhibit at the St. Louis Convention will consist of a pair of its type C 3½ thirty-five horse power motors mounted on a duPont truck and operated by a pair of its new type C 3 controllers. The unique feature of this controller is that either motor is run forward, backward, or cut out altogether by a movement of the reverse lever, without opening the controller. The company will also exhibit a pair of its type C 2½ motors not mounted, also the armature, commutator and field coils. This exhibit will be in charge of the company's general sales agent, Geo. W. Henry, and its chief electrician, E. C. Parham.

The Armstrong Manufacturing Company, of Bridgeport, Conn., is one of the best known manufacturers of machine tools in the country, and it has enjoyed an excellent trade with street railway companies. The construction of railway repair shops has produced a large call for machine tools, and this demand shows no sign of abating. Among the many tools of the Armstrong Company which have been found especially convenient in electric railway repair shops are the different sizes and kinds of pipe threading and cutting off machines. These are made for both power and hand service and are simple and durable. They cut off and thread pipes from one to six inches, requiring only one-half to four minutes to thread pipe from one to six inches, according to size.

The Ohio Brass Company, of Mansfield, O., has recently secured a valuable acquisition to its present efficient force in the person of M. M. Wood, who will take charge of its engineering department. Mr. Wood's long experience in the line of electrical engineering work, particularly in connection with electric railways, has fitted him pre-eminently to occupy this position, and the Ohio Brass Company is to be congratulated on securing his services. Mr. Wood is well known to the electrical fraternity, having been associated during the past several years with the Ansonia and Wallace Electrical Companies, of Chicago. The Ohio Brass Company is well represented in St. Louis in the way of overhead line appliances.

The A. Mertes Manufacturing Company, of Pittsburgh, Pa., whose gears and other products are well known in the street railway field, has recently been reorganized. The following are now the officers of the company: president, J. A. Donaldson; secretary and vice-president, N. Seibert; general manager, J. Parsons. All of these gentlemen have had experience in the manufacture of machinery or electrical apparatus. Mr. Donaldson is also manager of the Rosedale Foundry, of Pittsburgh. Mr. Parsons has made a special study of electrical apparatus for nearly ten years, having been early associated with the R. D. Nuttall Company, of Allegheny, Pa. This experience enables the company to understand the needs and requirements of electric roads, and to supply what is wanted.

The Southern Electrical Supply Company, of St. Louis, is the oldest supply house in the city, beginning business there in February, 1889, on Third Street, afterwards moving to larger quarters on Locust Street, and now located at 10–12–14 South Seventh Street. It has always been the local representative of the Central Electric Company, of Chicago, looking after the interests of its well known specialties, namely, Okonite wires and cables, Manson tape, products of the Interior Conduit & Insulation Company of New York City, including the well known Lundell fan and power motors, generators, etc. As is generally well known by the electrical trade, it has to offer only the very best goods on the market. The company extends a hearty welcome to all visiting friends to call and become better acquainted at its store.

A. O. Schoonmaker, of New York, importer of East India mica, reports a large business, especially in solid sheet mica segments and solid sheet mica washers. It is a well established fact that mica is now an absolute necessity to the electric trade; every practical electrician knows that he cannot do without it. To have the best and most satisfactory results, the mica must be in its native condition, that is, in the solid sheet as it is mined, and it is only in this form that Mr. Schoonmaker sells it to the trade. The mica that he sells comes direct from the original source in India. It is selected stock of guaranteed purity, and no region in the world furnishes a better article for insulating purposes. This mica has been used constantly by many of the most prominent electrical companies in the country, and has given perfect satisfaction.

The Goubert Manufacturing Company, of New York, has recently published a very tasteful catalogue descriptive of the Goubert feedwater water heater. The catalogue is illustrated by a number of handsome engravings, illustrative of the construction of the different types of heater and with details. Several illustrations are also given of different methods of connecting primary and secondary heaters in connection with a condensing engine, etc. Some tables, which are included in the pages of the pamphlet, show the percentage of the fuel saved by heating feedwater under different conditions. From the long list of users in the pamphlet it is easy to see that the Goubert heaters hold their popularity. These include the St. Louis & Suburban Railway, of St. Louis, in whose station visitors to the convention can see these heaters in operation.

