Street Railway Journal.

Vol. XII. *NEW YORK AND CHICAGO, JUNE, 1896.* *No. 6.*

THE WALKER COMPANY.

"INDEPENDENT" MANUFACTURERS OF ELECTRIC RAILWAY APPARATUS.

It is now evident that the Walker Company is to be the only "independent" manufacturer of street railway and electrical apparatus—the only company entirely disconnected with that great combination of electric manufacturing corporations which has been in the process of formation during the last ten years, and which is now strengthened by the practical absorption of one of its two important rivals. A few words, therefore, about the company which is destined to bear the brunt of the battle against this powerful combination of electrical interests—this attempted monopoly of a great field of industrial effort—and a brief description of its apparatus and its business policy, will not be out of place.

HISTORY.

The Walker Company is the successor to the Walker Manufacturing Company, which was organized in 1883 to carry on a general foundry and machine shop business with particular reference to the manufacture of cable railway machinery, which was then coming prominently into use for street railway operation. The company was remarkably successful in this special branch of the business, and its works were rapidly enlarged, eventually becoming one of the finest and best equipped shops in the country devoted to the production of heavy castings and machine work of the highest order.

In 1893 the company determined to enter upon the manufacture of dynamos and motors for electric railway and lighting purposes. As a necessary preliminary to the active work of manufacture it secured men of long experience and great engineering and technical ability to design its apparatus, knowing that, the design being perfect, the magnificent manufacturing facilities at Cleveland would be a sufficient guarantee as to the excellence of the product. The results have far more than justified expectations. The company has actually built and put in service no less than twenty-two different sizes and types of railway and lighting generators, and five sizes of railway motors, a sixth being now in process of construction. In these machines have been found merits which have instantly commended them to purchasers to such an extent that the immense plant at Cleveland is now devoted to the production of electrical apparatus to the practical exclusion of the general machinery business formerly an important factor in the company's prosperity.

In fact, the Walker Manufacturing Company soon found itself seriously handicapped in competition with other manufacturing companies by lack of adequate manufacturing facilities for its constantly growing business. An increase in these facilities and an expansion in all directions became absolutely necessary, and a few months ago the Walker Company was chartered with a capital stock of $2,500,000, to purchase the entire plant, patents and property of the Walker Manufacturing Company, of Cleveland, and several other electrical companies controlling valuable business and patents. Some of the strongest financiers and capitalists in the country have become interested in the new company, the working capital has been greatly increased, a

new factory has been acquired in New Haven, Conn., and large additions will be made to the present plant at Cleveland.

The following dispatch, appearing in the New York World some days ago, will be of interest in this connection.

(Special to the World.)

Albany, May 26, 1896.—A new electrical manufacturing combination called the Walker Company has been formed. New York, Philadelphia and Cleveland capitalists are interested among them being former Gov. Flower, J. W. Hinckley, Anthony N. Brady, Mr. Belmont, Dallas Sanders, William Rotch, Parker C. Chandler, Frank Billings and Jacob B. Perkins. They have factories in several places, the largest being in Cleveland, where 2000 men are employed.

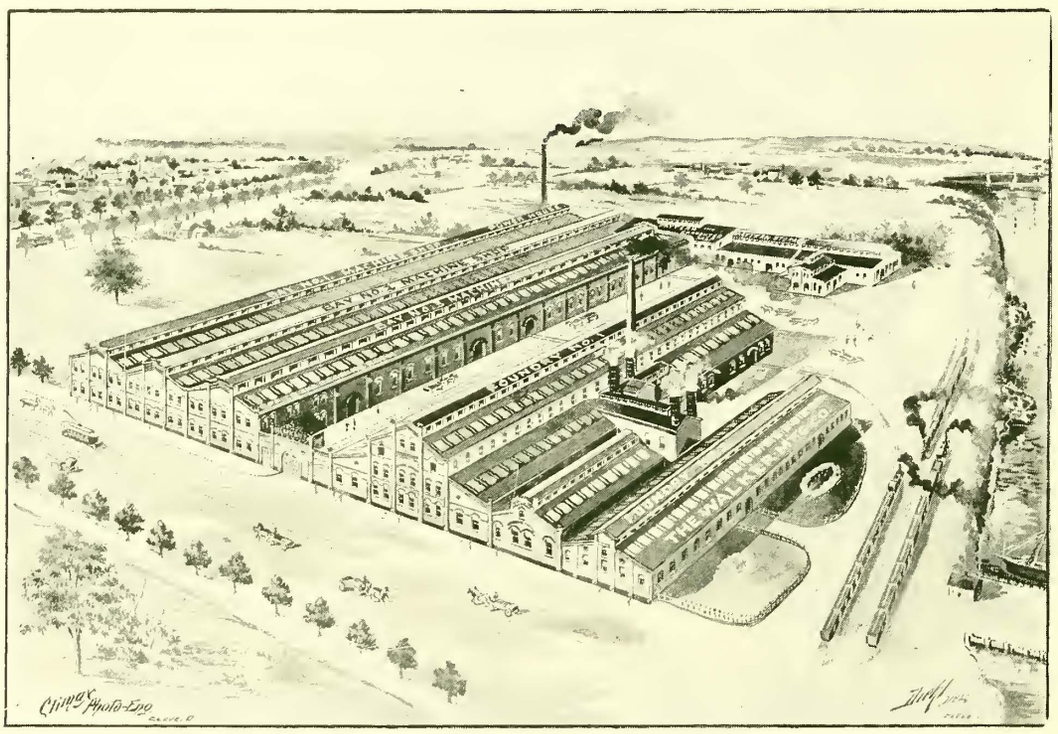
The company has secured the contract for furnishing the electric light plant for the Brooklyn Bridge, for two railroads in Chicago, for some of the equipment for the elevated railway there and for roads in Kansas City and Detroit.

J. W, Hinckley, who organized the new company and who was in town yesterday, said no combination would be made with the General Electric and Westinghouse Trust.

The capital of the newly combined companies is only $5,000,000 as against nearly twenty times that amount represented by the stock and bonds of the General Electric and Westinghouse Companies. They claim in consequence to be able to undersell the trust on all kinds of machinery and still make handsome profits. Mr. Hinckley says the company was incorporated in New Jersey.

BUSINESS POLICY.

Underlying the development of the Walker Company's business in the electrical field has been and is the idea that dynamos and motors are not delicate and complicated pieces of apparatus difficult of design and construction and mysterious in operation—they are merely machines and require only a high order of workmanship in the machine shop to make them thoroughly reliable and satisfactory in service. The old ideas have passed away. It is no longer possible to deceive purchasers by an air of supernatural wisdom and mystery into paying enormous prices for manufactured iron and copper. The Walker Company builds dynamos and motors much as the Brown & Sharp Company builds machine tools—and charges only fair prices for a high grade of workmanship.



THE CLEVELAND FACTORY OF THE WALKER COMPANY.

PATENTS.

Dynamos and motors have now been built in this country and abroad for about fifty years. The principles and details of their construction have long been well understood by scientists and manufacturers. There are no valid patents whatever which prevent any company from

constructing such machines substantially in any form desired.

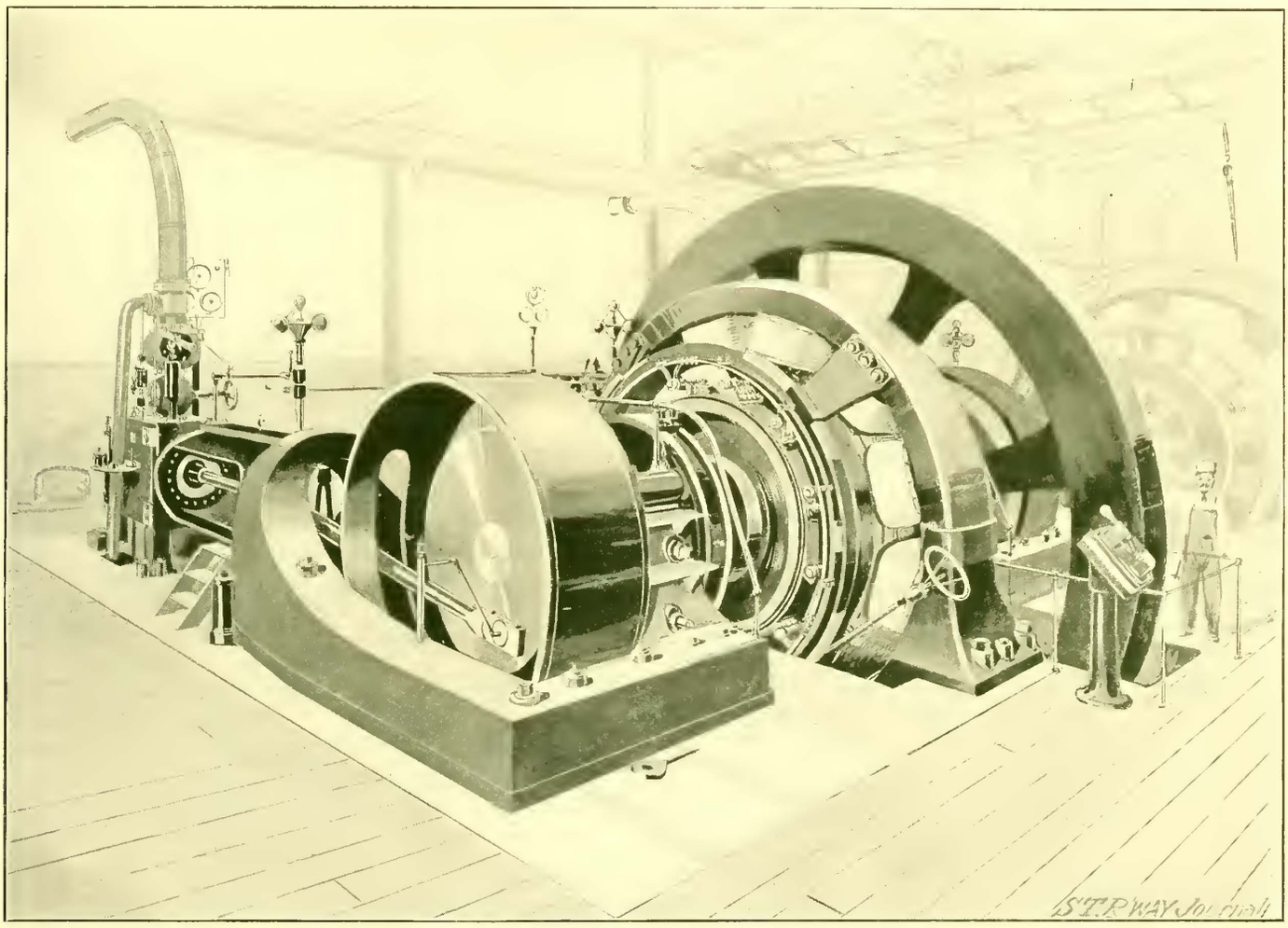
The Walker Company respects the valid patents of every competitor. It does not and will not infringe any patent which it believes to be legally sound, or patents covering inventions of real merit where the moral right to the invention belongs to a competitor.

This policy of non-interference with other nventions being clear and well defined, the company demands and will enforce equal respect on the part of others for its own patented inventions, many of which are of great value.

FACTORIES.

The company's principal factory is located at Cleveland, O. It covers ten acres of ground and is devoted exclusively to dynamo and motor work. Its foundry, lathes, planers and special tools are capable of handling the largest sizes of castings, and some of its planers are able to carry, for example, a complete 800 k. w. generator assembled, weighing 170,000 lbs. The Cleveland shops, exclusive of the further extensions now planned, have a capacity for turning out about 200,000 h. p. of railway and lighting generators, 75,000 h. p. of motors and 15,000 h. p. of arc lighting generators per annum.

Turning now to a description of the Walker Company's railway apparatus, the foundation of its complete distributing and



THE WALKER 800 KILOWATT DIRECT CONNECTED GENERATOR.

transforming system is, of course, found in the

WALKER RAILWAY GENERATORS.

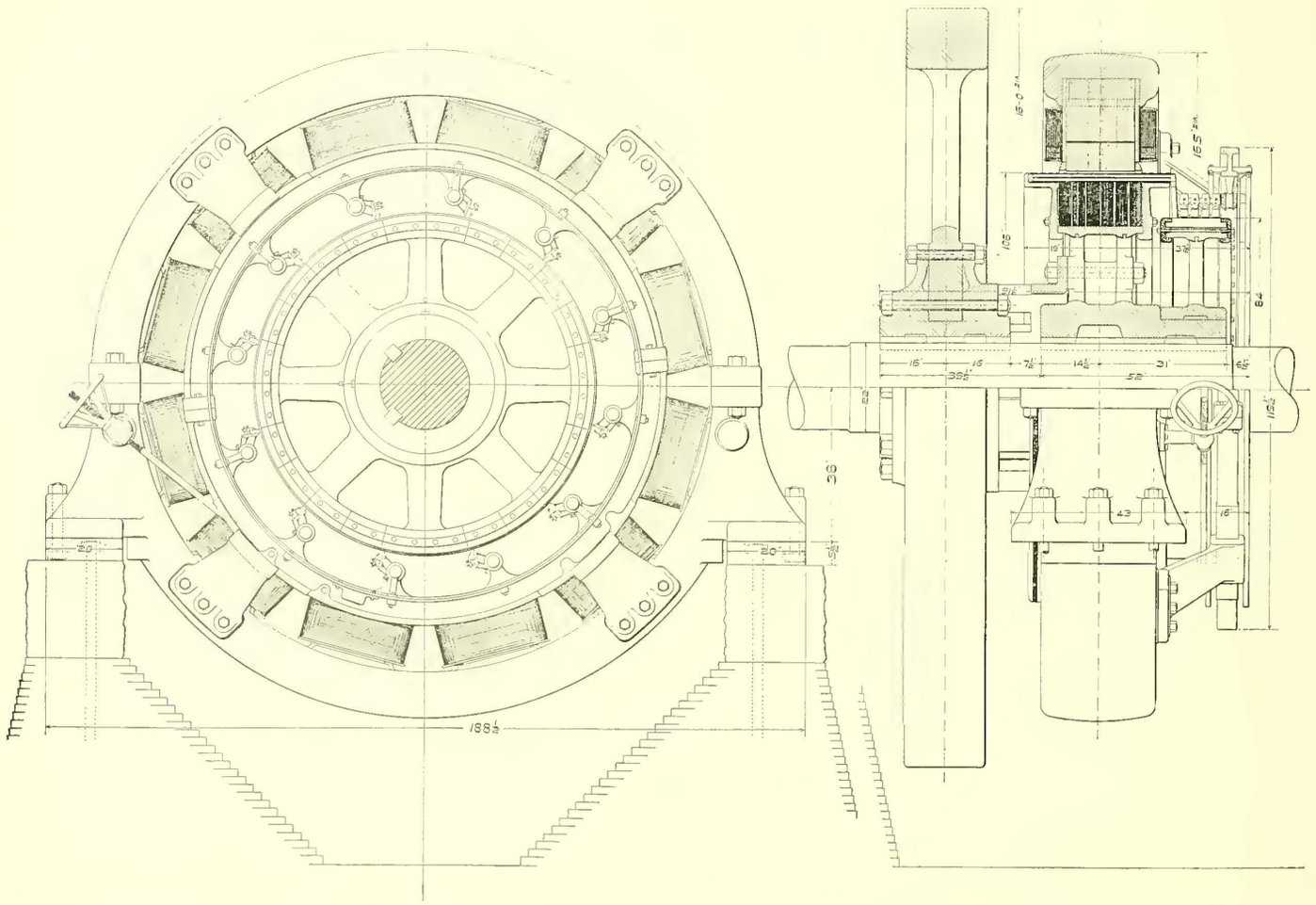
The Walker direct connected generators for railway service are of the multipolar type, the number of poles varying from six in the smaller sizes to fourteen in the huge 1600 k. w. [2150 h. p.] generator.

The mistake of providing too little iron and copper for the rated horse power of generators is too often made by manufacturers, and the

Walker Company has preferred to be liberal in its use of iron and copper, to the end of building machines which will run at high efficiency throughout the range of their rated power, and which will have a large reserve power to be called upon in case of emergency. For example, before the installation of the four Walker 800 k. w. generators in the Detroit Railway Company's power station, the railway company was trying to do a very large business with two 400 k. w. Walker generators, and on several occasions it ran these machines for upwards of ten hours with a fifty per cent overload without the slightest sparking or other injurious effect in any part of the machine. In fact, on one occasion each machine was forced to carry 1400 amperes for four hours at the time of a heavy snow storm, the rated output being 725 amperes. At that time the current was so excessive that the insulation of the 1,500,000 c. m. cables running from the generators to the switchboard was melted.

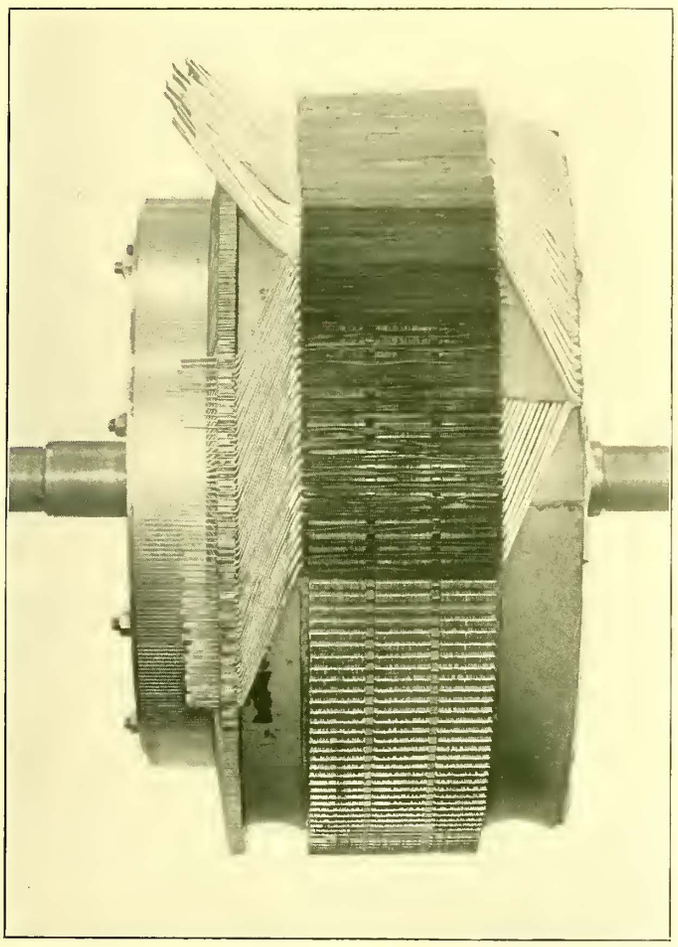
WALKER RAILWAY MOTORS

The principal characteristic of the Walker Railway Motor, and one which distinguishes it from all others now in use, is the peculiar way in which it is mounted on the truck so as to secure the greatest flexibility possible to be obtained in any plan of mounting—thereby avoiding that heavy blow upon the track joints which less flexibly supported motors always give, and which has meant such serious disaster to the roadbed of many electric railways. In the ordinary method of mounting a motor, a large part of its weight is journaled directly upon the axles so that the track joints have to bear not only the weight of the wheels and axles, but also this extra motor weight, which sometimes amounts to as much as the wheels and axles themselves. In the Walker suspension, however, the motor proper may be regarded as a closed cylinder, centered and free to revolve upon its own armature and carried in



SIDE ELEVATION, HALF SECTION AND END ELEVATION OF THE WALKER 800 K. W. RAILWAY GENERATOR, SHOWING DETAILS OF CONSTRUCTION.

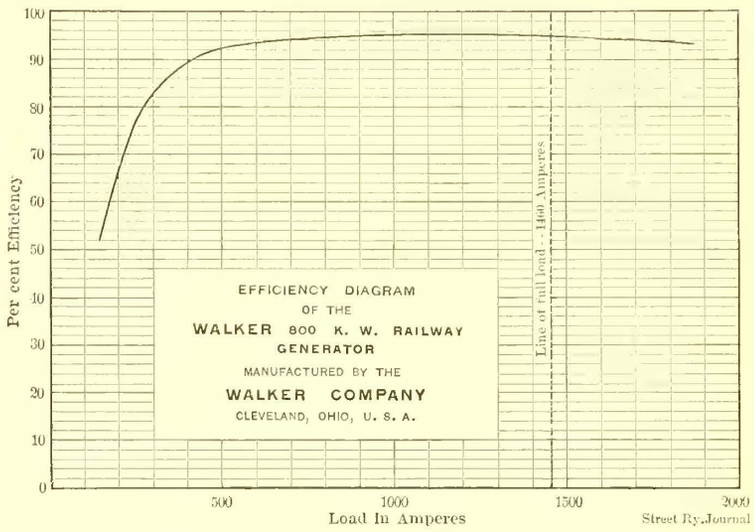
a rectangular iron frame, which is journaled upon the car axle. The weight of the motor is cushioned on the axle and truck by springs, and is felt by a low joint not suddenly, but gradually, the springs doing away with that hard, heavy "hammer blow" which is so destructive to the track joints. This method of suspension, moreover, tends to increase the life of the gears and pinions to a remarkable extent because of the double spring touch between the teeth, and Walker motors have run for



ARMATURE OF THE WALKER 800 K W. RAILWAY GENERATOR PARTIALLY WOUND.

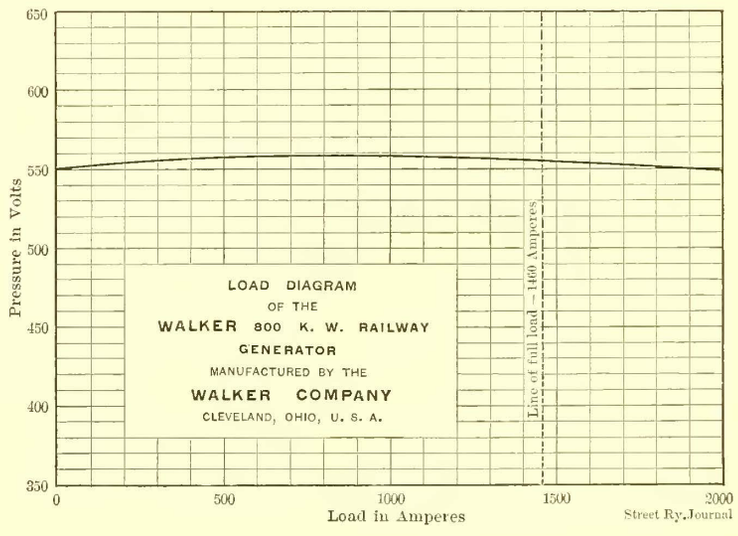
eighteen months, two hundred miles per day without changing gear or pinion.

The Walker motor is built with the utmost care to secure long life and high efficiency in service. Its characteristic curves are peculiar, as will be seen from the accompanying diagrams. The horse power ratings are established by one hour's run at a fixed load, this being the only practical method of properly determining the power of a motor; for example, a No. 5 motor [thirty horse power] is loaded at the factory with a Prony brake until the speed and weight indicate that the motor is actually delivering thirty mechanical horse power at the armature pinion. It is then allowed to run under this load for one hour, at the end of which time the tem-



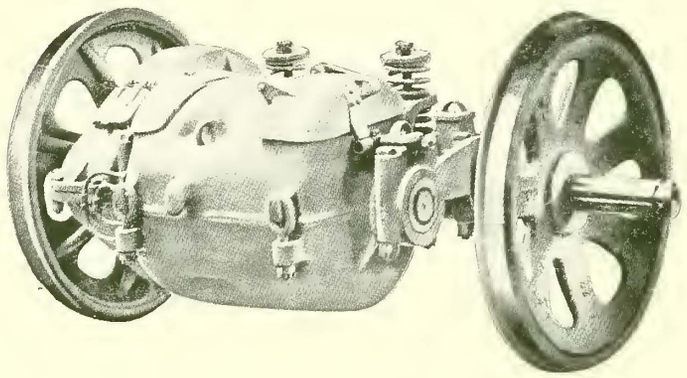
peratures of the armature fields and commutator are read and are never allowed to rise to more than 150° F. above the surrounding air, this being the limit of temperature to which the insulation should be subjected. These specifications are the result of long experience in rating motors and when motors are compelled to fill them they will operate an ordinary city car with trailer during the hottest summer weather without undue heating.