The Morrell Electric Works, of St. Louis, is devoted exclusively to the repairing of street railway apparatus. That it is rapidly gaining popularity is evidenced by the very liberal patronage it is receiving from the local roads. Among its regular patrons are the Union Depot Railroad, the Citizens' Railway, the Lindell Railway, the Missouri Railroad, the St. Louis & Suburban, the Southern Electric Railroad, the Venice, Madison & Granite City Railroad and the Laclede Power Company, of St. Louis. Outside of the city it has also a number of regular patrons including the Metropolitan Street Railway, of Kansas City; the Denver Consolidated Tramway Company, the Southwest Missouri Electric Railway Company and many others. The concern is especially well equipped for refilling commutators of all kinds, particularly for street railway motors and is very busy in this line.

The Central Union Brass Company, of St. Louis, was organized and incorporated May, 1892, by Geo. Kingsland and associates, for the purpose of manufacturing brass and bronze goods for street cars and other purposes. By increasing its facilities from time to time, and by the superior quality of its goods, the company has been able to build up a large trade and has now a well established business. In January, 1894, a railway department was added to its business. In this department the company carries a large and well assorted stock of street railway supplies, consisting of electric wires, motor repairs and other material used by electric roads. The company's trade has more than doubled since 1894, and covers a large territory. T. C. White, who has been identified with the supply business in St. Louis for a number of years, has charge of this department. The present officers of the company are Geo. Kingsland, president; F. L. Boquet, secretary; Patrick Flood, superintendent.

The Peckham Motor Truck & Wheel Company, of New York, through its president has published a circular letter to the trade reading as follows: I beg to call your attention to the following United States patents which have been granted to me for improvements in car trucks. Patent No. 481,704, Aug, 30, 1892, Car Truck Gear; patent No. 555,526, Mar. 3, 1896, Car Truck and its Gear; patent No. 560,816, May 26, 1896, Truss Brace for Railway Cars; patent No. 563,685, July 7, 1896, Car Truck. Having been

advised by my attorneys that the trucks being manufactured by the Diamond Truck & Car Gear Company, of Kingston, New York, are an infringement of the above named patents, I have begun an action in the United States Circuit Court for the Southern District of New York, against said company for an injunction and accounting. All users of the infringing trucks will be held responsible for the infringement due to such use. This notice is sent for your protection"

The St. Louis Register Company, of St. Louis, is enjoying an excellent trade both in St. Louis and in other parts of the country. The company was incorporated in 1890 with a paid up capital of $100,000, and has spent a large amount of money perfecting its machines. It has equipped some of the largest lines in the United States with them, and has been working to its fullest capacity during the past spring and summer filling orders. The company employs between forty-five and fifty hands at present, has increased its plant considerably during the past year and is prepared to turn registers out at a rapid rate. The company has a large number of registers on the West End Railway of Boston; Metropolitan Railway, of Washington, D. C.; Cincinnati Street Railway; Baltimore City Passenger Railway; City & Suburban Railway of Baltimore; on all of the St. Louis lines, the Market Street Railway, of San Francisco, and a number of other large roads in the United States. It has also made good shipments to Halifax, N. S., and also to Moncton, N. B.

The J. H. McEwen Manufacturing Company, of New York, is doing an excellent business, and judging from opinions generally expressed, the McEwen engines are giving good satisfaction. It is gratifying to manufacturers to receive a duplication of orders for their goods from people who, having tried them, are thoroughly familiar with their merits, for in thus purchasing more of the same kind they bear testimony to having been entirely satisfied. In this particular, the J. H. McEwen Manufacturing Company is no exception, and the company may well be proud of the numerous orders already received from former patrons, one coming from a well known firm, A. M. Rothschild & Company, of New York and Chicago. Messrs. Rothschild & Company have had in operation for the past eighteen months, two 100 k. w. Thompson-Ryan generators, direct connected to 15 in. 16 in. McEwen automatic engines, and have just placed an order for the third machine of the same size as the first two.

The Ball Engine Company, Erie, Pa., reports an encouraging increase in orders during the past few weeks for engines for electric work. Shipments for the past month are as follows: Bradford Electric Railway Company, Bradford, Pa., one 200 h.p. cross compound engine; Fox Pressed Steel Company, Pittsburgh, Pa., one 100 h.p. engine direct connected to Westinghouse generator; Rogers, Peet & Company, New York City, one 100 h.p. and one 25 h.p. engine; National Galvanizing Works, McKeesport, Pa., one 175 h.p. engine; National Tube Works, McKeesport, Pa., one 175 h.p. engine direct connected to Crocker-Wheeler dynamo; J. Q. Howe's Sons Electric Light plant, Phelps, N. Y., one 100 h. p. engine; Cambridge Fuel Company, Byersville, O., one 125 h. p. for electric mining; Institute for Blind, Janesville, Wis., one 40 h. p. engine; Bertha Mineral Company, Bertha, Mo., one 70 h. p. engine; Crook, Horner & Company, Baltimore, Md., one 35 h. p. engine; Gobierno del Distrito Federal Mexico City, one 80 h. p. engine; Toledo Glass Company, Toledo, O., one 100 h. p. engine.

The Safety Insulated Wire & Cable Company, of New York, manufacturer of seamless insulated wires and cables, has done a large business during the past year with street railway companies. The company's wire seems to be growing in popularity and the company numbers a large number of prominent street railway companies among its list of customers. The People's Traction Company, Philadelphia, purchased one hundred miles of 1,000,000 c. m. rubber covered, lead encased "Safety" cable. The Union Traction Company, of Philadelphia, since the consolidation of that city, has also purchased ten miles of 1,000,000 c. m. rubber covered, lead encased "Safety" cable. The North Chicago Street Railroad Company has in use ten miles of 350,000 c. m. cable of the same type. The West Chicago Street Railroad Company has ninety miles of from 350,000 to 1,600,000 c. m. "Safety" cable. The Chicago City Railroad Company has twenty miles of the company's cable, and the West End Street Railway, of Boston, has just received a lot of 500,000 c. m. cable from the Safety Insulated Wire & Cable Company.

The Clonbrock Steam Boiler Company, of Brooklyn, reports a large rush of business, its order sheets being so full that it is necessary to have on a night force to complete orders already booked for Jan. 1, 1897. Among its latest orders are for the American Manufacturing Company, Brooklyn, 500 h. p.; Hazelton Light Company, Hazelton, Pa., 800 h. p.; People's Light & Power Company, Jersey City, N. J., 800 h. p.; Municipal Electric Light Company, Brooklyn, 2000 h.p., and one steel, self supporting smoke stack 16 ft. diameter and 175 ft. high; Economy Light, Heat & Power Company, Scranton, Pa., 1000 h. p.; Johnson Coal Company, Priceburg, Pa., 400 h. p.; Marshall Paper Company, Turners Falls, Mass., 150 h. p.: People's Light & Power Company, Orange, N. J., 200 h. p.; Geo. Watkinson Rubber Works, Philadelphia, Pa., 250 h. p.; Esperanza Plantation, Bayou Lapourche, La., 600 h. p.; Mathieson Alkali Works, Providence, R. I., 300 h.p.; Brush Electric Company, Providence, R. I., 300 h. p.; New York Steam Company, new station, New York City, 3000 h. p.; Brush Electric Company, Baltimore, Md., 1000 h.p.; Coney Island & Brooklyn Railroad Company, Brooklyn, N. Y., 700 h. p.