A street car motor takes its maximum load at



starting. It soon drops to less than half load and for a portion of the time is receiving no current at all. The motors should therefore be so designed as to have a high efficiency at an over-

load and at a light load as well, while on roads with many grades or with a continuously heavy traffic the efficiency from light load to overload must be uniformly high in order that the minimum amount of current shall be consumed. The Walker motors comply with these requirements, rising rapidly in efficiency from no load to about one-quarter load and to a maximum at about one-third load, from which point they continue at an almost uniformly high efficiency to an overload



THE WALKER 30 HORSE POWER RAILWAY MOTOR.

of twenty-five to thirty-five per cent. (See diagrams on next page.)

Special care has been taken in the construction of the motor to provide for the utmost possible simplicity and to have few working parts. The frame is of soft steel, the armature of the softest annealed iron and the insulation is of mica and fullerboard covered with waterproof paint and tested to 5000 volts pressure in the shops.

One of the most important mechanical points in the motor is found in the arrangement of the bearings, which are entirely outside the motor casing and which therefore make it possible to wholly exclude oil and grease from the inside of the motor. In no other make of motor has this been hitherto accomplished and the result has been casings partly filled with grease and oil—and burned out armatures.

The Walker motor is made in six sizes—and by this it is not meant that different sizes are made by putting different windings upon the same fields, as is sometimes done by manufacturers---but that entirely different castings, fields and armatures have been built for each size.

STANDARD SIZES OF WALKER RAILWAY MOTORS.

Trade Number.	Horse Power.	Horizontal Effort.*
3	25	800
4	30	1000
5	35	1200
10	50	2000
15	75	3000
20	125	5000

*At ten miles per hour on thirty-three inch wheels.

Motors Nos. 3, 4 and 5 are for ordinary city service. No. 10 is used almost exclusively for interurban roads. No. 15 is for special interurban service and No. 20 is for elevated railway and steam railroad service.

WALKER "TYPE E" CONTROLLER.

The problem of building a street railway controller which shall properly handle the currents which the motor is often called upon to carry is one of great difficulty, not so much because of theoretical obstacles as because of the destructive quality of the spark which follows the attempted breaking of the current and the quick changes in resistances of the circuits. This spark, or rather ARC, [for its heating and "drawing" power are several times greater than

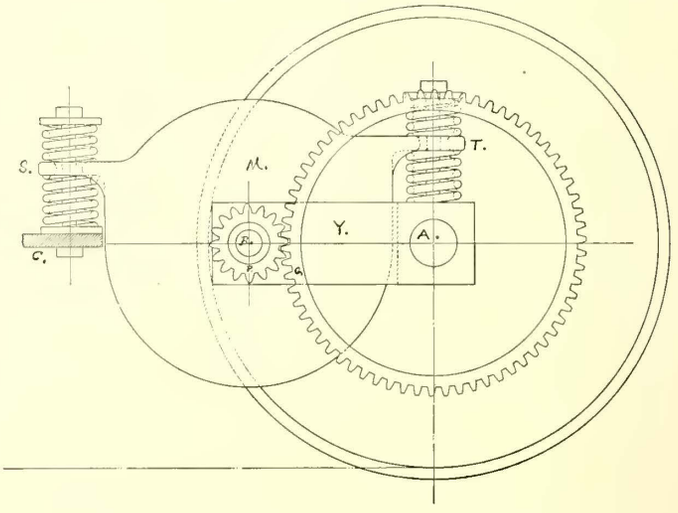


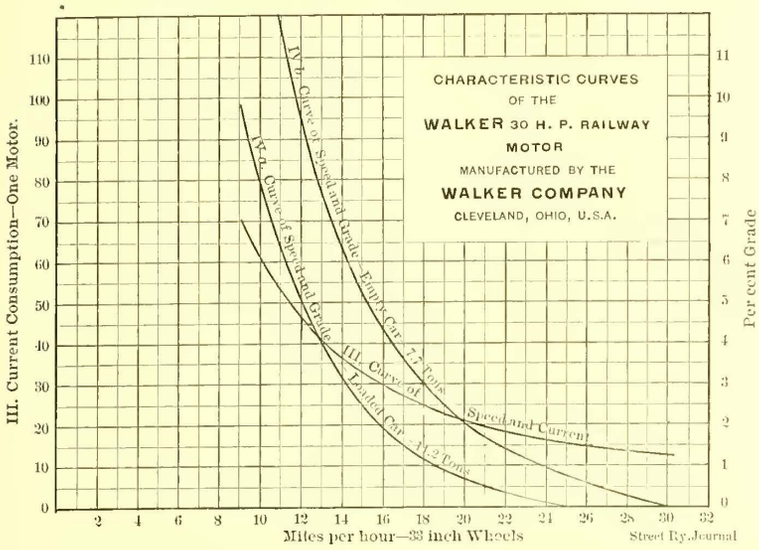
DIAGRAM SHOWING METHOD OF MOUNTING THE WALKER RAILWAY MOTOR.

the arcs of electric lamps] may easily destroy the entire controller by fire if it is not properly taken care of.

Various methods have been devised for opening a railway motor circuit with the least destructive effect to the terminals and with the least counter effect upon the motors. If the arc

is too suddenly broken there is danger of setting up a high electro-motive force which will pierce the insulation of the armatures or fields. This effect is much lessened if a very long arc is drawn.

For these reasons the Walker Company has entirely discarded the magnetic blow out prin-

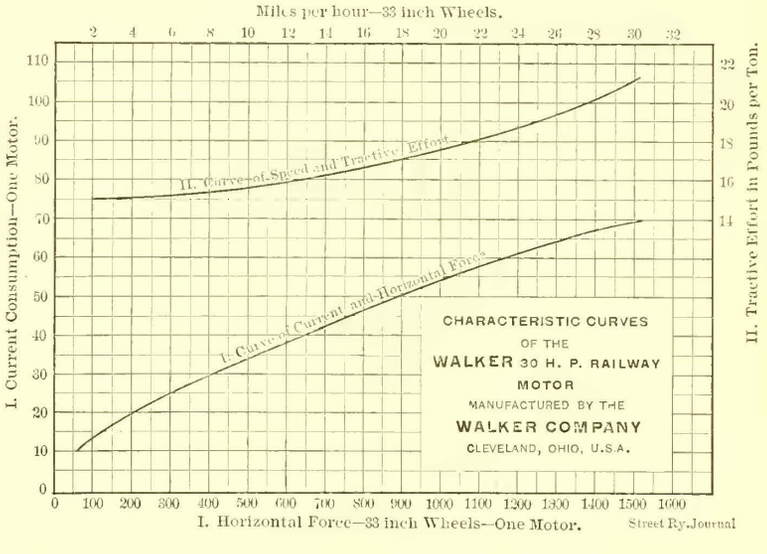


ciples found in some of the controllers now in use, and has designed a controller which is entirely unique and most effective in operation. In this controller are found three cylinders, the first, a reversing switch for changing the circuits in the motors; the second, the multiple series combination switch governing the speed and power exerted by the motors by putting the armatures and fields in various combinations; and the third, a special breaking switch by means of which the circuit is broken at twenty-eight points in such a way as to make it simply impossible for the longest arc which can be formed to have the slighest destructive influence upon any part of the controller or upon the motors. In fact, this switch would break an arc from thirty to forty inches in length, which, of course, is many times greater than any arc which could be sustained on a 500 volt circuit.

This complete separation of these three distinct operations which a controller is called upon to effect makes it possible to bring into this new device a number of features which have never before been found in similar work.

1. The slightest backward movement of the controller handle at any point in its travel operates a cog wheel in such a way as to throw the breaking switch and open the main circuit from the trolley—thus completely cutting off the motive power of the car and leaving the motorman free to use his brake to the best advantage. The importance of this feature in case of threatened accident can be easily understood. A half second lost in turning the switch back through its entire travel may mean a distance of ten or fifteen feet traversed by the car—the loss of a human life—and a damage claim for an amount sufficient to pay the entire cost of equipping a road with these controllers several times over.

2. Arcs are never formed and insulation piercing inductive currents are not set up during the forward movement of controllers, i. e., during the period when the resistances in the circuit are constantly decreasing and the motor speeds and power exerted increasing. The difficulties with controllers are all found when they are being turned back for the purpose of reducing and finally cutting off the current. It follows, therefore, that if, as in the Walker controller alone, the current is broken once for all



at the beginning of this backward movement there is no further difficulty in the circuits.

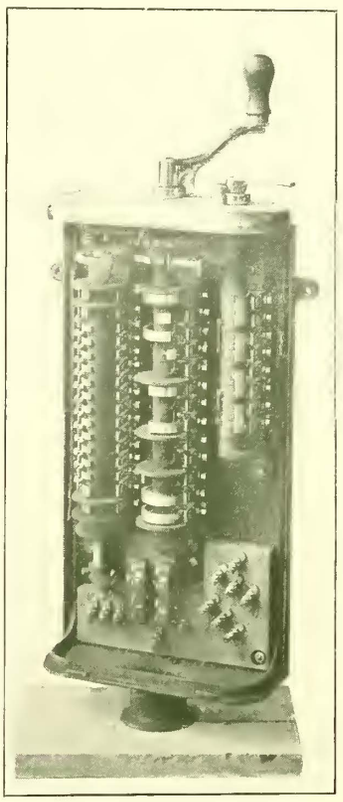
3. The mechanism is so arranged that the controller handle must be turned back to the zero point before the circuit can again be closed, i.e., current can never be thrown on to the motors suddenly or at an advanced position in the controller travel. With other controllers it is possible for a motorman to drop back one or

two notches in his controller and then go forward, by this means frequently setting up the most dangerous inductive tendencies in the circuits, and while instructions are carefully given to avoid this, they are often disregarded.

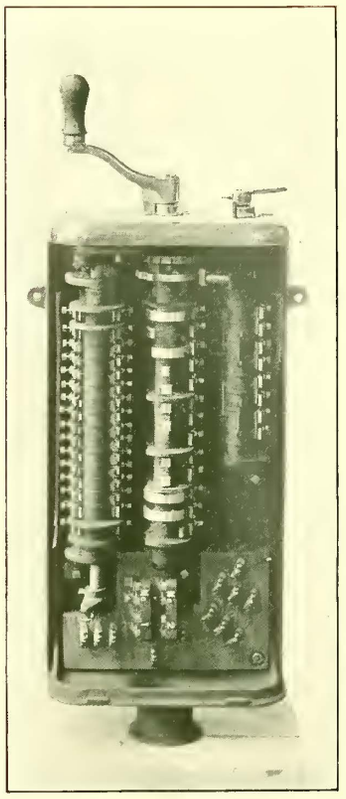
4. An ingenious interlocking device is found in the Walker controller, by means of which the controlling cylinder cannot be operated when the reversing switch is in any position other than the two extremes and the reversing switch cannot be used at any point in the controller travel except at the "off" position.

It is not too much to say that all controller problems have been solved by the devices described above. It has now been at work for several months and has been subjected to the most severe shop and service tests possible to be put upon it without the development of a single difficulty of any character. The breaking cylinder performs its function perfectly, the arc at each contact being so small as to have no appreciable effect upon the metal. The internal wiring of the controller itself and the general scheme of wiring for the car are much simplified, as will be readily understood.

The controller casing is carefully protected against the entrance of moisture and the cover is not hinged, but is so arranged that it can be entirely removed and set aside when it is desired to inspect the controller. The breaking cylinder is so designed that when the contacts have become worn the cylinder can be turned end for end and the opposite edges of contact brought into service, thus doubling the life of the terminals, which are, in addition, easily replaceable.



BREAKING SWITCH OPEN.



BREAKING SWITCH CLOSED.

THE WALKER "TYPE E" CONTROLLER.

GENERAL AND BRANCH OFFICES.

The Walker Company's headquarters are at Cleveland, O. The branch offices are as follows:

New York, 913 Postal Telegraph Building.

Chicago, 1645-1648 Monadnock Block.

Philadelphia, 1120 Betz Building.

Boston, 8 Oliver Street.

St. Louis, 715-717 North Second Street.

San Francisco, 13-15 Fremont Street.

Minneapolis, 470-475 Syndicate Arcade.

Pittsburg, 1012 Carnegie Building.

Dallas, 310 Trust Building.

Paris, France, Exploitation Des Procedes Electriques Walker, 6 Rue Boudreau.

Johannesburg, South American Republic, W. G. Gammon.

The Pearson Hub Car Replacing Jack.

The illustrations on this and the following page show the Pearson Hub Car Replacing Jack in actual use. This appliance is manufactured by the National Jack Company, of Lowell, Mass.

Fig. 1 represents the jack under a plow hoisted and ready to throw over. Fig. 2 shows the position of the plow and jack after the plow has been pushed over by one man. Fig. 3 shows the device set up to hoist and push the plow towards the rail. When the bar is turned it hoists and pushes at the same time and very rapidly. Fig. 4 shows the plow moved part way back, and Fig. 5 the plow on the rail again. All this work of setting off and pushing back can be done by one man in less than five minutes' time.

The jack used under the plow is the same that is used in pairs in steam railway work in handling freight cars. For this service the truck frame is first chained to the body. One jack is then set at each corner of the end to be hoisted and is arranged to push towards the rail. Two men with a pair of these jacks can then accomplish the same work which would otherwise take an engine, more men and more time.

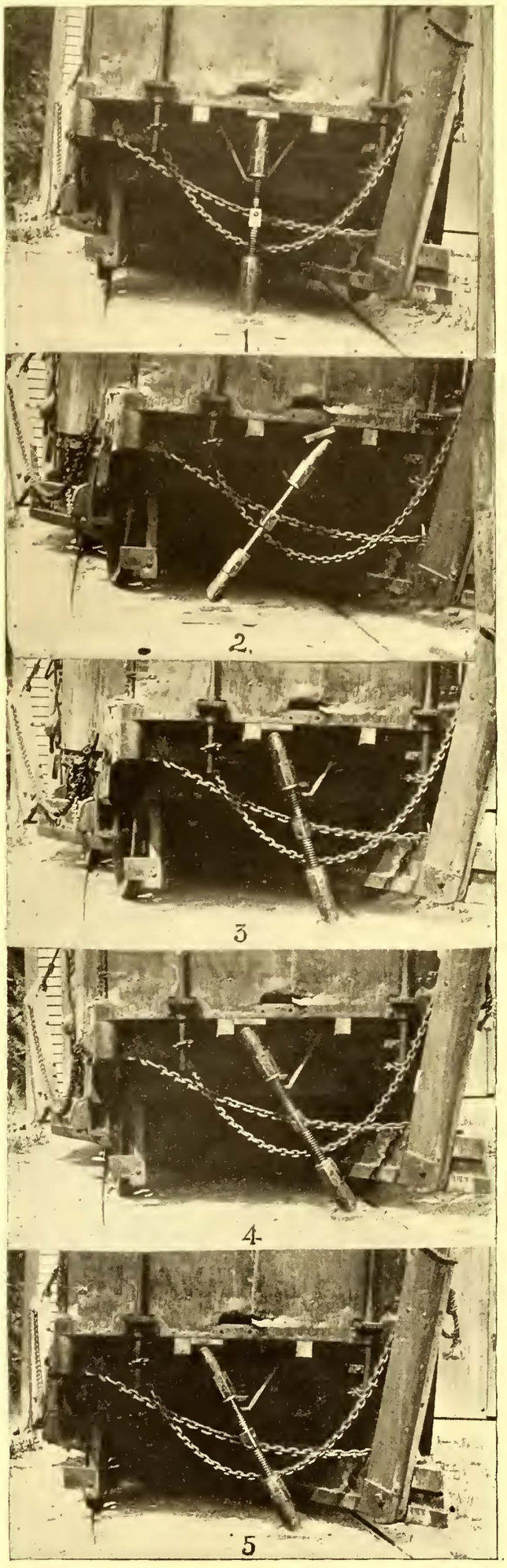
The Pearson Car Replacing Jack is one of the fastest hoisting made, adjusts itself to the work to be done and so simple in every way that any one can use it satisfactorily. The length of this jack is 28 inches, it hoists 16 inches, the diameter of the screw is 2 inches and the jack raises 1 inch at each full turn of the screw. The weight of the jack with a 3 foot bar is 85 pounds.

Fig 6 shows the street car jack, weighing only 30 pounds, hoisting the same load as the larger one. The diameter of this screw is 1½ inches, the length of the jack is 24 inches; it hoists 14 inches and raises ½ inch at each full turn of the screw. One man using a 2 foot bar can easily raise one end of a car with one hand, and throw or push over the load 1 foot in as short space of time as two minutes.

The device is very compact, can be carried easily on the car and may often save vexatious delays. A boy with its use could replace a derailed car without much loss of time, and every motorman or conductor, after once using the device, can certainly replace a car in a few minutes and, in eight cases out of ten, without asking for help.

The 1½ inch screw is the handiest tool for replacing street cars in many cases where tools are kept along the lines, being easy to carry in the hand. But for use in "hurry-up wagons," for all kinds of work, the 2 inch screw would prove most useful as it hoists just twice as fast and will take any load.

In throwing over a car the passengers inside would hardly feel the jar, as the trucks are raised only 2 inches to set over a foot and the springs are all slack. The work



FIGS. 1-5.—THE PEARSON HUB CAR REPLACING JACK.

is also accomplished without injury to the car and without jarring it as much as when it went off.

Fig. 7 shows the jack with chain attachment for raising the body, at the side, of a 4, 6 or 8 wheel car in cases where the trucks are not made fast to the body. It is designed in these cases to raise both body and trucks at once. As shown, a plate is first set under the body and on the jack, and the truck frame is chained fast to it. The operator then hoists the wheels clear from the ground and places inclined iron plates under wheel or wheels, setting the plates to square around the trucks if it is an 8 wheel car. The next step is to unchain the plate and set it on the other side of the car in the same way; then to hoist, and as the load commences to raise, it begins to move towards the rail. As the jack is adjustable to any angle the weight of the load does the pushing. If the jack is applied under a broken down truck or heavily loaded wagon and set at an angle to push, it will move the load towards the track at the rate of 1 inch a second or faster if the bar is turned faster.

For further particulars address the National Jack Company, Lowell, Mass.

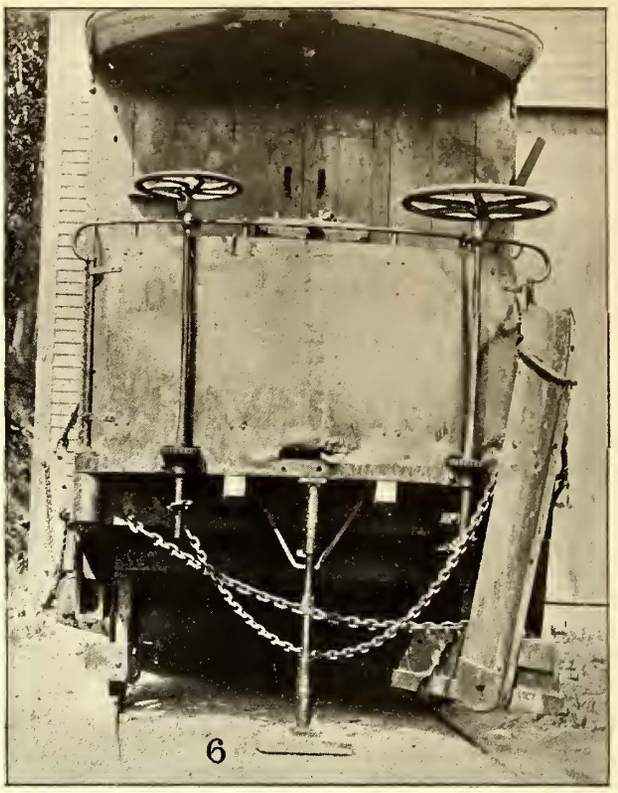


FIG. 6.—PEARSON STREET CAR JACK.

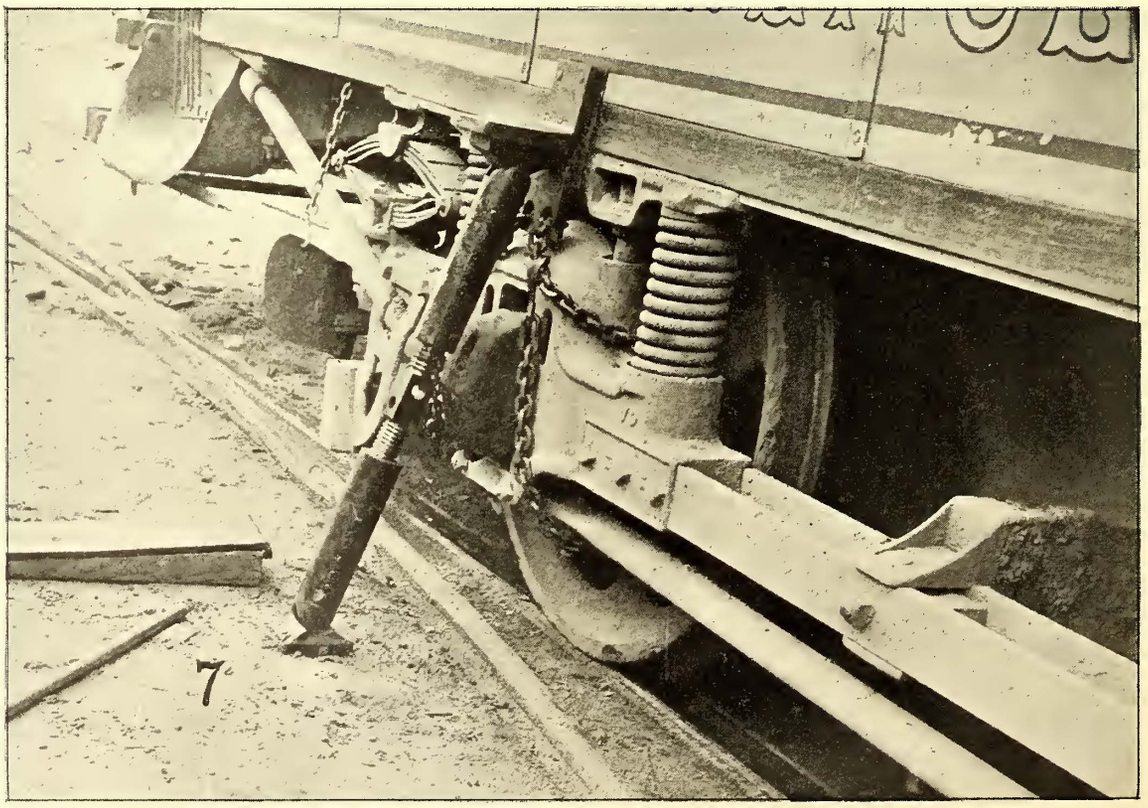


FIG. 7.—PEARSON JACK WITH CHAIN ATTACHMENT.

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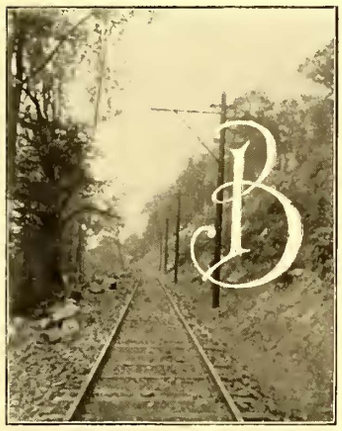
THE SYSTEM OF THE BERGEN COUNTY TRACTION COMPANY.



BERGEN COUNTY is in the extreme northeastern corner of New Jersey with the Hudson River as its eastern boundary. The Palisades rise abruptly from the river forming a wall extending from the New York State line as far as Hoboken and Jersey City, presenting physically as impassable a barrier as the river itself. On the western side a more gradual slope then leads to tide water in the valley of the Overpeck Creek, a branch of the Hackensack River. Here are located a number of beautiful and attractive suburban towns, Ridgefield, Leonia, Nordhoff, Englewood, Tenafly, Cresskill, Demarest, Norwood, etc. Still to the west of this valley and parallel to it is the Teaneck Ridge, and on the western side of this the Hackensack River valley, and another line of suburban towns including Hackensack, the county seat. As shown in the map (Fig. 2) the projected lines of this company will reach all of the towns in this section. At present they are served by steam railroads running north and south in the valleys and tunneling the Palisades to reach Jersey City.

Hitherto the rocky plateau on the top of the Palisades at this point has been practically inaccessible to suburban settlement. This strip of land is about a mile in width, is heavily wooded, and although just across the river from Harlem, it is as wild and desolate as some of the mountainous districts fifty miles further up the Hudson. Yet this country is naturally the most favorable for suburban residence in the immediate neighborhood of New York City. It is picturesque and healthy, and reveals the magnificent views up, down and across the river for which the Hudson is famous.

New York City has steadily extended to the northward. Recently has occurred the development to the south and the east in Staten Island and Long Island City, both operations being assisted by electric railway extensions. However the former is at a considerable distance from the center of New York, and the latter though accessible is somewhat flat and uninteresting, and perhaps because of its proximity to the east side of New York, has never obtained the approval of the better class of residents. A further extension to the north is at a large sacrifice to time of transit together with the high price of real estate in this direction. To the west then the tide has turned.

FIG. 1.—VIEW OF POWER STATION, CAR HOUSE AND UPPER END OF NEW YORK CITY FROM THE SWITCHBACK.

The Palisades were the barrier to extension. In the neighborhood of Fort Lee the terminus of the ferry from Manhattanville, as the region at the western end of 130th Street, New York, is termed, two attempts were made to reach the top of the bluff, one by means of an inclined plane, and the other by means of an electric railway up the highway. These failed on account of the expense and difficulty of the engineering features involved. They,

directed attention however to the possibilities of the development of this section and a syndicate was formed to carry out some plan to scale the bluff and to open up the territory beyond. Consulting engineers were employed, and the ferry company purchased. After a careful expert examination, it was decided to change the New Jersey terminus of the ferry to a point directly across the river from Manhattanville instead of at Fort Lee a mile above. The new ferry landing was then to be the terminus of an electric railway and the Palisades were to be scaled by a zigzag side hill cut with a switchback half way up.

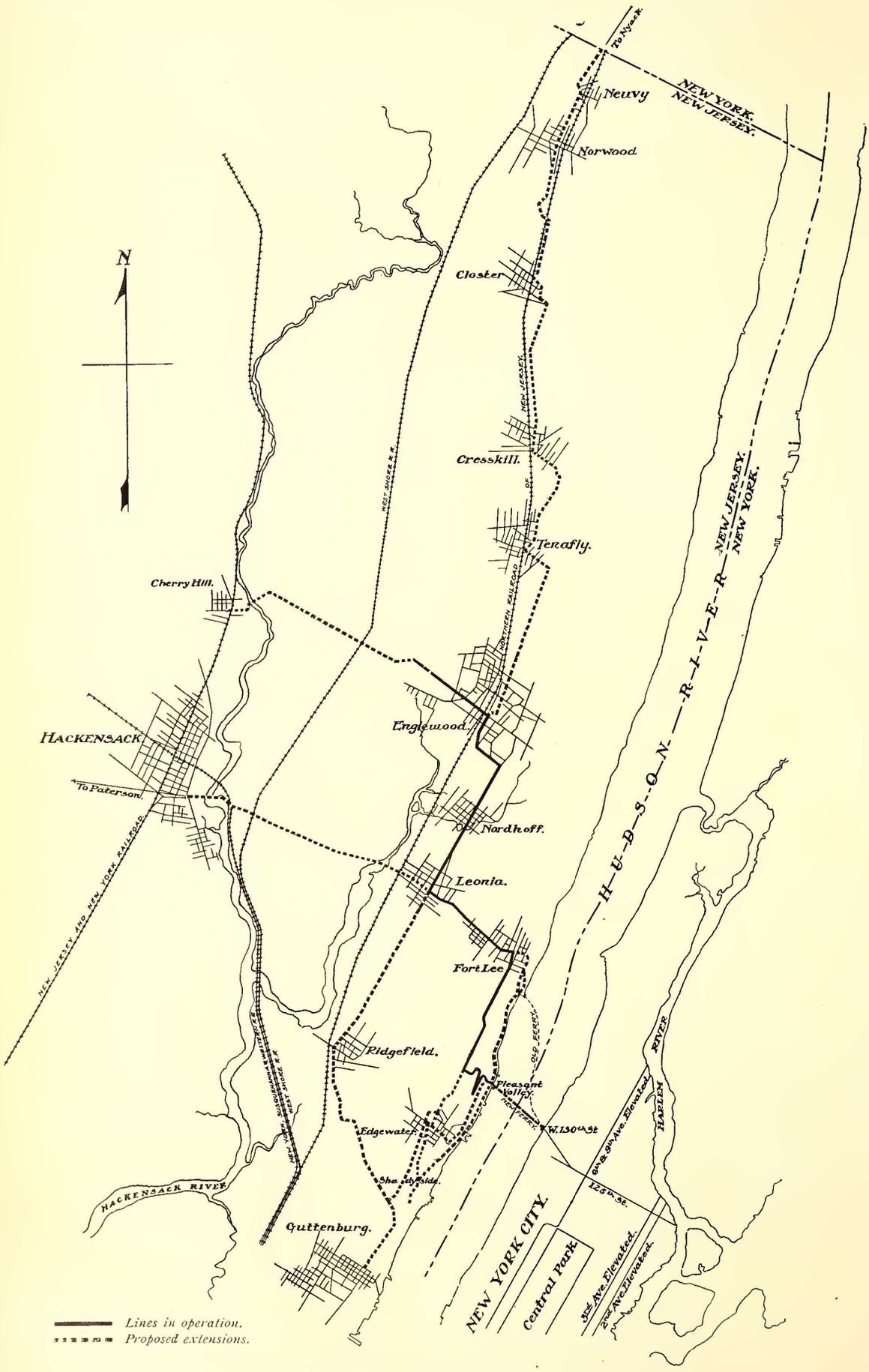


FIG. 2.—MAP OF SYSTEM OF BERGEN COUNTY TRACTION CO.

This general plan has been followed out. The Riverside & Fort Lee Ferry Company changed its New Jersey terminus to Pleasant Valley, directly opposite its New York slip, the foot of West 130th Street. Two slips, a ferry house, coal wharves and offices have been constructed at Pleasant Valley. Directly behind and adjoining these is the terminus of the Bergen County Traction Company with car house, power house and offices. The road has been in operation as far as Leonia since the middle of April, and already has developed a large suburban and recreation travel, on Sunday especially, the present car service being crowded to its maximum capacity. The extensions to Englewood and Hackensack are being constructed as rapidly as possible and will be completed for this summer's business.

For picturesqueness and magnificent scenery, this road has probably no equal among suburban roads in the neighborhood of a large city. Upon crossing the Hudson in the ferry the operation of the company can be seen as a whole, ferry buildings, power house, car house and the side hill cuts and switchback. The wildness of the district is apparent. A few small houses extend along the river under the bluff. At this point the rocky sides of the Palisades and summit are heavily wooded and apparently as wild as they were a hundred years ago. The electric railway after leaving the ferry and mounting the hill, traverses for the most part the side of the public highway, yet for a distance of two miles does not pass a single house. This statement is the more remarkable when it is considered that this section of the line is within five miles of

the center of a population of 3,000,000, the second metropolis of the world.

Taking a car at the ferry landing the ascent of the hill is commenced. The power house and the car house are passed and the line swings by a wide sweep on to the side hill cut, twice crossing the glen formed by a mountain stream which leaps in waterfalls two hundred feet down the bluff and finally is caught in a storage reservoir.

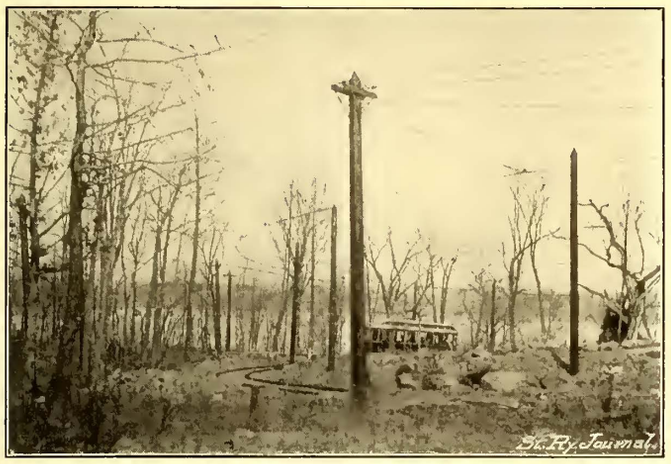


FIG. 3.—UPPER LOOP.

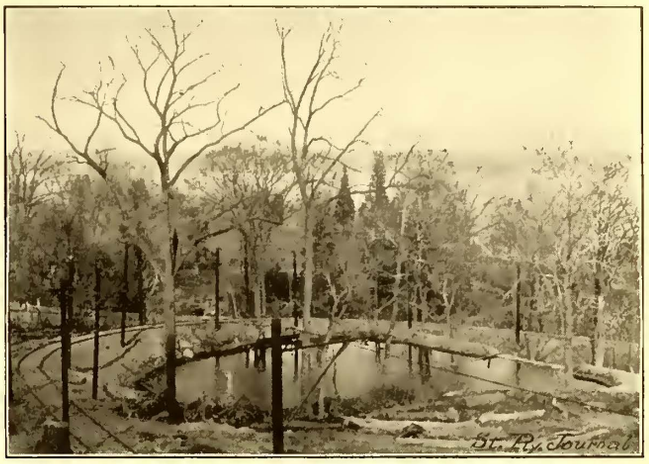


FIG. 4.—LOWER LOOP.

The side hill cut is broken in the middle by the switchback. These two ascending ledges appear to be shelves one above the other, cut for the most part from the solid rock and supported by massive retaining walls. Of all of Nature's building materials, the trap rock of the Palisades is the hardest, and this fact is testified to by the sharp jagged appearance of the projections. While ascending both cuts a constantly broadening view of New York City opposite is obtained. Riverside Park is directly opposite and General Grant's tomb is the most conspicuous object. When the upper part of the higher cut is reached a magnificent panorama is disclosed. The engraving Fig. 1 shows this view.

In the foreground directly below are the various buildings of the Bergen County Traction Company. The river at this point is about a mile wide and upon a clear day the view extends from Yonkers, ten miles above, to the hills of Staten Island, eighteen miles below, and over and across New York City to Long Island Sound and the hills of Long Island. At night the scene is also a fine one. Myriads of lamps trace the streets of the city and the sky and water glow with the reflection. The ride from the top of the Palisades to Fort Lee is through a heavily wooded forest. Thence it is along the side of the turnpike as far as Leonia. The de-

FIG. 5.—VIEWS SHOWING ASCENT OF PALISADES.

scent at this point, although not so precipitious, is actually at a more severe grade than the ascent of the Palisades. The view here up the valley of the Overpeck Creek is a fine one—a broad green valley with Englewood and Hackensack in the distance. From this point to Englewood the line follows the broad suburban avenues through what are generally conceded to be the finest suburban towns near New York City.

Apart from the engineering difficulties encountered owing to the topography of the line, there were a number of other important points to be considered, that make this probably one of the most carefully designed electric railways of its size. The sparseness of population at present along most of the region traversed, together with the expensive nature of the work, led the company to desire the most economical construction. At the same time the possibilities of future and rapid growth dictated the most substantial work, and the greatest flexibility for extension of plants and equipment.

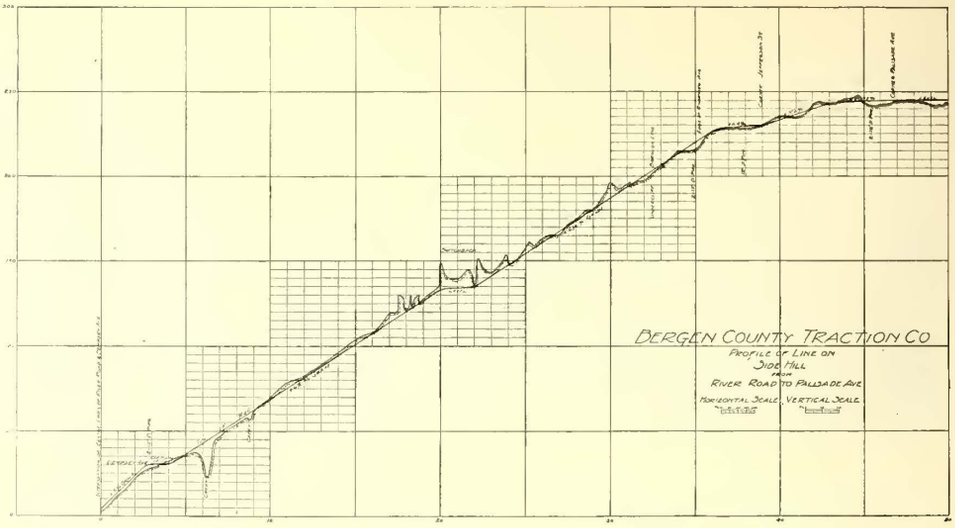


FIG. 6.—PROFILE OF LINE ON SIDE HILL.

Plans and specifications were prepared by the consulting engineers covering the complete construction, and contracts for the various parts of the work let to the following concerns. All the details of the work were subjected to the critical supervision of the engineers.

LIST OF CONTRACTORS.

LINE CONSTRUCTION.

Rail material,	Pennsylvania Steel Co.
Special track work,	Wharton Switch Co.
Grading and track construction,	Kearns & Egan.
Overhead line construction and material,	White-Crosby Co.

CAR EQUIPMENT.

Trucks,	Peckham Motor Truck & Wheel Co.
Car bodies,	St. Louis Car Co. and Jackson & Sharp Co.
Electric equipment,	General Electric Co.
Seats and backs,	Hale & Kilburn Mfg. Co.
Brakes and fare registers,	Sterling Supply Co.

POWER AND CAR HOUSES.

Steel roof trusses,	Berlin Iron Bridge Co.
Buildings and foundations complete,	J. W. Ferguson.

POWER MACHINERY.

Generators and switchboard,	General Electric Co.
Engines,	E. P. Allis Co.
Belting,	Page Belting Co.
Boilers,	Heine Safety Boiler Co.
Stack and breeching,	Warden Mfg. Co.
Condensers and pumps,	Geo. F. Blake Mfg. Co.
Separators and feed-water heaters,	Goubert Mfg. Co.
Pipe fitting complete,	Benj. F. Shaw Co.
Pipe covering,	H. W. Johns Mfg. Co.
Electric light wiring,	A. K. Bonta.

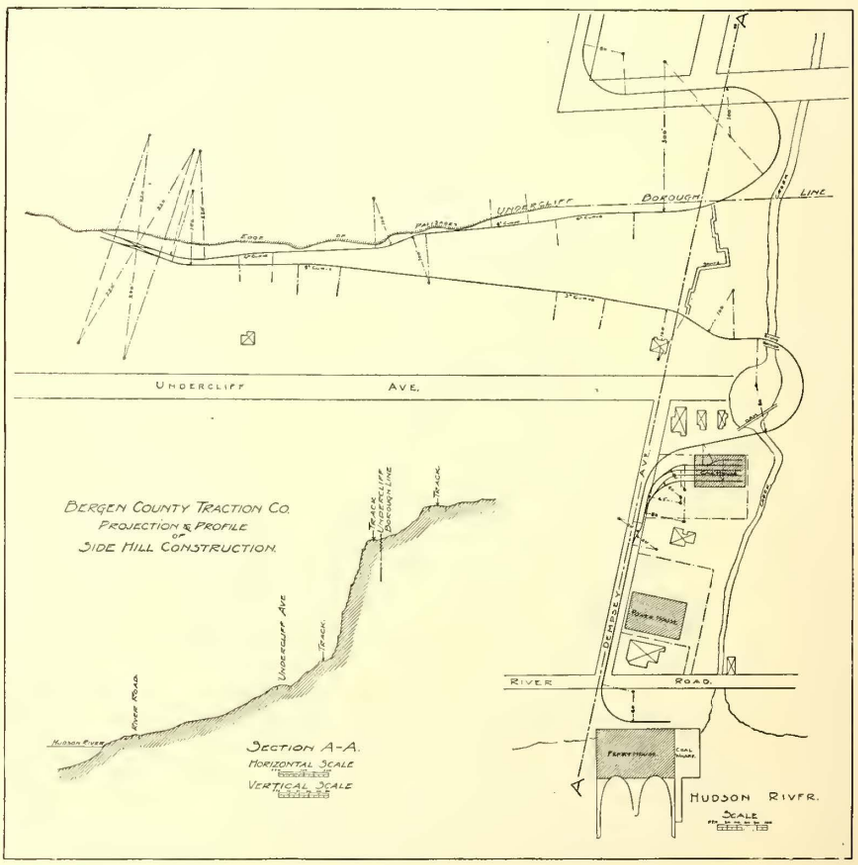


FIG. 7.—PROJECTION OF LINE ON SIDE HILL.

ROADBED CONSTRUCTION

THE track construction of this road, including the designing and the carrying into execution, has followed strictly the methods of the best steam railroad engineering practice. Ordinarily the track construction of an electric railway consists of a small amount of grading with the necessary track laying, lining, surfacing and paving. In this case, the roadbed and track contract included the following items: clearing, grubbing, general excavation and embankment, excavation in water, ballast of broken stone, masonry (first class, second class, third class or rubber and box culverts in cement and dry, slope walls, stone paving in cement and dry, concrete, brick work), iron drain pipe—various sizes, foundation timber—various kinds, trestle timber—various kinds, piling—various kinds, and track work, including ties and bonds.

A large amount of blasting was required in trap rock, and on account also of the inaccessibility of the side hill construction, the work was particularly expensive. All of the line is single track with 200 ft. turnouts spaced about every mile.

Starting at the ferry house on the river road up to the level of the car house there is an eight per cent grade and from this point to the top of the Palisades, excepting at the level of the switchback, the grade is an average of 6½ per cent for 3700 ft., a total vertical rise of about 240 ft.

This construction consists of two side hill rock cuts with retaining walls, joined by a switchback at the middle of the hill. The approaches are loops, necessitating an embankment for the lower one and a cut for the upper.

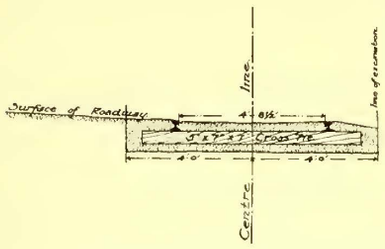


FIG. 8.—TRACK SECTION ON HIGHWAY.

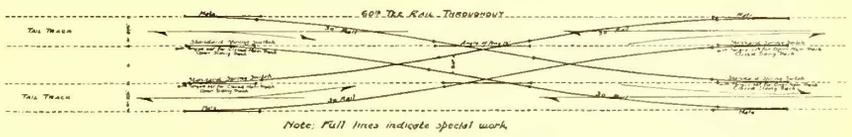


FIG. 9.—PLAN OF SWITCHBACK.

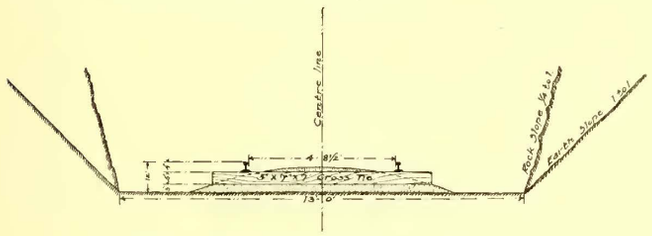


FIG. 10.—TRACK SECTION WITH CUT.

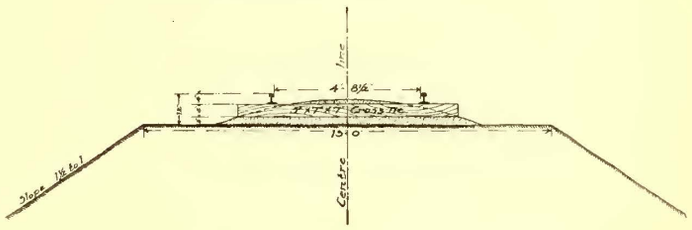


FIG. 11.—TRACK SECTION WITH EMBANKMENT.

The illustrations (Figs. 6 and 7) show the projection, section and profile of this work. Figs. 3, 4, 5, 12 and 13 are photographs showing the finished construction. Figs. 8, 10, and 11 give various sections of roadway.

The track work as far as Fort Lee, though nominally along the side of the highway, was practically new grading, requiring a large amount of blasting as the worn road was too crooked to follow. From Fort Lee to Leonia the track follows the side of the road, and from Leonia to Englewood the center. At Leonia a grade varying from eight per cent to ten per cent for 1500 ft. is encountered going down. A large amount of macadamizing of roads is required of the company under its franchises.

The track work is all standard T rail, sixty pounds per yard. Excepting the curves at the car house, which are forty-five feet radius, the curves on the lines are sixty feet radius or above. Standard diamond turnouts with spring switches are used. The special safety turnout and switchback used on the Palisades side hill cut is shown in Figs. 9 and 13. A stretch of track at twenty per cent grade with bumper is placed at the end of the upper track. The bonding is with No. 0000 stranded Chicago bonds, one to a joint, and cross bonded every third rail. The track is stone ballasted throughout; 5 in. × 7 in. × 7 ft. white oak ties are used, spaced twelve to the thirty foot rail and rail joints are suspended.

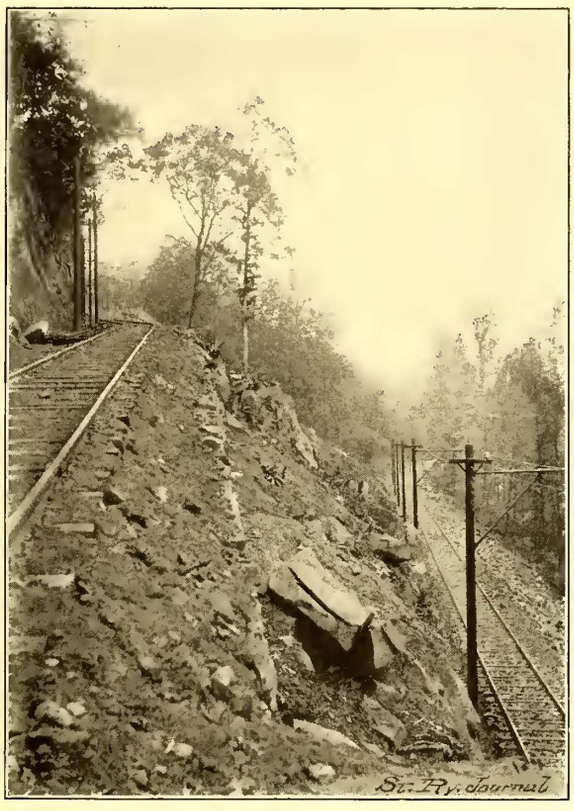


FIG. 12.—BOTH CUTS OF SIDE HILL CONSTRUCTION.

FIG. 13.—VIEW OF CAR ON SWITCHBACK, SHOWING SAFETY GRADE.