The Hoppes Manufacturing Company, of Springfield, O., manufacturer of the well known Hoppes purifiers and heaters, has been fairly busy for the past sixty days, having sold over 9000 h. p. of its apparatus. Among the recent sales of purifiers are the following: Salem Wire Nail Company, Findlay, O., 750 h. p.; Shelby (O.) Mill Company, 300 h. p.; Abendroth & Root Manufacturing Company, New York City (for export), 50 h. p.; City of Quincy, Mich., 100 h. p.; Kansas City (Mo.) Gas Company, 300 h. p.; Atlanta (Ga.) Gas Company, 150 h. p.; Springfield (O.) Light & Power Company, 850 h. p. The company also reports the following sales of heaters: Browning, King & Company, Chicago, Ill., 200 h. p.; Modern Heating Company, St. Louis, Mo., 500 h. p.; Kirkhoff Brothers, Indianapolis, Ind., 150 h. p.; J. B. Speed & Company, Speeds, Ind., 500 h. p.; Ellwood Wire & Nail Company, DeKalb, Ill., 1200 h. p.; Gibsonburg (O.) Electric Light Company, 100 h. p.; Harper Hospital, Detroit, Mich., 200 h. p.; Suburban Gas & Electric Company, Revere, Mass., 500 h. p.; J. W. Cottingham, Leipsic, O., 150 h. p; Preston (Minn.) Electric Light & Water Works, 100 h. p.; Greenville (Miss.) Water Works, 150 h. p.

Eugene Munsell & Company report that their mica business has been established more than fifty years, so that when there began to be a call for mica for electrical insulation they had experience which enabled them to meet the demand, and that they have since been constantly enlarging their facilities and studying to meet the varying and increasing requirements of the electrical trade. They also state that their mica is received direct from the mines and not through second hands. Franklin Brooks, the junior member of the firm, has recently spent considerable time among the rich mines of Bengal, India, perfecting arrangements by which they receive the finest electrical mica in the world, selected and prepared according to their own instructions. They also have extensive relations with Canadian miners which enable them to furnish the best amber mica where that quality is desired. The electrical trade, as a rule, prefer to have their orders filled promptly, and this is one of the features of Eugene Munsell & Company's business of the past, that they guarantee almost immediate delivery of any orders placed with them. The company has recently established a branch house at Chicago to supply their Western customers.

The Shickle, Harrison & Howard Iron Company, of St. Louis, claims to have furnished more steel castings for street railway use than any foundry in the United States. Since the company entered the steel foundry business, over four years ago, street railway work has been a large item of its business. About one year ago the company started its first machines for finishing cast steel motor gears. Previous to that time it had been furnishing cast steel blanks to several street railways in St. Louis, who had their own gear cutters. As is well known the consumption of gears in the city of St. Louis, is quite large, and it has only been within the past four months that the company has added sufficient additional machinery to put it in a position that it could solicit outside trade. The company is now prepared to do business in earnest, in the line of cast steel motor gears, and is getting out for the trade a small circular and price list, descriptive of the articles manufactured. These include pedestals, truck frames, brake beam hangers, equalizer frames, drawbars, brackets and arches, bumpers, platform beams, nose pieces, step risers, yokes and pole pieces for motors, grip castings, switches, crossovers, offset fishplates, cast steel motor gears and general railway and machinery castings.

K. McLennan & Company, of Chicago, sole manufacturers of the celebrated Gale's commutator compound, report their sales during the past year more than double those of any previous year. The satisfaction which the compound has given generally has exceeded their most sanguine expectations, and they are in receipt of enough testimonials unsolicited, to use their own expression, "to fill a volume." In response to numerous requests from their customers, the Fort Wayne Electric Corporation recently made a careful and exhaustive test, and the result, as expressed by it is as follows: "the application of Gale's commutator compound was attended with very satisfactory results. A slight sparking occurs at the moment of applying the compound; this however disappears instantly, and the commutator assumes a hard gloss. We recommend it to those having trouble with sparking, cutting of commutators, etc." The test was made under the personal supervision of Mr. Barnes. Mr. Isaacs, of K. McLennan & Company, states that this is but one of hundreds of similar tests, and with similar results. He will be at the convention with sufficient samples so that every delegate may make a personal test, and convince himself of the merits of Gale's compound. In the meantime samples may be had on application to their office, Marquette Building, Chicago.