OVERHEAD CONSTRUCTION

EXCEPTING for a short distance the overhead line from the ferry terminus to Leonia is side pole bracket construction. On account of the large number of vertical and horizontal curves in the track, this construction has averaged about ninety poles to the mile. About eighty per cent of the pole holes had to be blasted at an expense of twice the cost of the poles. Octagonal yellow pine poles were used with tops

varying from seven inches to nine inches for different constructions. The lengths of poles varied from thirty feet to sixty feet, depending on the relative height to track of the ground in which the pole was set, the line of the tops of the poles being parallel to the surface of the track. The

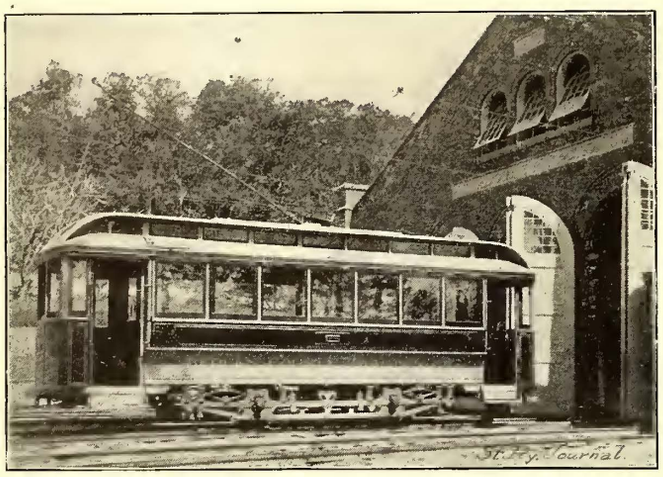


FIG. 14.—CLOSED CAR.

depth of pole setting varied from six feet to ten feet corresponding to the length of pole and the strain. Two particularly difficult pieces of line construction are shown in Figs. 3, and 4. These occur at the long curve approaches at the top and bottom of the Palisades. The curve formed by the track and trolley wire is a spiral with eighty feet horizontal radius and a vertical ascent of 6½ ft. in the 100. As the lower curve is on a high embankment, the pull-off poles are sixty feet in length. On the side hill construction in order not to require all the feeders to run out to the switchback and return, a cut-off feed line has been constructed in a straight line tangent to and joining the main line at the long curve approaches at bottom and top. This pole line runs up the face of the Palisades and the poles are wedged into holes blasted into the rock and are head guyed. The feed line forms an angle averaging about 45 degs. with the horizontal and is securely clamped by special strain insulators besides being tied to double cross arms on each pole. In sandy or marshy soil the poles are set in concrete.

In the town of Englewood 750 lb. and 1000 lb. steel poles are used. All the poles are painted a dark green and the line material black. Four feeders run from the power house; one feeding the switchback construction to the top of the Palisades; one feeding the line to the bottom of the Leonia hill and two running to Englewood.

ROLLING STOCK

EVERY effort was made to obtain handsome and easy riding cars for this road. Fig. 14 shows an exterior view. The bodies are twenty feet long with four foot platforms strongly vestibuled. The cars have broad monitors and wide double doors. The interior finish is light mahogany throughout. All fittings are solid bronze. The glass in sash and doors is French plate. The doors in the vestibule are two-fold, glazed with bevel plate glass similar to steam railroad parlor cars. The end double doors and panels contain drop sash so that a draught of air the full width of car is obtained when desired. The painting of cars is in carmine and light cream color. Ten sixteen candle power incandescent lights are used in each car. Four sand boxes to each car and a duplicate brake mechanism are used to provide safeguards for the severe grades encountered. Spring rattan seats and long spring base trucks afford easy riding qualities. The wheel base of the trucks is eight feet which prevents oscillation. The wheels have three inch treads and one inch flanges, thus producing less wear at switch points and securing additional safety from derailment. The electrical equipment consists of two G. E. 1200 motors per car.

CAR HOUSES AND REPAIR SHOPS

THE car house is located near the ferry house and measures 65 ft. 4 ins. × 104 ft. 4 ins. As real estate in this locality is valuable, it is intended that this house will serve in future for storage of night cars and for light repair work, the main storage car house being located at the western terminal of the line. As shown in perspective (Fig. 16), the building is of hard burned red brick set in red mortar, with Pennsylvania blue stone coping, water table and trimmings. The roof is of slate with steel trusses. Flat skylights and a large amount of window space afford abundant light. The general design of this building is in harmony with that of the other buildings in the operation. The ceiling is sheathed with matched yellow pine varnished, and the walls painted white. A car operatives' room and a store room with work benches occupy one side of the house. The pits are of brick with concrete and cement floors, carefully drained. The pits, work benches and car operatives' room are heated with live steam from the power house. Water

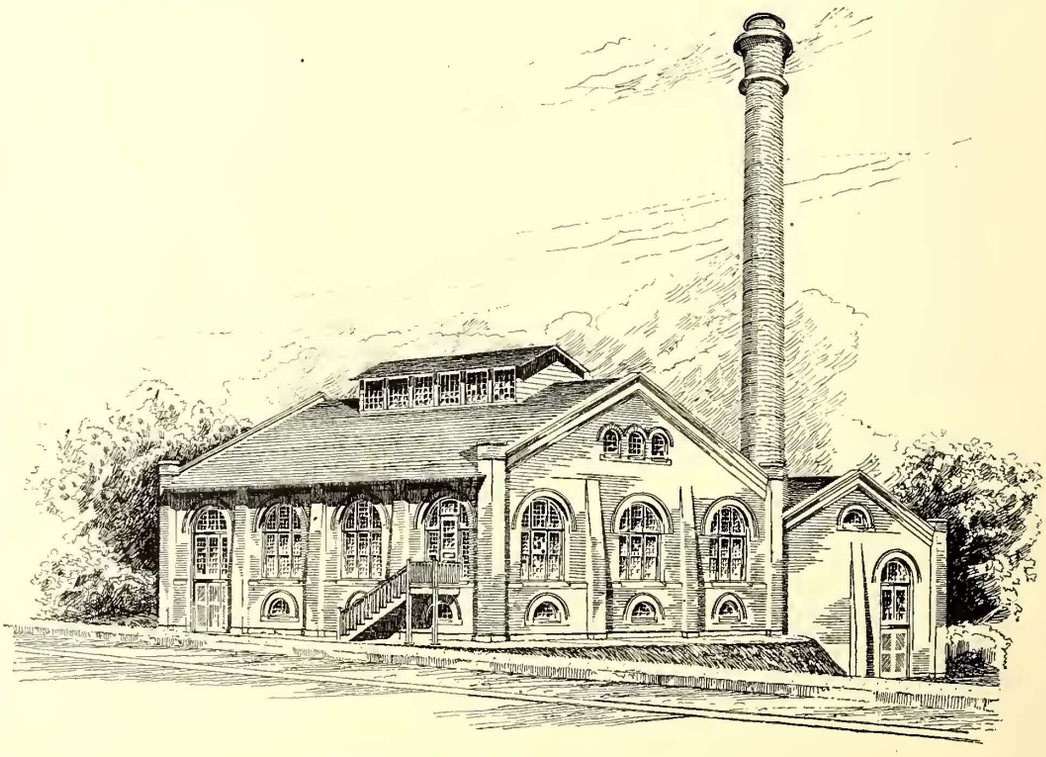


FIG. 15.—EXTERIOR OF POWER HOUSE.

under pressure of one hundred pounds per square inch for fire and house service is piped from the power house. The large swinging entrance doors are securely hinged to special cast iron hinged plates extending through and built into the brick piers between doorways.

POWER STATION

THE power house is located near the river convenient for condensing water and coal supply, as shown in Fig. 22. The general design in order to harmonize with the surroundings required a ridge

roof construction. Heavy pilasters with square finials and large arched openings give an appearance of massiveness. The building, as shown in Fig. 15, is of hard burned red brick set in red mortar with Pennsylvania blue stone trimmings, slate roof and steel trusses. The building is 111 ft. 4 ins. × 74 ft. 4 ins. external dimensions, and is divided by a fire wall into a boiler room and engine room, as shown in Fig. 18. The foundations for the building are of stone masonry on a concrete footing course. The foundations of the northeast corner of the boiler room are supported by piling. The location of the building is on the side of a slope, so that the boiler room floor is at the level of the coal unloading wharf and the engine room basement floor level seven feet six inches above this. This difference of levels facilitates the piping arrangements and is shown in the perspective section (Fig. 17). The foundations for all machinery are of hard burned brick set in Portland cement mortar, one to three. Provision for future extension of the power house is made towards the rear of the lot.

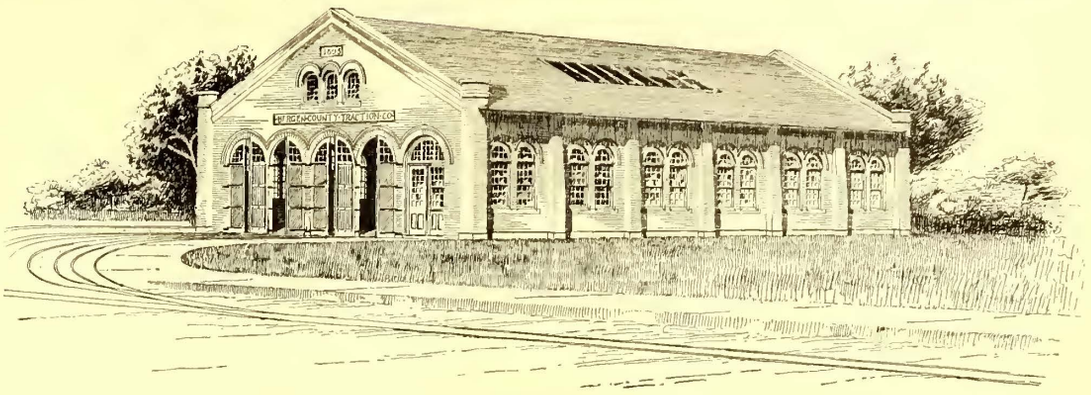


FIG. 16.—EXTERIOR OF CAR HOUSE.

liability to leakage should it be made to open as a ventilator.

A heavy mill construction floor provides an eight foot basement under the engine room, containing machinery foundations, piping and condensers to which a number of semicircular windows furnish light and air. The boiler room floor is of concrete with Portland cement top dressing.

The machinery consists at present of two 200 k. w. generators direct belted to 20 in. × 42 in. Corliss engines running at eighty revolutions per minute. Separate eccentrics are provided for steam admission and exhaust to increase the capacity of engines for overloads. The engines

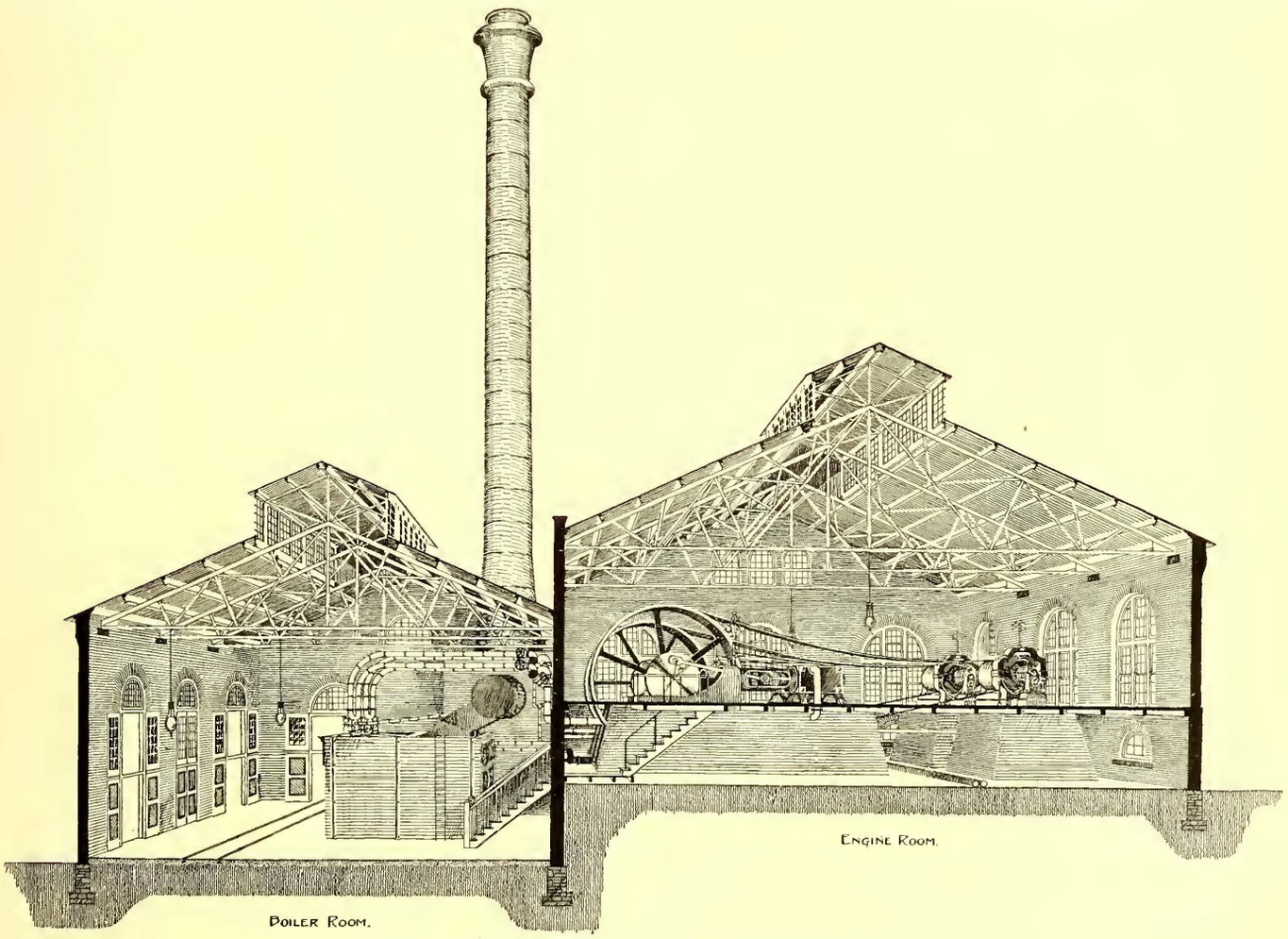


FIG. 17.—PERSPECTIVE SECTION OF POWER HOUSE.

The lighting and ventilation of boiler and engine rooms are carefully provided for. In the boiler room are six door openings, 8 ft. × 16 ft., besides end windows and a large monitor ventilator. The engine room has ten large semicircular window openings hung with double sash and six smaller pivoted windows at the ends. The monitor in the engine room is simply used for light, as there would be

are built extra heavy throughout to withstand the severe variations of the railway loads encountered, each flywheel weighing 32,000 lbs. The governors have safety stops to prevent dangerous racing, and the cylinders are fitted with metallic packing. Space is left in the engine room, as shown, for the addition of a direct connected 400 k. w. unit. The switchboard is a standard black enameled

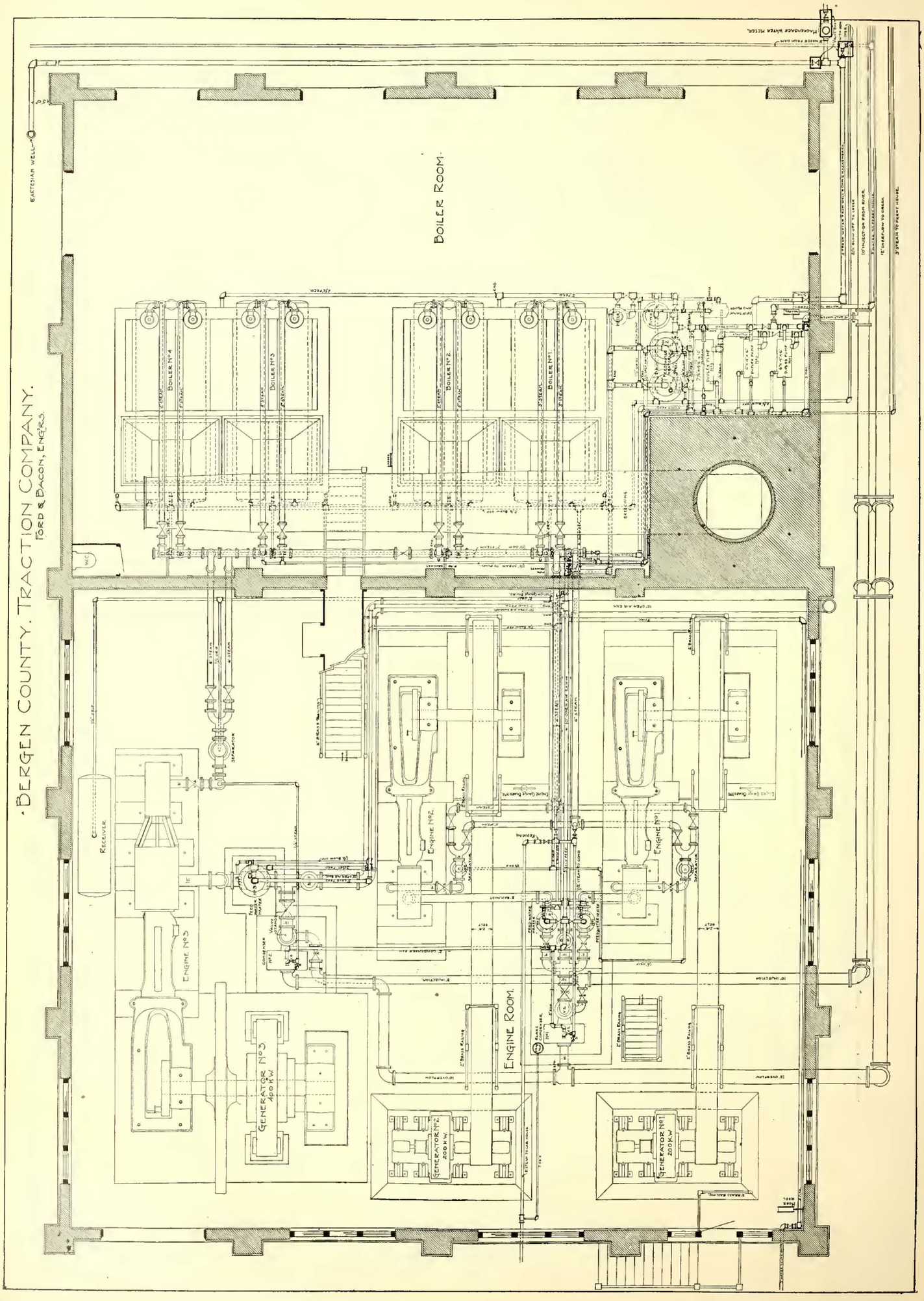


FIG. 18. PLAN OF PIPING.

slate board, of two generator and one double feeder panels with Weston instruments.

The boiler room contains a battery of 450 h. p. of water tube boilers, together with feed pumps in duplicate, drip pump and auxiliary feedwater heater. There is space for the addition of a duplicate battery of boilers with pumps, etc., as shown. The boilers are connected by wrought iron breeching and flue to the stack stub supporting the stack. The stub plans are shown in Fig. 21. The stack is of steel, self supported, 140 ft. high and 6 ft. 6 ins. in diameter, and lined with firebrick to above the roof level. It is securely bolted to the heavy cast iron foundation ring which is anchored to the stub by six 2¾ in. bolts, 22 ft. 6 ins. long. This stack is designed to provide for future extension to the plant, and is of sufficient height to counteract any loss of draught due to proximity to the Palisades. A duplex vertical air pump and condenser is located in a well in the engine room basement, so that the maximum lift at mean low water in the river is fifteen feet.

The piping of the plant has been carefully designed, as shown in the accompanying plans. Fig. 22 shows the relation of the various buildings with supply and discharge. Water can be secured from four sources, viz., the dam, artesian well, Hackensack Water Company's mains, or from the river. The artesian well water and the river water are not suitable for feed. Ordinarily feedwater is obtained from the dam and condensing water from the river at a point at the end of the coal wharf through a foot valve and strainer. Water mains run from the power house to the car house and ferry house. The feed pumps are in duplicate and are so connected that either or both can feed to the boilers or can pump fresh or salt water under pressure to any of the buildings of the company. The Hackensack water is delivered under heavy pressure and can also be used for fire or house service.

The power house furnishes live steam reduced to twenty pounds pressure for heating the car house and ferry house through underground mains. These steam pipes are insulated and protected, as shown in Fig. 22. Ordinarily steam pipes are run underground in wooden logs. Even if these are lined with tin, they will char and rot, are difficult to replace and the leakage will wet the insulating covering on the steam pipe, thus impairing its efficiency. In running underground steam mains the pipe covering should be depended upon for insulation, and the use of the outside casing should simply be to exclude water and to afford mechanical protection. As shown, the steam pipe is here insulated by asbestos fire felt covering. It is then laid in special halved drain tile and kept centered by three pronged cast iron chairs which allow an air space of an inch between covered steam pipe

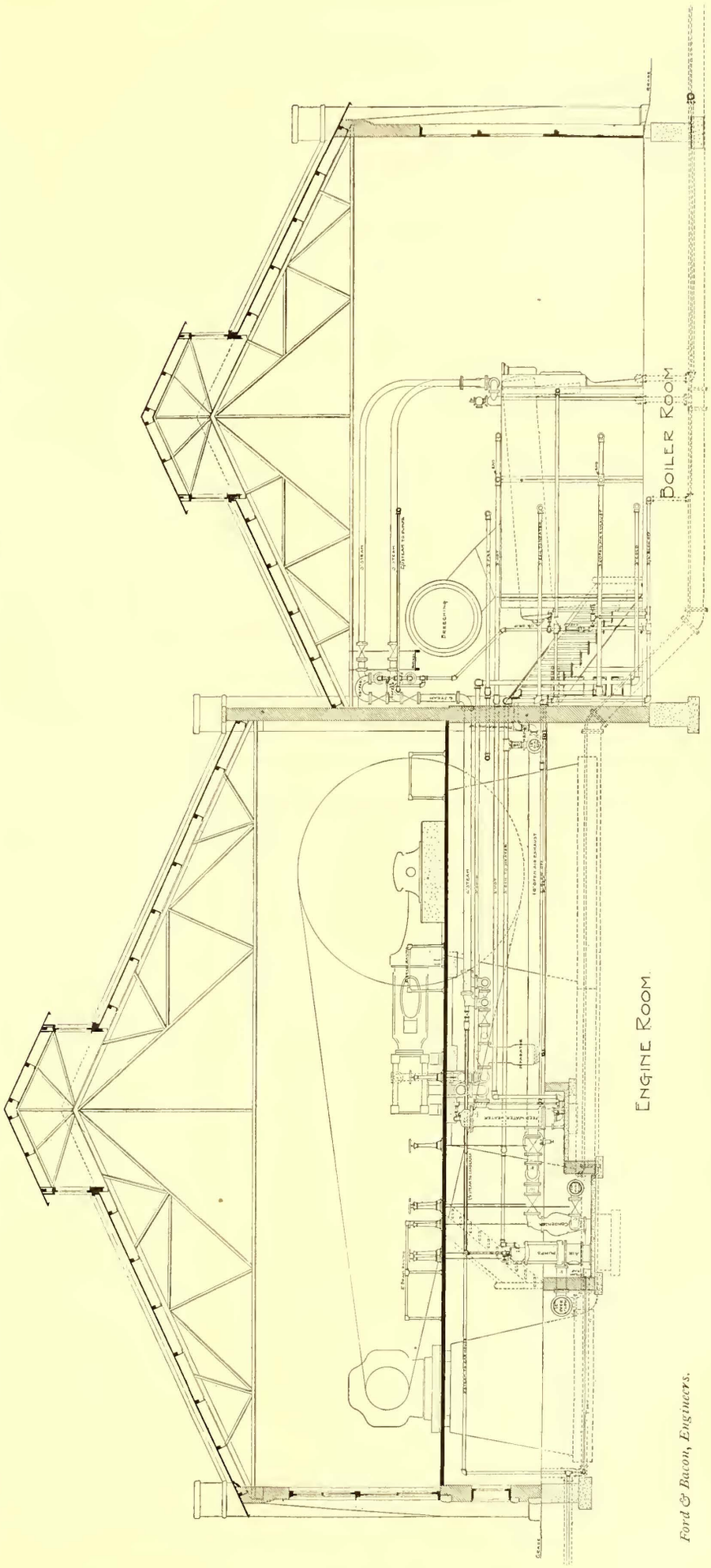


FIG. 19.—SECTION OF STATION SHOWING PIPING.

and tile. The joints of the tile are carefully laid in Portland cement so as to be watertight, and the drain is given a sufficient slope to carry off any water that might accumulate.

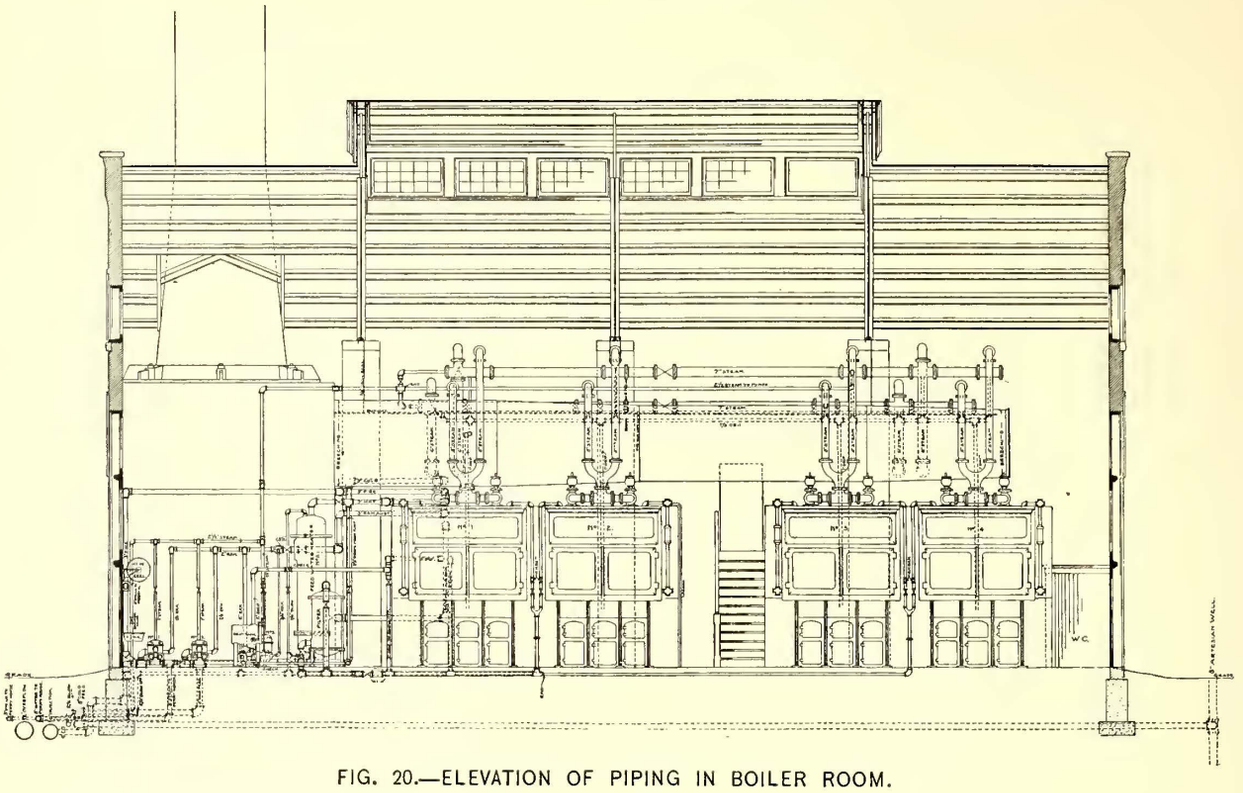


FIG. 20.—ELEVATION OF PIPING IN BOILER ROOM.

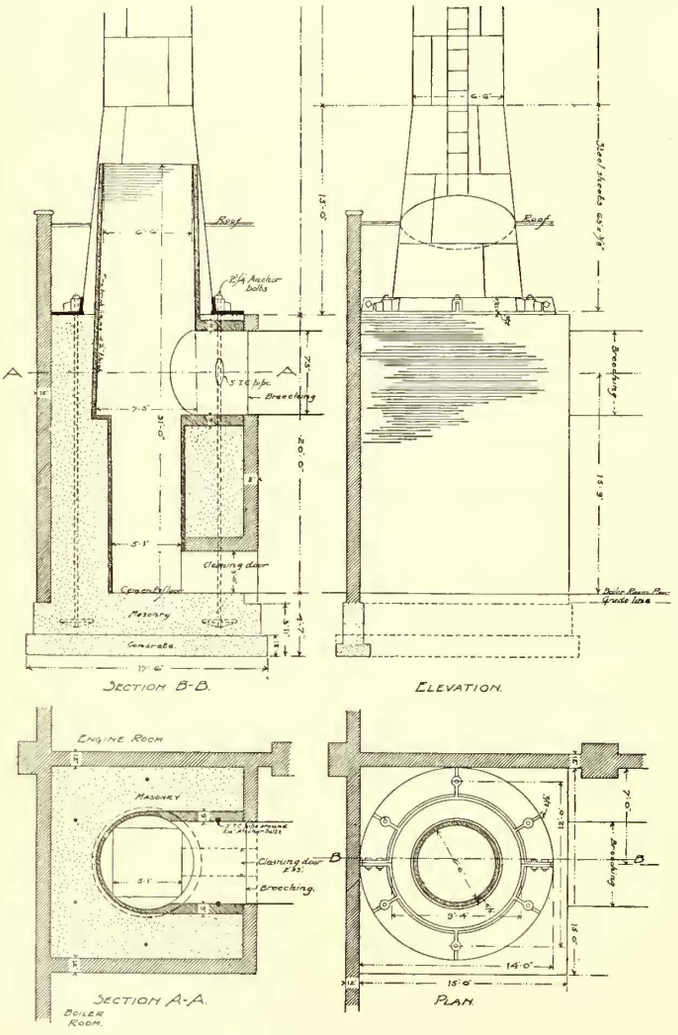


FIG. 21.—STACK STUB.

For high pressure live steam piping, the Davis duplicate system is used, as described in the STREET RAILWAY JOURNAL for April last. This system consists of two duplicate pipes of suitable section, both being used ordinarily. In case of accident to one, it is cut off and the other forced during the interval of repair. As shown in Figs. 18, 19 and 20, duplicate leaders from each boiler convey steam to duplicate headers extending along the party wall, one under the other, supported by heavy plate brackets, Duplicate leaders to the engines are joined to the headers by copper expansion bends, and drop down and through the party wall into the engine room basement. Here they are supported by heavy pipe stands from separate foundations built from the floor. All supports for main piping are rigid and prevent vibration of pipes. The leaders subdivide in the basement to sub-leaders to each engine. These converge at a Y into a receiver separator, and from this the steam passes through the throttle to the engine. The necessary stop valves are used in the duplicate high pressure piping to enable either pipe to be shut down in case of necessity.

The engines exhaust through individual primary vertical water tube heaters either into the condenser or through a back pressure valve into the open air. The feedwater is pumped through the primary heaters in multiple, then at a temperature of about 120 degs., when running condensing, into the auxiliary heater in the boiler room where the temperature is raised by means of the exhaust from all the pumps to a temperature of 210 degs. The primary and auxiliary heaters are each by-passed. A mechanical filter and a water meter are also by-passed into the main boiler feed. Steam for the pumps is taken direct from the special Y fittings joining boiler leaders. The live steam mains and separators are dripped and the drips returned to the boiler by gravity or by drip pump. The drip system is by-passed into the open air blow-off system which is connected to boilers and heaters. The blow-off and the overflow from condenser are discharged into the creek. Plumbing for water closets and lavatories is provided.

All live steam and hot feed mains are covered with asbestos fire felt sectional pipe covering painted. Heavy flanged unions and fittings are used throughout, designed for a working pressure of 150 lbs. per square inch. Chapman gate and Jenkins globe valves are used.

Individual gaugeboards are placed for each engine. The station gaugeboard differs from that usually employed in that it is of black enameled slate with nickel trimmings

to match the switchboard. Crosby steam recording and vacuum gauges are used.

The lighting of ferry house, car house and power house by arc and incandescent lamps from the railway circuit is carefully provided for. A separate panel of the switchboard is used and the lighting circuits are all controlled by separate switches and fuses at this point. The lighting bus bars are then connected through a separate circuit breaker to the railway bars, thus guarding against dangerous currents or grounds from the lighting circuits.

The decoration of the power house has been neatly planned. The ceiling is sheathed with matched yellow pine varnished. The trusses are painted a dark steel color, and the walls white with dark lead color dado. Heavy brass railings are used around stair openings and doorways, and beltways and flywheels protected by guard rails. The generators and engines are painted a dark "royal blue" with gold striping and lettering. Zinc flooring is laid under the engines. A rail divides the present machinery in the engine room from the reserve space, and special provisions are made for visitors.

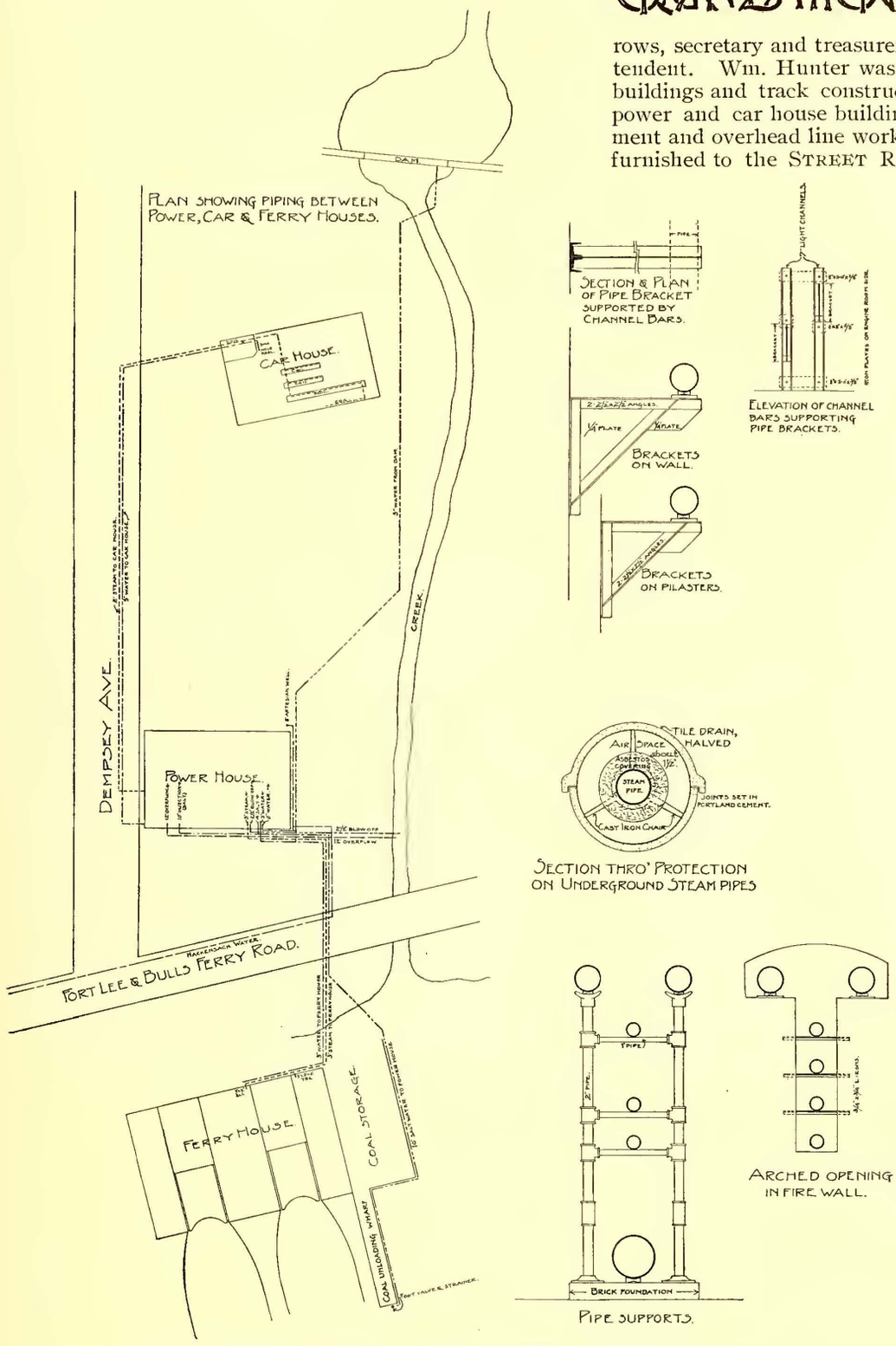


FIG. 22.—GENERAL PLAN OF OUTSIDE PIPING AND PIPING DETAILS.

ORGANIZATION.

THE officers of the company are Jacob E. Ridgway, president; Wm. H. Clark, vice-president; W. N. Barrows, secretary and treasurer and E. W. Lawson, superintendent. Wm. Hunter was consulting engineer for ferry buildings and track construction, and Ford & Bacon for power and car house buildings and machinery, car equipment and overhead line work. The foregoing plans were furnished to the STREET RAILWAY JOURNAL by Ford & Bacon.

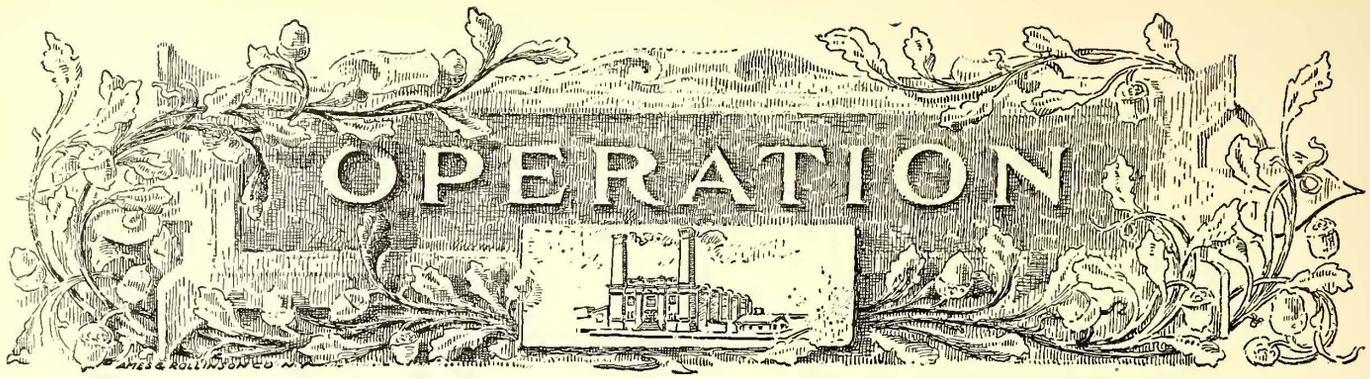
Electrical Equipment of the Lake Street Elevated Railroad.

The work of changing the Lake Street Elevated Railroad, of Chicago, from a steam to an electric system is progressing rapidly. The details of the electric construction have been carefully worked out by J. R. Chapman, manager of the electrical department of the Yerkes system, and his assistant, A. Hanson, and in some ways show a radical departure from those of the Metropolitan Elevated Railroad of that city. The electrical construction is under the supervision of W. F. Carr, who is also superintending the overhead construction of the West Chicago Street Railway and the Cicero & Proviso Street Railway.

The third or trolley rail is supported on insulated chairs, a patent of Messrs. Chapman and Hanson. This rail has been erected east of Western Avenue, the center of distribution of power, as far as Wabash Avenue, excepting a gap at the drawbridge over the Chicago River, and west of Western Avenue to Fortieth Street. The feed wire required east of Western Avenue (about 25,000 ft. of 1,000,000 c. m.) is in place, having been pulled up at night by engines between the half hour runs of the night trains.

The building and equipment of the thirty-five motor cars, which is being done at the shops of the Wells-French Company, is practically completed and most of them removed to the Fortieth Street car shed.

THE Third Avenue Railroad Company, of New York, will erect a power station, car house and other buildings on Kingsbridge Road between 216th and 220th Streets. The station will be used to operate the Kingsbridge extension of the Third Avenue Railroad Company.



Studies in Economic Practice: St. Paul-Minneapolis.

By C. B. Fairchild.

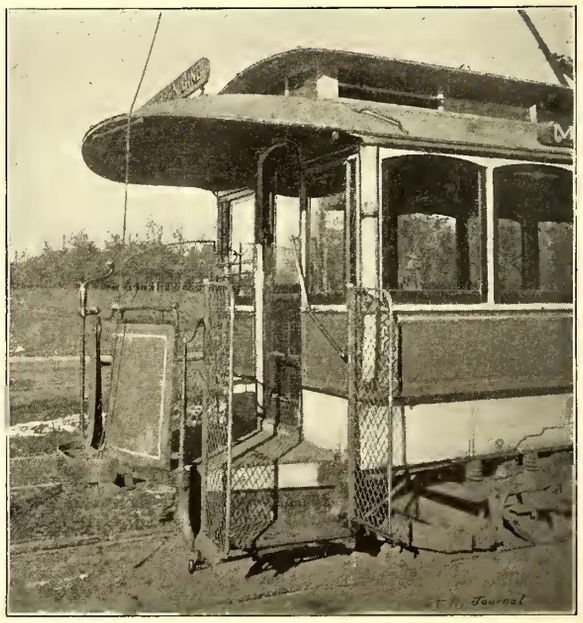
Second Paper—Rolling Stock, Accidents and Accident Blanks.

The laws of the State of Minnesota compel the use of vestibules on all cars during the winter months. This requirement was not opposed by the Twin City Railway Company, and is regarded as necessary in this climate. The vestibules have double windows, which prevent the formation of frost on the glass, so that the motorman's vision is not interfered with, as with single glass vestibules. The vestibules are also considered an advantage for the reason that the motorman does not have to muffle his hands and face so thoroughly in cold weather as he would be obliged to do on an open platform. This leaves him more free to operate his controller and brake handle, and it has not been observed that collision accidents have been any more numerous since the vestibule was adopted than formerly. In fact, it is said they have been lessened, owing to additional care exercised on the part of the motorman. The vestibules on the open grip cars are diamond-shaped enclosures in the middle of the car and have glass on all sides above the back of the seats, with a narrow door at the rear end.

It is estimated that the cost for heating the cars on the entire system is about $30 per day. Ordinary coal stoves are employed on the city lines in both St. Paul and Minneapolis. The interurban cars are heated with the Baker heater. These heaters are left in the cars throughout the season. They are so placed as to warm the vestibule as well as the interior of the cars, so that the motorman is not required to wear an overcoat even in cold weather.

The distance between the two cities is about ten miles, and the trips are made in about fifty minutes, with a headway of five minutes.

The practice of placing the rheostat against the dash or at the side of the platform on the cars, described in the Street Railway Journal for February, 1893, is still followed. The case enclosing the rheostat, which is of the old style semi-circular type, also contains the fuse boxes and cut-out switches. A modification however has been made in the connections, so that on the first few points the motors are coupled in series. After that, the multiple series is used as formerly.



PLATFORM GATE, OPEN AND CLOSED—INTERURBAN LINE.

In refitting the open cars for the coming season, the long cars are being strengthened by the addition of a truss rod an inch in diameter. This is anchored at each end and passes over pedestals nearly as high as the seats, adding largely to the strength of the car. At the same time the cross bolts have been enlarged and the side sills reinforced by a steel plate. The cross seats also of the open cars have been widened by lengthening the back supports, so that the seats are two inches wider than formerly. This does not take up any more room than formerly in the car, and has proven more restful and acceptable to the passengers. The open cars are being fitted with gates, and are being enclosed oneach side by wire screens, so that passengers can only enter or leave by the rear platforms.

A number of the open cars have been lengthened by cutting them in two and filling in the middle part with new construction. Hoods have been lengthened and supported by pipe posts from the platform. In some cases hard wood

is being employed for car floors, on the supposition that it will wear longer and be smoother and more agreeable to the passengers.

The cars of the entire system are painted of the same color. That employed for the sills, truck, and fenders of open cars is an olive brown with a lemon yellow for the posts and upper part, giving a solid appearance to the car.

The colors for painting the open cars are compounded as follows:

PANEL COLOR.	SILL COLOR.
10 lbs. Lead in oil.	5 lbs. Golden ochre.
1 " Lemon chrome in oil.	1/16 " Prussian blue.
1/2 " Golden ochre in oil.	1 " Indian red.
5/16 " Japan.	1 " White lead.
Turp.	

The brake mechanism on all the cars is operated by means of a horizontal hand wheel, instead of a ratchet handle. It is claimed for this arrangement that the motorman is often able to use both hands in applying the brake, and so can exert greater power than where a handle is employed, and that he can get a greater accuracy of adjustment than with the other method.

A new electric headlight has recently been designed in the company's shops. It is about a foot in diameter, with the ordinary reflector, but the socket for the incandescent lamp is at the apex of the cone, so that the bulb is held in a horizontal position.

Among the labor saving devices noted about the stations is a car jack, which is designed and manufactured in the shops of the company. It is of the ratchet screw type, and has a circular iron base, with a tripod supporting the nut. The top of the screw has a loose collar, and the ratchet is arranged above the screw. A tilting catch operates the ratchet and is contained in the horizontal hollow handle. A wooden handle of suitable length is used for operating the screw, which has a moderate pitch. By the use of a jack on each side of the heaviest cars, the ends are easily elevated for the removal of trucks or for their repair.

Another feature of this jack is the facility by which it may be moved about, as it has only to be tilted upon its circular base, when by taking hold of the collar and handle, it may be rolled or wheeled about the house.

The company has about twenty snow plows of the pilot type, but no sweepers. One of the plows is a large conveyor plow, modeled after those employed on steam lines. The pilot is an endless chain with buckets which lift the snow and carry it back to a cross conveyor by which it is dumped to the side of the track. There is also a very heavy steel plate wing operated from derricks by a motor for pushing the accumulated snow away from the tracks. The plow is operated by five motors, and has proved efficient in heavy drifts. The past winter however has been remarkably free from snow storms, and there has been very little use for the plows.

ACCIDENTS.

The table on this page gives a comparative statement of accidents reported for the months of January and February, 1895 and 1896.

CLASS OF ACCIDENT.	January, 1895.				January, 1896.				February, 1895.				February, 1896,			
	Minneapolis.	St. Paul.	Interurban.	Total.	Minneapolis.	St. Paul.	Interurban.	Total.	Minneapolis.	St. Paul.	Interurban.	Total.	Minneapolis.	St. Paul.	Interurban.	Total.
Boarding moving cars	28	10	6	44	3	2	1	6	20	5	1	26	2	2	. .	4
Cars starting—alighting or boarding	3	1	1	5	1	1	. .	2	2	2	. .	4	2	. .	. .	2
Cars off track	6	2	2	10	7	2	2	11	3	1	. .	4	8	1	1	10
Collision of cars	13	3	2	18	8	3	1	12	4	7	. .	11	8	6	1	15
Collision of cars with persons	3	4	2	9	6	4	1	11	6	6	1	13	1	1	. .	2
Collision of cars with vehicles	37	29	3	69	29	27	6	62	29	20	9	58	24	13	9	46
Collision of cars with animals	1	7	1	9	2	1	. .	3	2	3	1	6	5	. .	. .	5
Cable slot injury	. .	3	. .	3	. .	2	. .	2	. .	8	. .	8	. .	1	. .	1
Center pole injury	2	. .	1	3	1	. .	. .	1	1	. .	. .	1	. .	. .	. .	. .
Disturbance on cars	. .	. .	. .	. .	. .	. .	1	1	2	. .	. .	2	. .	. .	. .	. .
Disorderly conduct	5	1	. .	6	1	. .	. .	1	2	. .	4	6	2	. .	2	4
Employes injured while on duty	8	8	1	17	10	3	1	14	15	4	2	21	8	. .	. .	8
Electric shock to persons	. .	1	. .	1	1	. .	. .	1	. .	. .	. .	. .	1	. .	. .	1
Electric shock to animals	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Ejectment from cars	. .	. .	2	2	. .	. .	. .	. .	. .	1	. .	1	. .	. .	. .	.
Fell off cars on curves	1	. .	. .	1	. .	. .	. .	. .	1	. .	. .	1	. .	. .	. .	. .
Fell—alighting or boarding	20	2	5	27	10	6	4	20	10	6	2	18	5	1	. .	6
Fell in, on or off cars	4	3	1	8	3	1	. .	4	1	1	. .	2	. .	1	. .	1
Frightened horses	17	5	2	24	6	6	. .	12	11	3	4	18	7	4	3	14
Injury to company's property	2	1	. .	3	3	. .	1	4	4	. .	. .	4	1	. .	. .	1
Left moving car	34	26	11	71	3	6	1	10	25	22	2	49	8	8	. .	16
Trouble, account fare	. .	. .	2	2	. .	. .	. .	. .	. .	. .	2	2	1	. .	. .	1
Transfer trouble	. .	. .	1	1	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Trouble, account change	1	1	. .	2	1	. .	. .	1	. .	. .	. .	. .	. .	. .	2	2
Miscellaneous	19	11	5	35	17	8	7	32	25	14	4	43	11	4	1	16
Gate injury	. .	. .	. .	. .	3	. .	1	4	. .	. .	. .	. .	4	1	. .	5
Bicycle account	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1	. .	1	2
Total	204	118	48	370	115	72	27	214	163	103	32	298	99	43	20	162

The figures show the following per cent of decrease in 1896 over 1895:

	Jan.	Feb.
Minneapolis division	43.63	39.26
St. Paul division	38.98	58.25
Interurban	43.75	37.50
Average	42.16	45.64

From this table it will be noted that there was an enormous reduction (viz., from 44 to 6) in the total accidents under the first item "Boarding Moving Cars." This is accounted for chiefly by the employment of safety gates (page 346) on all cars.