The Electric Insulating Company, of St. Louis, is the manufacturer of a new compound known as the Peerless armature compound. This compound is an insulation for armature work for which it is claimed that the qualities of high resistance and non-susceptibility to the action of the heat, oil or water are combined with sufficient elasticity and comparative cheapness of cost. These claims are supported by the testimony of many who have used it. The compound is applied in the form of paint of rather heavy consistency, but when it is dried it becomes very hard, yet not brittle, and holds the wires firmly in place, preventing loosening through vibration. It effectually isolates each individual wire from contact with its neighbor as the paint is thin enough to soak into the cotton insulation, forming a mold around the wire when hardened. Another point claimed for it is that it does away with the use of mica and linen in winding armatures, substituting therefor a much

cheaper material. It is used by a number of the large electric railway companies of the country, such as the Metropolitan Street Railway Company, Kansas City, Mo.; Market Street Railway, San Francisco, Cal.; Union Railroad Company, Providence, R. I.; Rochester Railway Company, Rochester, N. Y.; City & Suburban Railway Company, Portland, Ore. This company will have an exhibit at the St. Louis convention.

The McGuire Manufacturing Company, of Chicago, has received the following late orders for its well known trucks: Consolidated Traction Company, Pittsburgh, Pa.; Toledo (O.) Traction Company; Burlington (Ia.) Electric Railway Company; Citizens' Street Railway Company, Memphis, Tenn.; Colorado Springs (Col.) Rapid Transit Railway Company; New Castle (Pa.) Car Manufacturing Company; Chicago City Railway Company; Jackson (Tenn.) & Suburban Railway Company, and many smaller orders. The outlook in this sweeper department is very promising, and the company has taken during the past week orders from Richmond, Va.; New Castle, Pa.; Findlay, O.; Pittsburgh, Pa.; Rutherford, N. J., and South Chicago, Ill. Shipments have already been commenced of sweepers on early contracts, and the McGuire works are running to their fullest capacity. The recent fire entirely destroyed the company's stove department, but manufacturing was commenced in one of the company's other buildings within forty-eight hours, and all orders are now being filled promptly. The orders for this popular car heater already exceed the number shipped last year, with a prospect of a larger increase when the real cold weather arrives. The demand for the company's ratchet brake handles increases daily, and they are being recommended by conservative roads for their durability and simplicity.

The International Register Company, of Chicago, has been at work for the last six months on a new double register which will be on exhibition at the St. Louis convention. On account of the superior construction and durability of its mechanism, and unusual attractiveness in appearance, this machine will undoubtedly receive the attention of all at the convention and particularly interest those who have two rates of fare on their lines, or who wish to register transfers. The trip mechanism is the same as that of this company's well known numeral stationary register, which is giving satisfaction on so many railways. The trip register shows the total number of passengers for each trip, thus avoiding the unnecessary complication incident to having separate trip registers for each class of fare. There are two totalizers with figures large enough to be read from the other end of the car, and a very plain sign in the center showing the word "cash" on a red background, when the cash side is rung, and the word "transfer" on a white background when the other side is rung, this indicator always showing what the last registration was. The totalizers on this machine are superior to anything of the kind so far produced. With the mechanism of the register entirely exposed, there is no way of preventing them from registering by holding any part, and in many machines, and they cannot be set back as in all other existing machines when open. There are many points in this register which are entirely novel, and will commend themselves to railway managers who realize that it is an economy to have the best in a machine which so directly affects the income.

The E. P. Allis Company, of Milwaukee, Wis., numbers among the large work lately completed or under contract one tandem compound engine with cylinders 30 ins. and 60 ins. × 48 ins. with a speed of seventy-five revolutions. This is for the Metropolitan Street Railway Company, Kansas City. It is similar to the engines built for the Detroit Citizens' Street Railway. It drives a 1200 k. w. Walker generator. For the Brockton Street Railway, Brockton, Mass., one cross compound with cylinders 20 ins. and 38 ins. × 48 ins., speed 110 revolutions. Direct connected to General Electric Generator. Syracuse Street Railway Company, Syracuse, N. Y., two cross compound with cylinders 26 ins. and 50 ins. × 48 ins. speed eighty revolutions; direct connected to Walker generators. Northwestern Elevated, Chicago, three cross compound, cylinders 30 ins. and 60 ins. × 60 ins., one with cylinders 23 ins. and 46 ins. × 48 ins. direct connected to Siemens & Halske generators. Canal & Claiborne Railway Company, New Orleans, two tandem engines, cylinders 16 and 32 ins. × 42 ins., speed 100 revolutions, driving General Electric generators. Peoria General Electric Company, Peoria, Ill., one compound with cylinders 22 ins. and 42 ins. × 48 ins., speed 100 revolutions, driving General Electric generator. Also for Trieste, Austria, two compound vertical blowing engines for the largest iron concern in Austria, that is building new blast furnace plant at Trieste, steam cylinder 40 ins. and 78 ins. × 60 ins.; two air cylinders 76 ins. × 60 ins., same style as those built for the Carnegie Steel Company, twelve in number. Shipping weight of each is 618,000 lbs., and also 3000 h. p. direct for South Africa to run generators that are being built in Switzerland.