The gates are on the rear platforms of single ended cars, and on the diagonal platforms of double enders. They are of two-leafed wire, open outward from the center and have a framework of gas pipe with interlacing wire.

Each gate is hinged above the lower step and is operated from the front platform by bell cranks and a crank lever. It is thus entirely under the control of the motorman. This gate prevents the egress and ingress of passengers while the car is moving. As soon as the car comes to a

full stop, the motorman opens the gates, and after getting the signal he closes them before starting, so that there is no possibility of persons attempting to board the car after it is once in motion.

This relieves the motorman of a great deal of anxiety, as he ordinarily would be continually looking back before starting to see if the rear platform was clear. The cranks and levers are so arranged that when the gate is fully open or closed it is locked in position and cannot be moved, except by the handle in the motorman's cab. Since their adoption, these gates have proven very acceptable, both to the patrons and management. The few accidents noted under the head of "Boarding Moving Cars" have been almost entirely on the trailers, a few of which are run during the busy hours without gates. These gates were designed and manufactured in the company's shops, and are attached at a reasonable cost. On the interurban line a more elaborate gate is provided.

In experimenting for the best form of gate different types were tried. The first included a folding step, but this interfered with people standing on the platform, and so was not satisfactory. The second was a lifting lattice gate, but it closed against the people standing on the platform and was finally discarded for the double gate illustrated. In elaborating more fully the advantages found in the use of platform gates, it may be stated that the first car was equipped Nov. 20, 1894, and after being run for some time as an experiment, the remaining cars in both cities were equipped, the work being completed by Apr. 15, 1895.

The class of accidents which are eliminated by the use of gates are as follows: boarding moving cars, leaving moving cars, cars starting while alighting or boarding. Since the equipment of the cars, this class of accidents has shown a steady decrease in number from those of the corresponding months of previous years. Commencing with March, 1895, and ending with February, 1896, as compared with the same periods during the years 1894 and 1895, the decrease in the number of accidents was 1319, or 34 per cent. Since the gates were placed upon the cars however a new class of accidents, classified as gate injuries, has developed, and during the period noted above, March, 1895, to February, 1896, there were reported from all divisions, including the interurban, 132 of this class of accidents. With one or two exceptions, however, these accidents were of a trivial nature, due to the unfamiliarity of the public with the gates. The few serious accidents with them were due to early faulty construction and were caused by the catching of ladies' dresses in the guard at the bottom of the gate. The guards have since been removed and the only dangerous feature from the gate has thus been eliminated. With the exception of the three accidents mentioned, the gate accidents have cost less than $1000, while it is estimated that they have saved in actual cash disbursement for 1895 at least $30,000 and a contingent liability that might possibly develop into payment of many thousands more. The above class of accidents have been favorite ones for contingent fee lawyers to work against the company.

It is also noticed that as the gates when open, stand out from the car, they compel persons passing behind or leaving the car to step out at a little distance from the rear platform and they are thus prevented from stepping before an approaching car on the other track. In one case when a car was on a down grade, the trolley wire broke and caught in the trolley base. This caused an arc which created a panic and tended to stampede the passengers. They rushed to the rear platform, but the conductor by the aid of the gate was able to prevent any one from jumping from the car.

With these gates, other precautionary measures have been employed to prevent accidents, notably a wider step than formerly used. The standard foot rest of the steps is now fourteen inches and the ends of the platform floor boards are left flush with the supporting sills. This avoids the liability of passengers tripping while boarding the car, and the wide step provides a surer footing than a narrower one would. With the latter, passengers frequently lost their balance and pitched forward, from carelessness in placing their foot too far over the edge of the step.

Other factors besides the above have also entered into the reduction of accidents, notably, a better class of car employes, the adoption of a more thorough and continuous system of instruction as to their duties, the impressing upon them the necessity of care and watchfulness, and a ceaseless system of inspection.

Accidents have been somewhat lessened too by the adoption of fenders on all the cars. The fender used is known as the Buffalo type, and consists of a pipe frame, with rope netting. This fender however is mounted on the cars of the Twin City system in such a manner as to be dropped down by foot attachment when approaching a fallen body.

ACCIDENT BLANKS.

The claim or accident work of this company is conducted in a very orderly and scientific manner, and the methods have resulted in a great saving of accident expense, both in preventing and in settling of accident claims.

When an accident occurs on a car the conductor at once passes blank cards, similar to that shown in form 1,

The Minneapolis Street Railway Company:

I hereby certify that while a passenger on car No. .....

of ..... *line of* The Minneapolis Street Railway Company,

on the .....*day of* ..... 189 . *I was not injured by an accident which occurred at* ..... *about* .....*M.,*

and the trainmen of said car were in no way to blame for said accident.

Dated, ... 189 *Name* .....

Conductor ..... *Address* .....

FORM 1.

to such persons as may have witnessed the accident, and also obtains the name of the injured person, getting his signature to form 1, if possible. He then telephones the general office as quickly as possible. Witnesses are asked to write their own names and addresses when the collector collects them. This avoids the possibility of misspelling the names.

If the accident is of a serious nature, some member of the claim department hastens to the place in answer to a telephone message to secure evidence, attend to the injured, etc., and also makes a map of the location, showing the tracks, position of cars and such other memoranda as may be necessary. The train crews are relieved and called to the claim office as soon as possible to make out full reports.

In ordinary cases, however, where the accident is not of too serious a nature, the conductor writes out a report

IMPORTANT.

CAREFULLY FILL IN TIME AND DATE.

Accident Occurred, - - - - - - { *Date* ..... 189.

..... *o'clock* .....*M.*

Accident Reported, - - - - - - { *Date* ..... 189.

..... *o'clock* .....*M.*

Report Delivered to Claim Department, { *Date* ..... 189.

..... *o'clock* .....*M.*

When Investigated, - - - - - - { *Date* ..... 189.

..... *o'clock* .....*M.*

By whom Investigated .....

FORM 2.

of the accident as soon as relieved at the station and sends it to the office with the witness cards. The blank used contains the following instructions:

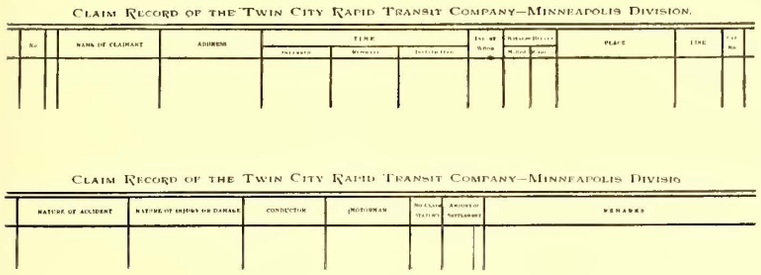
Whenever an accident occurs, however slight, to any person or property either on or near the car or to the property of the company, you will at once stop your car and obtain *all* the facts connected therewith, the names of all witnesses (both on and off the car) and their residences. If persons are injured, obtain their names and addresses in full. You will then immediately report the case to the foreman, and fill out the following report, stating minutely every particular connected therewith, and hand the same into the foreman's office.

When any person is ejected from a car for any cause whatsoever, all quarrels, disputes, etc. (which occur on the cars), must be reported on these blanks with names and residences of witnesses.

N. B.—Any violation or neglect of this rule will result in immediate dismissal.

The form contains room for filling out number of car, time of accident, names of conductor and driver, place where accident happened, damage to car, names and addresses of persons injured, names and addresses of witnesses, etc. On the back of the report is printed the form for memoranda shown in form 2.

As soon as this report is received a clerk registers the time of its arrival. It is then carefully read by the chief and assigned to some member or members of the department with notations, "W. B.," which indicates that witness blanks should be sent out, or "W. B. Emps. & per Inv." Three exact copies are then made on the typewriter, witnesses' names being inserted. The report


CLAIM RECORD OF THE TWIN CITY RAPID TRANSIT COMPANY—MINNEAPOLIS DIVISION.

No. | NAME OF CLAIMANT | ADDRESS | TIME | Day of Week | PLACE | LINE | CAR No.

CLAIM RECORD OF THE TWIN CITY RAPID TRANSIT COMPANY—MINNEAPOLIS DIVISION

NATURE OF ACCIDENT | NATURE OF INJURY OR DAMAGE | CONDUCTOR | MOTORMAN | No. CLAIM STATED | AMOUNT OF SETTLEMENT | REMARKS

FORM 3.

is then given a number, by which it is afterwards filed and known.

From the original typewritten copy a letter press copy is taken, and this original copy is passed to the file, and a second one goes to the superintendent, and one to the claim clerk to whom the case has been assigned. At the bottom of each copy the name of the class or kind of accident is recorded, and such classification is always kept after having been so made. The original copy is used for sending witness blanks in case it bears the notation "W. B.," and when such blanks are mailed (with return envelopes) the fact is recorded in ink on the face of the copy. The original copy is also used for entering the case in the record book, which gives a few points of the case—for instance, the name and address of the claimant, time, place, line, car, classification, names of trainmen, memoranda, as shown in form 3.

The original copy is then attached to a file cover and put in its proper place in the file box, the case having been entered in an index under the name of the claimant if known. A calendar index is also kept which shows records under the dates of their occurrence. All of the blanks are of the same width. It provides for the case of———*vs.* Minneapolis Street Railway Company, amount of claim, name of attorney and other memoranda. The blanks in their order are fastened to the cover by a paper clamp and the filling boxes being of the same size as the cover, the papers are placed in without folding.

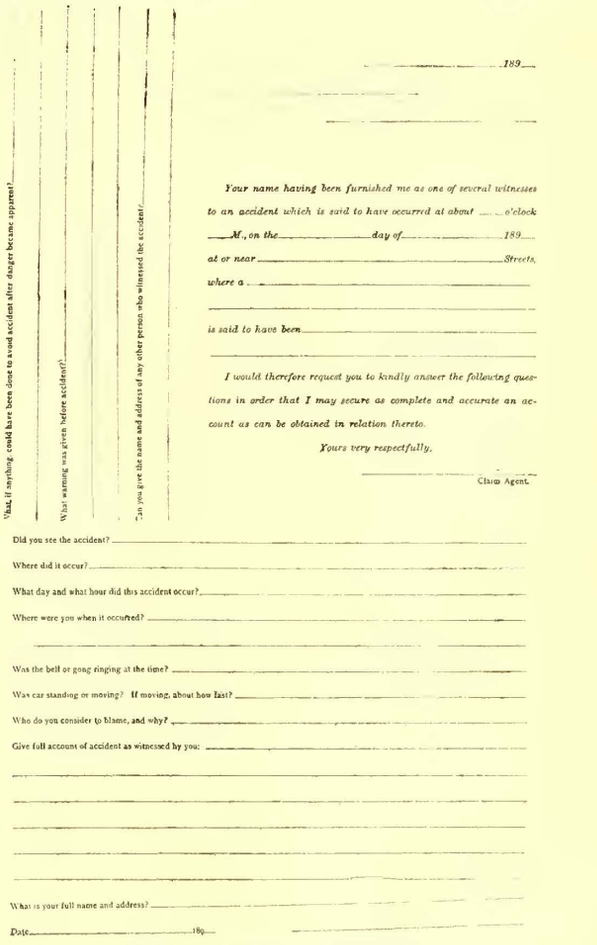
Before the original conductor's report is filed, it is carefully checked over by some member of the claim department and a criticism, if any, is noted on the back of the report, which is then sent to the superintendent, who has the matter investigated. The criticisms have reference to whether an insufficient number of witnesses are obtained, with no excuse on the part of the conductor, as the rules provide that the names of five witnesses in all cases if possible should be secured. Other points are "late report," "report not clear," "not signed," or other omissions.

An index with the names of all trainmen is also kept, and opposite each name is the number of the accident reports on which the name of the person appears. The object of this index is the ready reference in informing the operating department as to the necessity of keeping certain trainmen in the company's employ, in case there is reason for their discharge, as it is sometimes of advantage to retain a man who may be an important witness. When a trainman receives a time check, he is obliged to have it O. K.d at the claim office, to see if there is any important accident case charged against him, or whether he will be a valuable witness. In case he leaves the service, his address is entered in the same book, and a watch is kept on him so that he can be found when necessary.

The claim clerk, to whom the second copy has been assigned for investigation, secures statements from the witnesses (forms 4 and 5) calling upon them personally or awaiting answers by mail, according to circumstances. As the information is received a notation is made opposite the witness's name or otherwise as to the value of the witness, whether good, bad, in favor of the company or not. The investigation being finished, the copy with all files is handed to the head of the claim department who passes upon it, making a decision or disposition of the same. The copy is then checked off in the record books and is filed. In serious cases the statement of every witness and physician and all other evidence possible to secure is obtained. The physician's report is made on form 6.

Members of the claim department to whom cases are assigned make typewritten reports in full of their work, showing the circumstances under which witnesses were interviewed, claimants visited, affidavits or releases taken, etc. In many cases the injured parties are called upon and often "no claim" statements secured from them. These statements recite that the injury was not serious and that the company in their opinion was not to blame, often giving reasons for same. In visiting persons that are not supposed to be seriously injured, care is had not to excite their cupidity so as to make them feel that possibly they have got a claim and so refuse to settle, until they shall have consulted legal advice.

If the injured person insists upon damages, an affidavit is taken in which the claimant is requested to state fully the injury suffered and all of the damages de-


———189—

Your name having been furnished me as one of several witnesses to an accident which is said to have occurred at about ——o'clock ——M., on the——day of——189—— at or near——Streets, where a——is said to have been——

I would therefore request you to kindly answer the following questions in order that I may secure as complete and accurate an account as can be obtained in relation thereto.

Yours very respectfully,

——Claim Agent.

What, if anything, could have been done to avoid accident after danger became apparent?

What warning was given before accident?

Can you give the name and address of any other person who witnessed the accident?

Did you see the accident?

Where did it occur?

What day and what hour did this accident occur?

Where were you when it occurred?

Was the bell or gong ringing at the time?

Was car standing or moving? If moving, about how fast?

Who do you consider to blame, and why?

Give full account of accident as witnessed by you:

What is your full name and address?

Date——189—

FORM 4—FRONT AND BACK.

sired. These affidavits are often of great importance in making settlements and are frequently used in court as contradicting the plaintiff's testimony. They are taken carefully with witnesses to the signature and are executed and sworn to before a notary, all the clerks in the claim department being notaries. Affidavits are generally written out by the claim clerk, but the claimant is made to understand and adopt the statements fully. Releases are also taken with the same care, witnesses to signature secured

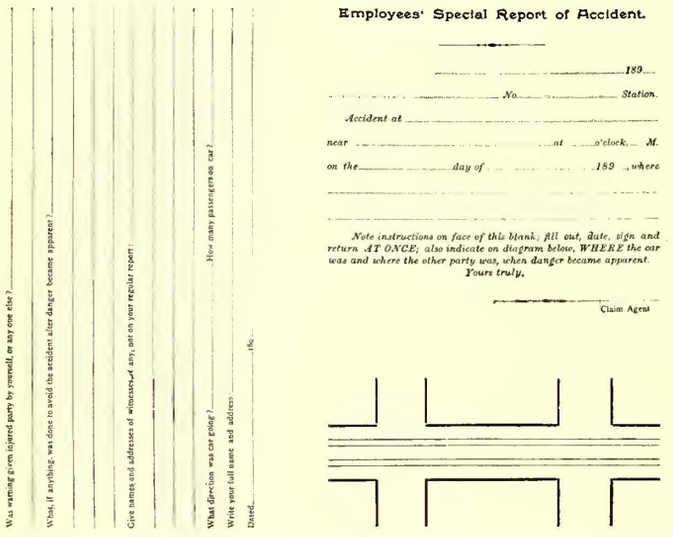
and acknowledgment taken. The signature of the injured person is also secured to a voucher as well as to a release and the payments are generally made by check.

The following is a copy of the release:

I, , for and in consideration of the sum of dollars, lawful money of the United States of America, to in hand paid by the Minneapolis Street Railway Company, a corporation duly organized under and by virtue of the laws of Minnesota, have remised, released, and forever discharged, and by these presents do for heirs, executors and administrators, remise, release and forever discharge the said Minneapolis Street Railway Company, its successors and assigns of and from all causes of action, suits, controversies, trespasses, damages, judgments, executions, claims and demands whatsoever against the said Minneapolis Street Railway Company, which ever had, now have, or which heirs, executors or administrators, hereafter can, shall or may have, by reason of any matter or thing whatsoever, to the day of the date of these presents, and also by virtue of any claim or demand for damages by reason of an accident and injury to claimed to have been sustained on or about the day of A. D. Eighteen hundred and ninety (189).

Releases are copied in a letter book by press and are then turned over to the auditing department where the release is indexed and filed with the voucher. The amount of settlement is also handed to the bookkeeper.

All items of claim expense are entered on vouchers and in the auditing department are handled as follows: after being entered on the journal, each item is transferred to a ledger, in which a separate account is kept for each case, with heading so that each item is entered under its particular class. The headings are: Case Number; Class; Date of Accident; Line; Date of Payment; Explanation; Folio; Court Fees; Witness Fees and Mileage; Special Services; Briefs and Transcripts; Medical Expense; Physicians' Witness Fees; Incidentals; Amount of Release; Total Debits; Total Credits. Only the cases upon which expenses have been incurred are entered in this book and



Employees' Special Report of Accident.

189

No. Station.

Accident at

near at o'clock, M.

on the day of 189 , where

Note instructions on face of this blank, fill out, date, sign and return AT ONCE, also indicate on diagram below, WHERE the car was and where the other party was, when danger became apparent.

Yours truly,

Claim Agent

Was warning given injured party by yourself, or any one else?

What, if anything, was done to avoid the accident after danger became apparent?

How many passengers on car?

Give names and addresses of witnesses, if any, not on your regular report:

What direction was car going?

Write your full name and address

Dated, 189

Employees' Special Accident Report.

Upon receipt of this blank, employees will as soon as possible make complete answers to all the questions asked and also make a full statement of all the facts regarding the accident, being very particular to report the whole truth and nothing but the truth. If your statement is not complete, you will be required to report at the office to give full particulars.

Did you see the accident?

Where did it occur?

What day and at what hour did the accident occur?

Where were you when it occurred, and what doing?

Was the gong ringing at the time?

Was the car standing or moving? If moving, how fast?

How far did car run after accident, before stopping?

How many feet from nearest street crossing was car at time of accident?

Was any one hurt, or any property damaged?

Give name and statements of injured party, or owner of property damaged:

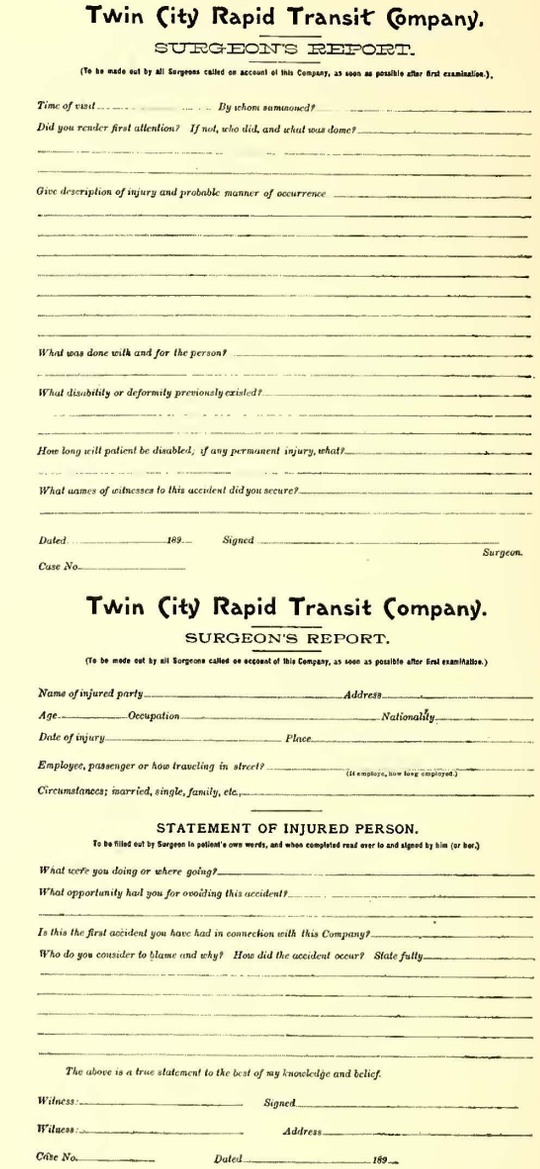
Give full account of accident as witnessed by you:

FORM 5—FRONT AND BACK.

each account is held open for a short time after amount of release or paid judgment is entered. From this ledger monthly statements are drawn which show the classified expense of the department for a certain month, divided according to years in which accidents occurred, also showing expense for the year to date.

From the record book in the claim department a monthly statement is also made which shows the number of cases reported for investigation, compared with the same month for the previous year. These are classified as shown in form 7.

During the day and until late at night one or more members of the claim department is within call of the operating department, as often quick action is of great ben-



Twin City Rapid Transit Company.

SURGEON'S REPORT.

(To be made out by all Surgeons called on account of this Company, as soon as possible after first examination.)

Time of visit By whom summoned?

Did you render first attention? If not, who did, and what was done?

Give description of injury and probable manner of occurrence

What was done with and for the person?

What disability or deformity previously existed?

How long will patient be disabled, if any permanent injury, what?

What names of witnesses to this accident did you secure?

Dated 189 Signed

Surgeon.

Case No.

Twin City Rapid Transit Company.

SURGEON'S REPORT.

(To be made out by all Surgeons called on account of this Company, as soon as possible after first examination.)

Name of injured party Address

Age Occupation Nationality

Date of injury Place

Employee, passenger or how traveling in street? (If employe, how long employed.)

Circumstances; married, single, family, etc.

STATEMENT OF INJURED PERSON.

To be filled out by Surgeon in patient's own words, and when completed read over to and signed by him (or her.)

What were you doing or where going?

What opportunity had you for avoiding this accident?

Is this the first accident you have had in connection with this Company?

Who do you consider to blame and why? How did the accident occur? State fully

The above is a true statement to the best of my knowledge and belief.

Witness: Signed

Witness: Address

Case No. Dated 189

FORM 6—FRONT AND BACK.

efit in handling accident cases. In the claim department a book is also kept in which the names of such employes are recorded as are called into the claim office, with reasons why called, by whom called, when called, etc., and this entry is checked off after the employe has been sent back to his station. When sent back he is handed a slip for the foreman on which his name and the hour in which he left for his station are recorded, with instructions to return him to work unless otherwise directed by the superintendent.

A note book with carbon paper is kept on the telephone desk on which the telephone messages of accidents are written. One copy is left in the book and one attached to the files of the case.

There is also a form filled out daily and sent to the superintendent which informs him of all releases taken during the preceding day. This information is of importance to him in the handling of his men.

As soon as an action is begun a file of the case is sent to the attorneys of the company, which they promptly review They return an outline of the case, in which appear the names and addresses of all witnesses, a brief memor-

anda of the action and a request for such further information as may be wanted before trial.

Where maps and charts are made they are signed by the person for whom made, and when possible are attested by the claimant as to their correctness. There are other details of the work which are common to all claim departments. When once inaugurated the system described is not complex, is easily understood by the employes in the department, and the results so far have justified the care and methods employed.

OTHER OPERATING DEPARTMENT DETAILS.

In both cities the cars are run on loop systems, so that nearly all cars pass certain points. Upon the loop in the heart of each city there is a small house or octagon box. Here is stationed a starter who checks up the time of all cars, makes change for the conductors, acts as a general bureau of information to the public and telephones the office of any irregularity of service. The conductors on every trip deposit here their envelopes with their transfer fares and give brief information, often of great value, of any accident they may have had. Here, too, articles found on the cars are first left, and much other business transacted, so that the usefulness of these starters fully warrants the expense of their salaries. The checking up of the time card by the starters has a good effect upon the trainmen, causing them to use every effort to pass these points on time. In all delays of over five minutes, motormen are obliged to send in reports stating cause of delay, etc.

Every conductor is required to carry a trip sheet upon which full data are entered showing the time "up" and time "down," the fares received, and similar information. When relieved the conductors turn in these sheets at the different stations with the cash fares. Upon the follow-

DIVISION
MONTHLY STATEMENT

CLASSIFICATION	No.	18..	Increase	18	18
Boarding cars while moving,	1				
Leaving moving cars,	2				
Cars starting, alighting or boarding,	3				
Fell " " "	4				
" on or off cars,	5				
" off car on curves,	6				
Cars off track,	7				
Collision of cars,	8				
" " with persons,	9				
" " " vehicles,	10				
" " " animals,	11				
Cable slot injury,	12				
Center pole injury,	13				
Employes injured while on duty,	14				
Electric shock to persons,	15				
" " " animals,	16				
Frightened horses,	17				
Disturbance on cars,	18				
Trouble account of fare,	19				
Ejectment from cars,	20				
Miscellaneous,	21				
Total Releases,					
Court fees,	22				
Witness fees and mileage,	23				
Special services,	24				
Briefs and transcripts,	25				
Medical expense,	26				
Physician's witness fees,	27				
Incidentals, office expenses, etc.,	28				
Salaries,	29				
Total Claim Expense,					
GRAND TOTAL,					

FORM 7.

ing day these trip sheets are checked over by the mileage clerk and cashier, and then go to the operating department. In the latter place passenger records are kept, made up from the trip sheets, and showing plainly the travel upon the various lines during the preceding day.

Adjoining the manager's office are two frames in which record cards and extra badges for conductors and motormen are kept. The frames are about 3 ft. × 6 ft. and have glass doors. The record cards, which are about two inches square and of manilla cardboard, are held in place by steel hooks which pass through holes punched in the corners. These cards are numbered as shown.

The cards are placed close together and cover the entire backs of the cases. In case an employe leaves the service, his card and name remain and a new card is prepared for the conductor who may have that number. In such a case the pin badge worn by the former employe is placed upon the hooks with his card where it remains until the badge is again used. The badges are numbered with a

CONDUCTOR No.

O 153 O

Name,—ALBION JOHNSON.

East Side Station.

Appointed 1 10 '96.

different hundred figure for the different stations, so that it is easy to select a badge that belongs to any particular station.

The cards furnish a ready reference for the number and name of the employe, and correspond to the numbers kept in the record books.

There is also a car record board with double doors opening in the middle, in the manager's office. In this the assignment of the different cars at each station is shown. The numbers are painted on the tops of small plugs, the heads of which are about ¾ in. in diameter, while the spindle is only ¼ in. in diameter. These plugs are adjusted in holes in the back of the case and inside of the doors to correspond with the position of the cars, whether in the shops or at different stations. The record can thus be changed every day according to the car reports.

READY REFERENCE BOOK.

The president, vice-president and general manager are each provided with a ready reference book which is ruled and indexed, and contains a comparative statement of cost of operation, number of passengers, cost per car mile, and other details to which it is necessary for the manager frequently to refer. Each month these books are corrected to date in the accounting department, and are always kept handy or carried in the pocket for reference. By this means, when called upon, the officers are able to give definite information, avoiding guess work and are also able to compare the monthly results with those of corresponding months in previous years. The books have an alphabetical index and the headings are readily located and contain the following information:

List of equipments, description, when purchased, cost.
Comparative statements by months since organization of road of
Gross Passenger Earnings.
Gross Expenses.
Surplus Earnings.
Car Mileage.
Gross Earnings Per Car Mile Run.
Gross Expenses Per Car Mile Run.
Surplus Earnings Per Car Mile Run.
Per Cent of Operating to Gross Earnings.
Insurance.
Injuries and Damages.
Legal Expense.
Contingent Expense.
Interests on Bonds.
Interest on Floating Debt.
Taxes.
Net Earnings.
Average Passengers Carried Per Car Per Day.
Average Passengers Carried Transferred.
Average Transfers Collected Daily.

A LARGE installation of individual electric motors has been made at the Illinois Steel Company's plant. About eighty motors ranging in size from three horse power to fifty horse power and aggregating 1500 h. p. of rated capacity have so far been put in position, the attachments being in most cases made directly and without the use of belts to the different machines. The generating plant consists of one 300 k. w. generator with two 126 k. w. generators as spare. The average load in the engine room runs at about 1200 amperes at a pressure of 240 volts, which is that used on the power circuits.

Power Distribution for Electric Railroads.

By Louis Bell, Ph. D.

IV.—Electrolytic Action in the Return Circuit.

Recurring to Fig. 25, and granting the conditions to be such that a current flows from track to pipe at some point in the system, that current must leave the pipe and either pass back to a part of the track having a lower potential or to some other conductor by which it may work its way back towards the station.

Now wherever an electric current leaves a metallic conductor for one which owes its conductivity, as does the earth, to the presence of liquid, the surface of the former is corroded—gnawed away by the chemical action set up by the current. Hence the pipe under consideration would soon show a surface pitted with rust, and eventually the

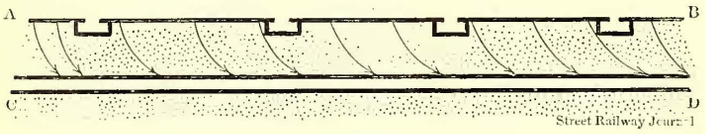


FIG. 25.

corrosion would extend through to the inner surface of the pipe and start a leak. Similarly the rails are corroded from the exit of the current, but the result is not of much consequence.

This matter of electrolytic corrosion of water pipes, gas pipes and other buried conductors is serious in very many electric railway systems, so serious that it is worth detailed study as one of the gravest factors bearing on the design of the return circuit. One would naturally suppose that the actual amount of damage done by the comparatively small currents distributed over a large space, would be rather slight. So it would be if it were intermittent, but when the electrolytic process goes steadily on week after week and month after month, the aggregate result is somewhat formidable. One ampere flowing steadily from an iron surface will eat away very nearly twenty pounds of metal per year. So, in the case of conduction to a pipe just investigated, the resulting corrosion would amount to *half a ton per year*. This destruction would be done in the surfaces of exit from the pipe and if the conditions were such as to limit these surfaces to a comparatively small area the local damage would be very serious.

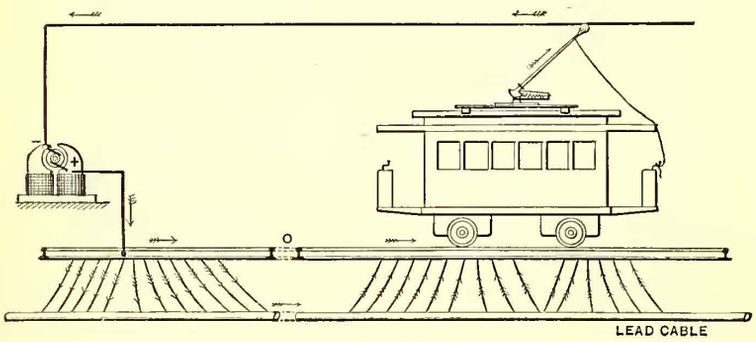


FIG. 26.

Electrolytic corrosion of underground conductors by stray currents was first noticed in the case of lead covered telephone cables in Boston by I. H. Farnham, to whose researches much of our knowledge of the subject is due.

Lead is attacked at the rate of about seventy-five pounds per ampere per year, so that the result is extremely marked. Fig. 26 gives a diagrammatic view of the circuit through such a cable. Part of the current used on the railway circuit passes from the rails to the cable and thence along it to the neighborhood of the power station, where it passes back to the track and the dynamo. The mischief is done at this point and not while the current is flowing in the cable. The effect produced is a severe corrosion of the lead covering of the cable taking place irregularly upon the surface and forming pits, which may penetrate the sheath and destroy the insulation of the cable.

Investigation showed the state of things on the Boston system to be very interesting. At the time, the positive poles of the dynamos in the power station were connected with the rails so that the current passed into them and thence to the pipes and cables, emerging from them at various points in the system. The corrosion was thus widely distributed, but from local conditions of conductivity was most apparent in spots. Careful measurements of the potential between the track and the cables were made in a large number of places with the result shown in the map (Fig. 27). Near the power stations the flow was from track

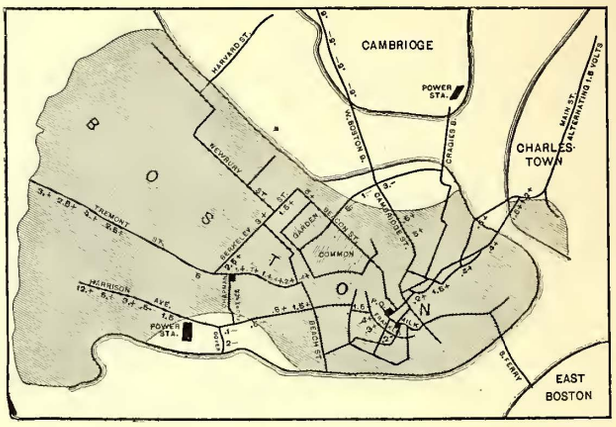


FIG. 27.

to cables, but over the main area of the city it was from cables to track, giving a large area in which corrosion might be expected. Differences of potential as high as five volts were observed, while experiments in other cities have shown as much as twenty-five volts. It is interesting to note that one of the first experiments tried to relieve this electrolytic action was to sink in the earth ground plates connected to the cables in the hope that the current flow would take place mainly through them. The potential differences even at points quite near these plates were quite unchanged, showing very plainly the intense badness of the earth as a conductor, which has already been pointed out.

The method of treatment which proved most effective

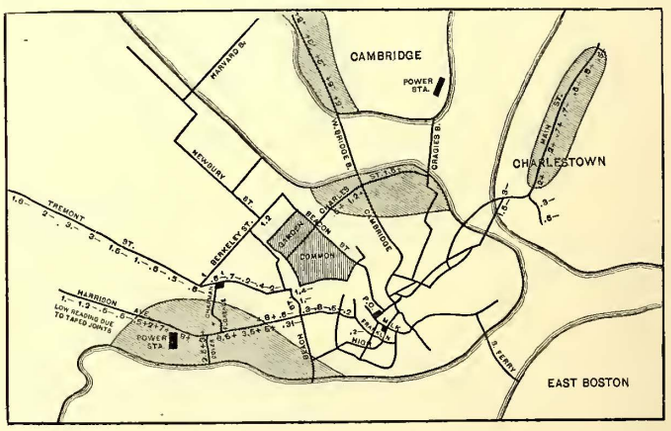


FIG. 28.

in reducing the electrolytic effects, was first to locate the trouble as nearly as practicable in definite areas and then to check it in these areas. In the first place the dynamo connections were reversed so that the stray current would enter pipes and cables over the most of the system, but would leave them en route for the negative terminal of the dynamo only in the districts immediately surrounding the power houses. Thus it would be certain that the damage would be limited to known areas which could be attacked locally with success, instead of being scattered where the trouble would be hard to locate and harder to remedy.

Fig. 28 shows the result of this change. The "danger areas" shown here as before by shading on the map, are comparatively small, although within them the differences of potential were quite as great as before. Now the problem was to lead the current back to the dynamo without compelling it to leave the pipes, and corrode them at the points of exit. To this end, large copper conductors were extended through the danger area and thoroughly connected at intervals to the telephone cables. The result was excellent, since the stray currents, instead of passing

FIG. 29.

from the cables through the earth to the track, took the easier path through the supplementary conductors. Hence electrolytic action was practically obviated so far as the cables were concerned.

A measurement of the current thus collected from the telephone cables into a main ground wire from the station showed over 500 amperes capable, if flowing continuously, of eating away 37,500 lbs. of lead per year. And as this current did not include that which found its way to water and gas pipes, the real amount of current which left the rails and wandered home through underground conductors was considerably larger than the figure mentioned, probably several times as great. The distribution of this current is so irregular from place to place, as indicated on the map, that it would be very hard indeed to estimate the total proportion it bears to the whole current on the system. So far as data are available however they indicate that we would not be wide of the truth in saying that ten to twenty per cent of the current on the system may follow other paths than that through the rails and bonds. Even more than this may appear in occasional instances. So while the earth helps the return circuit directly but little, buried conductors may help very materially, perhaps to their own serious detriment. It should be remembered that the electrolytic action is not necessarily proportional to the differences of potential such as are noted on the maps. The places most injured depend on local conductivity and some of the worst instances recorded have occurred where the measured potential difference was only one or two volts.

Figs. 29 and 30 give a graphic idea of the kind of

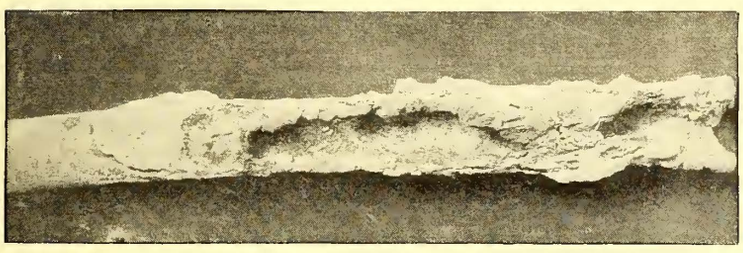


FIG 30.

damage that is done to pipes by electrolysis from stray currents. Fig. 29 shows the effect of corrosion on an iron gas pipe, and Fig. 30 that on a lead water pipe. Both are from photographs of the "horrible examples." As the action tends to become concentrated in spots, a pipe may be perforated in a rather short time. Iron water pipe has sometimes been riddled in five to eight months. That this is easily possible may be readily seen, for suppose that conditions are such as to get in a certain spot a flow of half an ampere in a space of one square foot. Suppose the pipe to be ⅝ in. thick, therefore weighing about twenty-five pounds per square foot of surface. If the electrolytic action were perfectly uniform the pipe would be reduced to an unsubstantial shell in a single year, and since the corrosion always shows irregular pits the pipe would almost infallibly be perforated in six months.

It is worth while to note that surface protection of pipes by painting with asphalt and the like has been shown by the Boston experience to be practically worthless, as the corrosion seems to work under the film which can never be made really insulating to any useful extent.

In spite of the quite perceptible assistance that may be rendered by underground pipes to the general conductivity of the return system, every effort should be made to avoid it. For, even if the various lines of pipe are protected by the supplementary wire method described, there may be electrical differences at the joints of the pipes quite sufficient to cause local corrosion in serious amount. Joints in water pipe are better mechanically than electrically and the currents flowing through them may, as we have seen, be rather heavy. Take for example Fig. 31. Suppose that owing to oxidized and dirty surface of contact the joint A has a resistance of .005 ohm and that a current of one hundred amperes is flowing through it in the direction indicated by the arrow. The fall of potential through the joint would then be .5 volt, lines of current flow would be set up as shown by the dotted lines and a ring of corrosion B C would be set up on the positive side of the joint. Half a volt is quite enough to do the work, and though the action might be slow it would be sure.

Therefore all conduction by pipes ought to be avoided as far as possible unless they are electrically continuous. Even if they are, protection by supplementary wires is somewhat risky since while it may relieve trouble in the conductors so connected it may enhance the danger to neighboring pipes not thus protected.

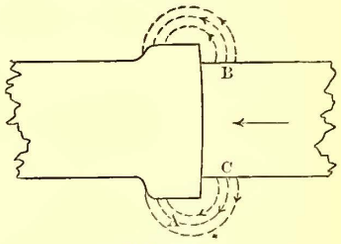


FIG. 31.

Liberal use of supplementary wires has great use as an emergency measure, applied to systems already existing, but here, as generally, an ounce of prevention is worth a pound of cure. The proper return circuit of the railway should be made so good that the stray currents shall be quite negligible, and all methods of palliating their evil effects should be considered secondary in importance and to be shunned rather than courted. It must not be understood that these methods are condemned, for they may be of much use, but they should be employed only to deal with the residual currents after they have been reduced to the lowest practicable terms by means of improving the track circuit.

The main point of such improvement lies in the connections between rail and rail. If the resistance of the bonds and their contacts were negligible there would be very trifling stray currents.

For example, if we are dealing with a double track of ninety-pound rail, the resistance is about $\frac{1}{120}$ ohm per thousand feet or .00733 ohm per mile. Such a structure could carry 1000 amperes with a loss of but 7.33 volts per mile and should reduce the stray currents to a very minute percentage since the resistance is not only very small compared with any probable value to the earth resistance between track and pipes, but also very small compared with the resistance of the pipes themselves including their bad joints. With, say, one per cent of the current in the earth conductors the electrolytic action while not absolutely suppressed would be so slow and so trifling as to be scarcely worth considering save at a few points which could be protected if necessary.

All this points to the necessity of the most perfect bonding, as before pointed out. All sorts of devices have been tried. Two of the most ingenious, aside from those already referred to, consist respectively of a plastic con-

ducting film squeezed between the bond surface and the rail surface, and of a heavy copper dowel pin driven into a hole in the end of one rail and the other forced upon it and held with the fishplate. The uncertain point about these as about many other bonds is their ability to endure jarring and corrosion. Bonds are sometimes subject to the same sort of electrolytic action just mentioned in connection with pipe joints.

The most radical cure for joint resistance of rails may be found in the two now familiar processses for making continuous rails. That a continuous rail is entirely feasible mechanically now admits of no dispute. Expansion does not and cannot take place longitudinally when rails are firmly embedded in paving, even under the extremes of temperature encountered. Whatever yielding there is is lateral, and the track is not thrown out of line.

The electrically welded joint when carefully made is strong and reliable and of almost infinitely small resistance. The contact is non-corrodible, of great surface and so intimate as not sensibly to increase the resistance of the track. It is as far superior to a bond contact as the latter is to the contacts made through rusty fishplates. A track so excellent mechanically and electrically needs no commendation here, more than to reiterate the value of a complete and permanent connection between rails.

The "cast welded" joint has now come into very considerable use. Mechanically it is admirable and electrically it is virtually the equivalent of the welded joint. Between these two rival continuous rail processes it is difficult to choose. Certainly both afford at once the solution for the joint alignment and the bonding difficulties. Both are likely to come into very extensive use in large city roads where the electrolytic troubles are usually most noticeable, although small roads are not exempt from them. Electrically these continuous rails are ideal, since not only is their total resistance a minimum, but it can be counted upon with certainty.

It has often been urged that a double trolley system should be employed to avert danger of electrolytic action. Experience has shown that the double trolley is not likely to become a favorite with street railway men. It can be worked successfully with proper care, but the mechanical difficulties in the way of installing and keeping up the overhead system of frogs, crossings and the like are somewhat formidable. On a straightaway road with no branches or few the task is easier, but for the purpose in hand such roads are not the ones requiring the most serious consideration. The troubles belong especially to complicated city systems in which the difficulties of a double trolley system are something terrific. Inasmuch as every electric railway company has to pay for what can be made a magnificent ground circuit, it seems totally needless to throw away the rails and operate a double metallic circuit overhead. Especially is this true in view of the fact, that considerations of track stability and durability point to the use of the continuous rail which avoids at the same time the electrical difficulties.

It must be remembered that in long distance lines such as are found in interurban and similar work, the use of continuous rails is liable to cause trouble from insufficient resistance to expansion, as such roads generally lack the strong lateral support of the paving and are often exposed to more violent changes of temperature. On the other hand in the case of such roads trouble from electrolytic action is usually relatively small or entirely absent, so that bonding is sufficient. Also, as will be explained later, in these roads for heavy service and rather high speed there may sometimes be good reason for using two trolleys, quite aside from all questions of ground return.

Of course, when the alternating current motor is thoroughly developed for railway service all danger of electrolysis will be past, whatever the character of the return circuit, but there will still exist every reason for making the rail return as perfect as possible from motive of economy alone. For when bad bonding can increase the total resistance of the track circuit ten or a dozen times, as has happened many times, the waste of energy due to the increased drop in the circuit becomes somewhat burdensome.

For example, take a single track of ninety pound rail 10,000 ft. long. With continuous rails the resistance per thousand feet would be $\frac{1}{3\,6\,0}$ of an ohm and for the whole distance .027. With 200 amperes flowing, the drop would be 5.4 volts and the loss of energy a trifle over one kilowatt. Now suppose each bond contact with its half of the bond wire to have a resistance of .001 ohm. On each line of rail there would be 660 of these so that the total bond resistance of the track would be .33 ohm and the drop due to this bond resistance with a current of 200 amperes would be 66 volts. The corresponding loss of energy would be 13.2 k. w. more than enough to operate an extra car. At the cost of power generally found this waste would represent in the vicinity of $750 per year net loss, a pretty high price to pay for the privilege of having a poorly connected track, liable to cause serious trouble from stray currents. And this instance represents not at all an extremely bad case, but a very common one.

The moral of all this is that just as much care should be spent on the joints underground as on those overhead, in fact more, since the latter are but slightly liable to corrosion while the former run great risk of it. For this reason the continuous rail is doubly desirable since it not only avoids constant loss of energy in the rail joints, but averts a rather heavy cost of maintenance. With continuous rails some cross bonding may be desirable to give security against breaks, but it comes into use only in emergencies.

To prevent electrolytic destruction of neighboring conductors by stray current from the rails the best simple advice that can be given is as follows:

1. Use the continuous rail system; or
2. Bond very thoroughly; put the positive pole of the dynamo on the overhead line; join the negative directly to the track without intentional earth connection, and
3. In any case investigate the potential between track and buried conductors and run supplementary wires from these conductors to the dynamo if necessary.

This applies to small systems as well as large. The only cases which may be fairly excepted are electric roads running through country where there are no buried conductors near, and elevated roads which are really a special case of the double trolley system. As electric railways have become more common and more thoroughly understood the conditions of the return circuit have been much ameliorated, but sins against Ohm's law are still distressingly common. A feeling still seems to be rife that what is concealed from the eye may be scamped, as when the guileful wiring contractor runs underwriters' wire through the ceilings and puts okonite at the joints. It is bad enough for a dishonest contractor to do that sort of thing, but what shall we say to a man who cheats himself by doing poor work on his return circuit without even the excuse of a great economy?

We are now in a position to determine the quantity which was the ultimate object of this investigation into the details of the return circuit; i.e., its total net value as a conductor compared with the outgoing circuit.