The H. W. Johns Manufacturing Company, of New York, will make an attractive exhibit of its electric materials at the St. Louis convention and a number of representatives from its Chicago, Philadelphia and Boston branch houses will attend, as usual. There will be a complete display of the various forms of moulded mica trolley wire insulating devices, including the "J. P." and "H. W. J" styles of hangers and pull-overs, the Giant strain insulators, the Philadelphia insulated crossings and section insulators, iron clad feed wire insulators, etc., all of which may be seen in service on the various street railways in St. Louis. Moulded mica trolley insulators are in general use throughout the States and are a familiar feature to every attendant at conventions. In addition to the line materials, the H. W. Johns Manufacturing Company will exhibit "H. W. J." car heaters, which possess advantages and improvements in construction combined with economical and satisfactory distribution of heat not found heretofore in any street car heating system. The resistance or heating wire is thoroughly insulated and protected by asbestos and woven into a mat enclosed in a shallow perforated steel case. A sufficient number of heaters is installed in a car to effect an equal distribution of the heat under the most economical conditions. In addition to economy the company claims great safety and durability, comparatively low working temperatures per heater with consequent comfort to the passengers, and general desirability. An exhibition car of the St. Louis Car Company will be equipped with "H. W. J." heaters, and all visitors are cordially invited to witness their operation. The H. W. Johns Manufacturing Company has done a large business in St. Louis as well as in other cities in the country. Most of the lines in this city are its regular customers either for vulcabeston field spools, overhead line parts, commutator rings, moulded mica sockets and other apparatus.

The Central Electric Company, of St. Louis, will make a creditable and interesting display of street railway and electrical supplies at the St. Louis convention. Messrs. Garton and White, representing the Central Electric Company's railway department, will have charge and will endeavor to spread the gospel of first class material where it will take root to the best advantage. Probably no other company in the United States carries a larger stock of miscellaneous railway appliances. These, added to its well known capacity for general electrical supplies and insulated wires and cables, enables the company to offer many advantages to its customers in the way of prices and prompt shipments of complete orders. That the managers of the company follow up their opportunities is evidenced by the many letters received from purchasers commenting on this feature of the Central's work. A short extract from one of these letters received from Denver, Colo., will serve as an example: "Yours of the 26th, like your goods, came on time. We greatly appreciate your promptness in filling orders, also your service in sending goods as ordered." Many of the Central Electric Company's specialties, in fact the most of them, are made from patterns and designs furnished by and under the direct supervision of the company. All new fixtures and appliances are thoroughly tested by actual service before being approved and offered for sale. By this careful attention to important details, the company has hoped to gain the confidence of electrical buyers, and the results show that it has not been amiss in its calculations. The managers of the company are giving considerable attention to the refilling of commutators and rewinding of armatures and other repairs usually required on short notice. The Central Electric Company is very well satisfied with the results so far attained and feels confident that it is on the eve of a period of increased activity in all departments of the electrical trade.

The Neal Electric Headlight Company, of Boston, Mass., has acquired the entire business of the Bash Combination Headlight Company, and together with its own facilities is well prepared to fill orders promptly. This company's headlights are now in use, it is claimed, on over one hundred of the most prominent roads in the United States and Canada. The Neal Headlight Company was the pioneer in the manufacture of electric headlights. It has been engaged in an extensive course of experiments and improvements designed to secure the very best headlight, one constructed mechanically and in the best and most durable manner. Its claim has been that its headlights are made to withstand the severest service, and for this reason sheet metal casings have been abandoned for the best of malleable iron casings with solid bronze glass holders. A headlight has thus been obtained that is practically indestructible. The latest type of headlight, No. 5, has a perfect parabolic reflector of spun brass, heavily nickel plated and an adjustable lamp socket, thus allowing for perfect focusing, necessitated by the irregularities in size of the different makes of incandescent lights. The headlight will throw a light 200 ft. ahead of the car. No greater proof of the merit of these headlights is needed than the fact that more than 10,000 have been put in service during the past twelve months. The headlights are used on every car on the West End road of Boston, and were the first to be permanently fixed to the dasher. Among the roads that have adopted them, besides the West End of Boston, are Brooklyn Heights Company, of Brooklyn, N. Y.; Worcester Consolidated, of Worcester, Mass.; Houston Street Railway, of Houston, Tex.; Lynn & Boston, of Boston, Mass.; Winchester Avenue Railroad, of New Haven, Conn., and in all over one hundred roads. The advantages of this headlight are that it becomes a permanent fixture on the car, saving all cost of maintenance. One light is cut out of series and placed into the headlight. The frame is a casing of malleable iron with a holder of bronze glass. The reflector is of spun brass heavily nickeled. There is claimed to be absolutely no danger of possibility of breakage and the light only projects an inch in front of the dasher. The company also furnishes a headlight for vestibule cars which can be placed on the front of the dasher without cutting it. The cost of installation is merely nominal and is usually charged to operating expenses. The company has also a device for preventing the trolley from catching on the headlight and pulling the trolley pole from the wire. The last light has been worked out through a series of experiments and is considered by many railroad men to be the best thing on the market. The officers of the company are F. E. Huntress, president and treasurer, Geo. N. Towle, vice-president, and Geo. C. Ewing, secretary. Mr. Huntress is a young man well known among the business men of the East, and has made a decided success in all his undertakings. He is the senior member of the firm of F. E. Huntress & Company, iron and steel merchants and dealers

in all kinds of railway supplies. In addition to this business he was for two years selling agent for the Laconia Car Company, but resigned to take the Eastern agency of the Walker Company, of Cleveland. Geo. N. Towle, vice-president, is the junior member of the firm of Leland, Towle & Company, members of the New York & Boston Stock Exchange. This firm is one of the largest bond houses in Boston and has handled the financial end of some of the most successful enterprises in New England. While Mr. Towle is comparatively new in the street railway field, he will certainly make a welcome addition. Geo. C. Ewing, secretary, is well known among the street railway companies with whom he has had many contracts for equipments. For several years he was with the General Electric Company, leaving it to go into the general supply business for himself. He is located at present in Boston and by his untiring efforts and strict business principles has built up a considerable business and an enviable reputation as a salesman throughout the country. The company has protected its different designs of headlights by strong patents.

A Great Railway.

The Chicago, Milwaukee & St. Paul Railway Company owns and operates 6169 miles of road.

It operates its own Sleeping Cars and Dining Cars.

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Its General Passenger Agent asks every man, woman and child to buy tickets over the Chicago, Milwaukee & St. Paul Railway—for it is A Great Railway.***

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Utah—the 45th State.

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The Territory of Utah entered the Union of States on Jan. 4, 1896, with a population of about 200,000 people and a climate unsurpassed in the wide world. It is richer in agricultural resources than any other State. It has within its borders nearly all of the known minerals and metals—gold, silver, copper, iron, tin, etc., in abundant quantities. It has, best of all, a health-giving climate, always temperate in summer and winter. It has hot sulphur springs and is, in fact, one large sanitarium. Utah is the ideal place to build a home in which to spend the balance of your days, surrounded by farm and orchard which guarantee all of the necessities and most of the comforts of life. There are millions of such homes now awaiting settlement. Send to F. A. Wadleigh, Salt Lake City, for copies of Utah pamphlets. It will pay you to post yourself on the merits of the new State, which has been aptly termed "The Promised Land." ***