This is obviously not a fixed quantity in either absolute or relative value, for even neglecting joint resistances there is far less difference between the weights of the rail used in various systems than between the weights of overhead copper. An ordinary electric road uses perhaps a rail of seventy pounds per yard. A single track so constituted is, neglecting joints, of conductivity equal to 2,800,000 c. m. of copper. If the rails were continuous it is clear enough that in a road of small or moderate size they would be perhaps ten times as good a conductor as the overhead system. This would allow for a No. 0 trolley wire and a No. 000 main feeder on the average all over the line. On the other hand, taking the resistance of bonds and joints as double that of the rail itself, the equivalent of the rail in copper falls to, say, 933,000 c. m., which is less than four times the overhead system just assumed. If this system averaged a No. 0000 feeder, plus the trolley wire, it would have almost exactly three times the resistance of the track circuit.

In large systems the rails often run as high as ninety

pounds per yard, so that a single track would be equal to 3,600,000 c. m., of copper. With continuous rails this full equivalent could be taken, but the feeder area plus a No. 00 trolley wire would hardly be less than 750,000 c. m., so that the resistance of the overhead wiring would be about five times that of the track. More commonly, making the same allowance for bonds as before, the track equivalent would be 1,200,000 c. m. and the trolley and feeder copper would have only about one and a half times the track resistance. Not unfrequently the bonding is imperfect enough to reduce the track equivalent to 900,000 c. m., which would frequently be equaled or exceeded by the trolley and feeder copper, raising the ratio to equality. We may tabulate these results somewhat as follows, calling R^1 the track resistance and R the overhead resistance.

$R^1 = .1$ to $.2$ R. Exceedingly good track and very light load.

$R^1 = .2$ to $.3$ R. Good track and moderate load.

$R^1 = .4$ to $.6$ R. Fair track, moderate load.

$R^1 = .2$ to $.3$ R. Exceptional track and large system.

$R^1 = .3$ to $.7$ R. Good track, large system.

$R^1 = .7$ to 1.0 R. Fair track, large system.

In cases now somewhat exceptional the track resistance may exceed the overhead resistance considerably. The assumption now generally made, that the track resistance is one-quarter that of the overhead system really represents a better state of things than usually exists. To justify it requires the combination of continuous rail or exceptionally perfect bonding, with conditions of load that do not require large feeder capacity. Under the ordinary conditions $R^1 = .4$ R is probably nearer the truth. The proportion between R and R^1 has, of course, a very important bearing on the design of the overhead system. If the return circuit had no resistance then the entire drop would take place in the overhead conductors and we could calculate the line for any given drop by the simple formula

$$(1)\quad c.\ m. = \frac{11\ C\ D}{E}$$

with D for the linear single distance. Bearing in mind however the resistance of the return circuit, it is evident that for a given total loss in volts more copper must be placed overhead than would be necessary if the return circuit were of zero resistance. In other words, if we are

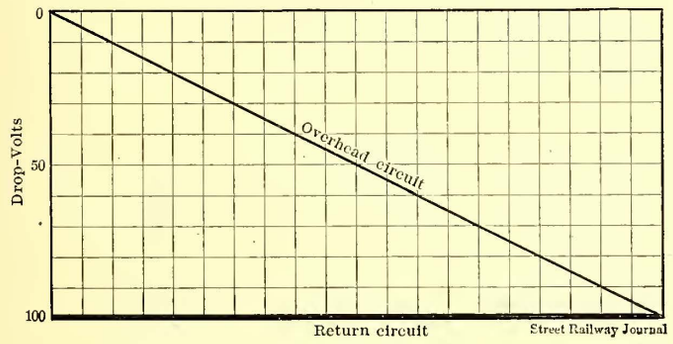


FIG. 32.

confronted by a considerable loss in this return circuit it is necessary to have proportionately less elsewhere in the circuit. With no resistance in the return circuit the drop in voltage may be represented graphically by Fig. 32. Here the whole drop is in the outgoing circuit which can consequently be rather small. If, on the other hand, we take the actual case in which the return circuit has a very perceptible resistance, the distribution of the drop will be as in Fig. 33, which is given by $R^1 = .43$ R. This means that to preserve the same conditions of total loss in the circuit the overhead copper must be increased by forty-three per cent, since of the total 100 volts to be lost it is now permissible to lose but 70+ in the outgoing circuit.

Hence to take account of loss in the return circuit the formula just given must be altered by changing the constant in accordance with the new conditions, which are there actually found in practice. The proper amount of increase in the constant is a little uncertain as is indicated by the table just given. For $R^1 = .4$ R however the constant is 14.4 so that we may rewrite the copper formula as follows:

$$(11)\quad c.\ m. = \frac{14.4\ C\ D}{E}.$$

In the vast majority of cases the constant will lie between 14 and 15. The exact value to be assumed depends on the conditions as to track circuit and load in the particular case considered, and can be judged approximately from the table. It may sometimes be desirable to make a

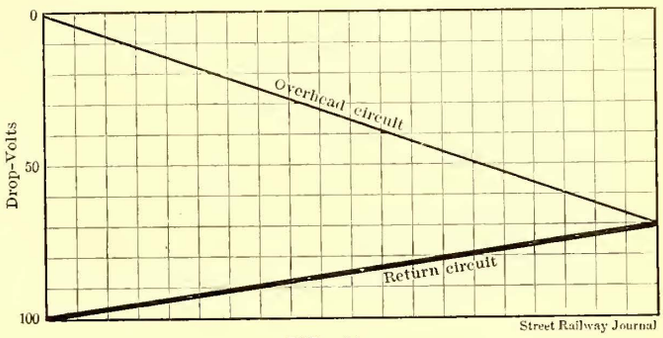


FIG. 33.

few trial calculations with different constants in order to get a clear idea of the possible amount of copper.

It is, of course, possible to determine a condition for minimum cost of the conducting system, taking account of the cost of copper, rails and bonding, but, generally speaking, the rail is fixed by purely mechanical considerations while there are, as has been shown, good reasons for making the track circuit thoroughly good. In applying the above formula, as we shall in the next chapter, it should be remembered that in extensive systems the constant may have to be modified in passing from one locality to another, for the rail conditions will probably vary and the load conditions most assuredly will change.

An Experiment in Repair Shop Handling.

In a recent interview with an engineer and master mechanic in charge of one of the largest street railway repair shops of the East, he stated that he had commenced, after careful deliberation upon all the problems involved, the process of turning over all or nearly all the repair work in his charge from time work to piece work. This is being done gradually and prices are being carefully worked out in advance, but the results already reached after a few weeks' experience are such as to convince him that the move is in the right direction. Seventy-eight men were employed under the old time work system. These have, so far, been reduced to sixty-eight, of whom twenty-eight are on piece work and the remainder still on time. There has been a reduction of twenty per cent in the cost of work done by these twenty-eight men, and of eight per cent in the entire expenses of the shop.

But this is not all. Under the old system about seventy-four cars on an average passed through the shop for all kinds of repairs in a seven-day week; now, seventy-six cars pass through in six days and with a force, as before stated, of about sixty-eight men as against the seventy-eight men of former times. In the paint shop, which has been put largely upon piece work, twenty-four cars are now turned out in four weeks' time; where under the old system but fifteen cars were turned out. Figures are being made up as rapidly as possible for a further extension of the piece work system.

It is worthy of note that this innovation was at first vigorously resisted by the foremen and the men, but the results have been as satisfactory to the latter as they are to the company, as the men on piece work are making at least ten per cent more per day than before.

A Car Collision.

Fig. 1 and 2 show the result, as far as the car was concerned, of a collision which took place some time ago on the West End road, of Boston. The accident was caused by a steam roller running into the side of the car, or coming down upon it in such a way that the heavy T iron frame in which the front rollers were carried struck the side of the car just below the level of the seats. While accidents are to be deplored, yet their results form the most valuable and instructive lessons for the railroad man. In this case the complete want of strength shown by the posts of open cars is shown plainer than can be given by any words. The first post struck broke at the seat and at the upper corner of the car. The second post snapped off at the mortise and also at the seat arm. The other posts were broken below the level of the seat, none of them offering any appreciable resistance to the blow. The panels were of wood strengthened with ribs and canvas in the usual way, and as far as can be known, were in no way defective. They were made of the usual size and the ribs and the posts seemed to have been of about the average strength and straightness of grain. Fig. 1 shows that they were well secured to the letter board, for two of them at least splintered just below it, one of them splitting for several feet. The step or running board was entirely carried away and the brackets holding it twisted out of shape. The body of the car was practically untouched and uninjured.

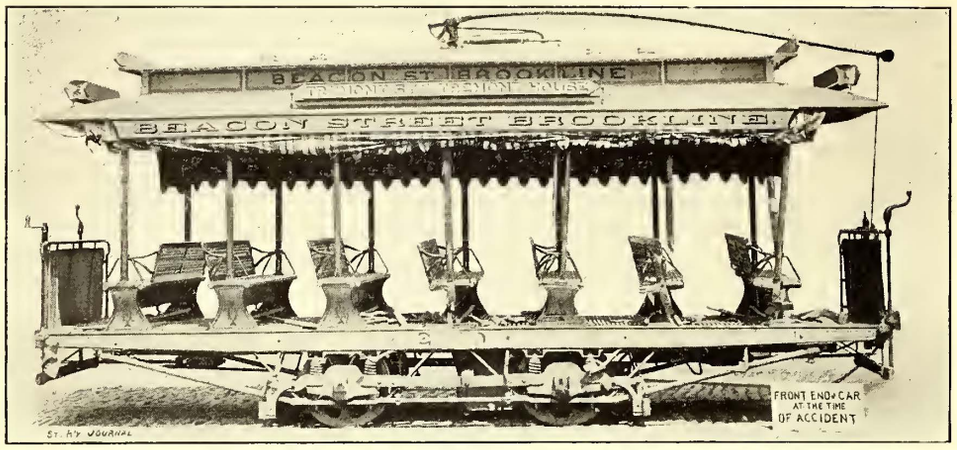


FIG. 1.—RESULTS OF A COLLISION.

Several lessons may be drawn from this accident. The open car, with cross benches and entrance at the side, presents so little strength at or above the level of the seats, that even a trivial collision is liable to not only do serious damage to the car, but to inflict grave injuries upon the passengers. With wooden panels to hold and support the posts the strength is too small to be worth consideration. How iron panels would have fared under similar circumstances is a question. The form of the post is as bad as could possibly be designed for securing strength from wood. Only bent timber could have any resistance in such a form, natural crooks being, of course, out of the question.

Perhaps one question which should be raised in considering such an accident is whether or not the best form for an open car is one which has a center aisle and entrances at the ends with solid sides to the seat level. A car of this pattern would, no doubt, have had such strength in the side that it would have been lifted from the track bodily by such a blow and in this way, by yielding to the blow struck by the steam roller, would have escaped such serious injuries and would have protected its passengers to much better advantage.

While we do not build cars with accidents in view, yet since accidents will occur it is not unreasonable to consider them, especially as in providing against them we also obtain a strength which is useful in enabling the car to wear longer. Cars of this general type do not give a sufficient strength to the posts and do not have proper stiffness to safely carry the roof. The open cars with a partition at the ends are very much stronger, carry their roofs with less whipping and in accidents have at least one bench which is strong enough to make some show of resistance. No fault in this case can be reasonably found with the construction, but the design is one which is certainly not altogether desirable, and it is gratifying to know that the public demands are growing in the direction of a different style of car.

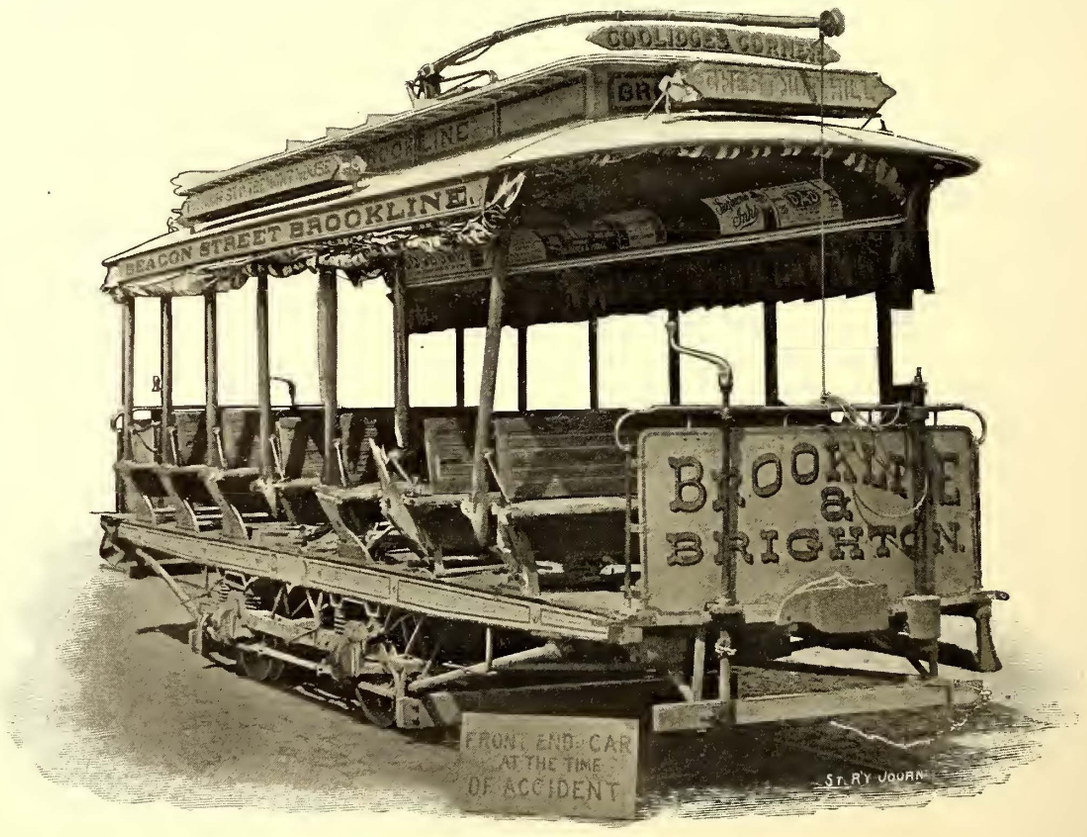


FIG. 2.—RESULTS OF A COLLISION.

An electric car on the Lorain-Elyria Electric Railway, of Lorain, O., recently made a record of a mile in one minute and thirty-five seconds.

LETTERS AND HINTS FROM PRACTICAL MEN.

Express Service in Brooklyn.

THE BROOKLYN HEIGHTS RAILROAD COMPANY.
BROOKLYN, N. Y., Apr. 23, 1896.

EDITORS STREET RAILWAY JOURNAL:

This company, after having been urged by a great many different persons in the city, has arranged to put in effect an express service for the carriage of high class express matter in a manner similar to our carriage of United States mail and which we have been doing in special post-office cars constructed for that purpose since last fall.

Brooklyn always has been materially hampered by the dilatory and expensive methods in vogue for the distribution of all the natural and manufactured commodities on which the physical and commercial welfare of a community depends. The Brooklyn manufacturer has been discriminated against by purchasers in other cities because orders placed with his competitors in New York, or even in Newark, N. J., could be more quickly filled and would frequently reach Chicago and other Western points at about the same time that those shipped by Brooklyn manufacturers would get started from New York. The Brooklyn merchant desiring patronage from contiguous points has been at a disadvantage because he cannot make as quick delivery to his customers at those places as can his competitors elsewhere. This inadequate service has, in fact, been felt by all classes. Improved facilities have heretofore been impracticable because of the long and expensive wagon hauls in Brooklyn.

In January last the Committee on Commerce and Transportation of the Manufacturers' Association of Kings and Queens Counties took up the question with a view of ascertaining if the plants of the surface railroads could not be utilized for the quick and economical transportation of high class express matter, small parcels for delivery at residences, etc., on somewhat the same system by which the United States mails are so successfully carried with such beneficial results to every individual in the city.

The companies were at first inclined to believe that the establishment of such a system would entail too large an advance expense for equipments, etc., to warrant their putting it into operation, but expressed their willingness to take hold of the matter when it was clearly shown to them that every business interest in the city required better facilities for development.

After looking the project over carefully it was ascertained that quick and economical distribution and collection of such business could readily be made in the entire territory covered by the surface lines by the use of a few express cars to start simultaneously several times a day from one central station, each running over a prescribed route, along which, at convenient points, should be located depots into which cars could be switched while loading and unloading their express matter; the local collections and distributions to be made by wagons working from these depots.

In connection with the express service elsewhere a very comprehensive system is contemplated under which from three to five collections and deliveries a day will be made in all parts of the city by cars running between the East River and Coney Island, Fort Hamilton, Bensonhurst, Jamaica, Flushing and Newtown.

All kinds of high class express matter can thus be carried between Brooklyn and neighboring cities much more expeditiously and economically than it can possibly be done with wagons, and this will be done without the slightest interference with passenger traffic.

The service will enable Brooklyn retailers to make deliveries to their customers in Brooklyn at a nominal cost several times a day soon after purchase is made, and will also enable them to deliver to their patrons in suburban towns beyond New York as quickly as their competitors do.

Express goods shipped by Brooklyn manufacturers to Western points will be delivered at destination as quickly as the New York City or Newark manufacturers can have their express shipments delivered in such places.

Fresh vegetables and fruit from Long Island points will be delivered at Wallabout Market in much better condition than it now arrives after its long and dusty journey by wagons, while all Brooklyn food products which are now brought into New York markets by rail will be taken direct to Brooklyn and by this comprehensive system will be distributed and delivered in Brooklyn fresh and in prime condition every week day morning before breakfast.

I would say in addition that the service is to be performed in such manner as not to interfere with our regular passenger traffic, as we should keep the cars on the routes where the passenger traffic is lightest and owing to the easier movement and larger load carried, of course, it will remove considerable trucking from the streets. We expect to confine it to the handling of parcels and food products and matter usually handled by express companies, and the idea has been received with a great deal of favor on the part of every one in the city. Owing to the fact that Brooklyn is situated on an island and therefore has no through railroad connections, it has been at a disadvantage compared with other cities.

We expect to have the cars in operation by the 15th of June. Very truly,

C. L. ROSSITER, President.

Kerosene Instead of Salt for Keeping Switches Clear of Snow.

CHICAGO CITY RAILWAY COMPANY,
CHICAGO, May, 18, 1896.

EDITORS STREET RAILWAY JOURNAL:

We have used no salt on any of our electric lines for the past two winters, but have used instead kerosene on all switch tongues and movable parts which were liable to freeze. We have used no kerosene on straight track as it has not been necessary.

The results have been very successful and we have had no trouble worth mentioning in keeping our cars at all times in service. Besides a saving in expense we get rid of any possible trouble incident to deterioration of bonds, rusting of motor parts, trucks, springs, etc., from the action of salt. We use snow plows, and every car is also equipped with track cleaners and scrapers.

We use a cheap coal oil costing about seven cents a gallon. Yours truly,

M. K. BOWEN,
Superintendent.

Transition Curves for Street Railroads.

CLEVELAND, O., May 11, 1896.

EDITORS STREET RAILWAY JOURNAL:

Having read in the September, 1895, number of the Journal the article on "Transition Curves," by Mr. Emery, I would beg to take exception to some of the conclusions and recommendations contained therein.

While the distance required to gain elevation in the outer rail is not a governing condition in street railway work, in determining the length of a spiral, as it is in steam road work, we should nevertheless use a true spiral and one long enough and with changes enough so that a car with a long overhang will enter and leave at a moderate rate of speed without a jerky or unsteady motion. The solution is the railroad spiral with *short* chords.

By reference to Fig. 1 of the accompanying sketch it will be seen that the statement to the effect that the center of the truck is approximately the center of rotation for the car on entering and leaving the curve, is in error. Let A C be the center line of straight track, and C B of curved

track. Let *m*F R*n* represent the center line of the car, C is the point of curve, *m* is the front and *n* the rear of the car. F is the front and R the rear wheel of truck. Suppose the front wheel to have entered the curve for the distance C F. Then *m n* makes an angle with the straight track equal to A R *n*. R is the only point in *m n* which has moved in a straight line. For simplicity let *m* F = FR = R*n* = wheel base = overhang. In some cases the overhang is almost twice the wheel base. Under the above

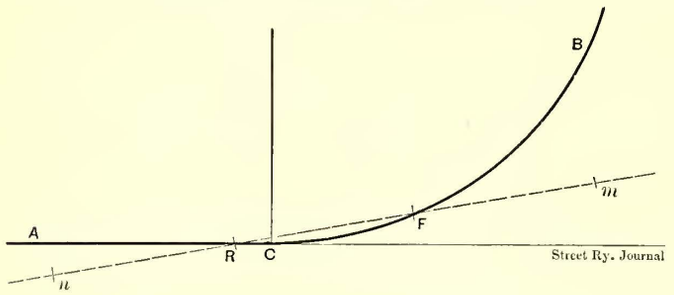


FIG. 1.

assumptions *n* and F will have rotated through equal distances while *m* has moved twice as far from the tangent. That, of course, accounts for the fact that the greater shock is felt on the front platform on entering, and on the rear platform on leaving a simple curve. It is evident that there will be a jerk at any abrupt change of radius regardless of the chord length. To change from a sixty-five or seventy foot to a thirty-five foot radius is an abrupt change. What is to be aimed at is to get enough changes so that none of them will be abrupt.

In reference to the recommendation for the adoption of a spiral within the limits practicable for switch construction there is hardly a valid reason given. At any point where there is no switch required, use the best possible spiral to fit the case. In the majority of cases I would recommend two foot chord lengths with a constant increment for the chord angle. The first chord angle will constitute the increment. Suppose we want a spiral for a thirty-five foot main radius. If we have room for about a thirty foot spiral we would get the following lengths of radius with two foot chords and twelve minute increments: 572.96, 286.48, 190.98, 142.24, 114.59, 95.49, 81.85, 71.62, 63.66, 57.30, 52.09, 47.75, 44.07, 40.93, and 38.19 ft. (You will note that the initial radius 572.96 ft. corresponds to the radius of a ten degree curve in railroad practice.)

For a lower limit I would recommend two foot chords and thirty-six minute increment, which gives the following lengths of radius: 160.98, 95.49, 63.66, 45.75, and 38.20 ft. For a mean between these limits use 286.48 ft. initial radius and twenty-four minute increment with two foot chords.

By constructing three tables on the above basis a spiral can be readily selected to fit almost any case arising in city streets. It is not at all essential that the spiral radii should end in even feet. Even chords and even angle increments should govern. The formulae given in Searles' work on "The Railroad Spiral" are applicable to the construction of spiral tables for street railway work.

In Fig. 2 of the accompanying sketch I have drawn curves "A" "B" and "C" from the same tangent and marked some of the principal elements of each thereon for comparison. Each curve has a thirty-five foot main radius. Curve "A" is a simple curve; curve "B" has an initial radius of one hundred feet with eight foot six inch chord, and intermediate radius sixty-five feet with chord of six feet six inches as recommended by Mr. Emery. Curve "C" has an initial radius of 572.96 ft. with two foot chord lengths, and fifteen changes of radius as given above. To get the best effect of the comparative difference hold the sketch so as to be nearly parallel with the line of sight and look along the direction of the tangent. As the deflection for the first six feet, or "wheel base" will not show on a drawing of limited scale I have given the deflection for each curve in a note on the sketch.

Will say in conclusion that long chords and abrupt changes in a spiral for street railway curves should be avoided in good engineering.

Yours truly,
C. K. Mohler.

Some Power Station Problems.

Montreal Park & Island Railway Company.
Montreal, Apr. 17, 1896.

Editors Street Railway Journal:

I have charge of a small plant operating about fifteen miles of road, with all the variations of load attendant on small lines, our load ranging from 0 to 450 amperes in ordinary winter weather, and to 700 in summer and heavy snow storms. We have two generators, one of 200 k. w., one of 100 k. w., the former being compounded for a ten per cent rise, the latter for ten per cent drop. It is often necessary to run the two in parallel which I find it very hard to do without constant attendance at the switchboard, for as soon as the load goes off, the 100 k. w. machine will take what there is left, and the larger one with its engine will run above its normal speed unless the breaker is pulled on one of them. Then when the load comes on again the breaker must be thrown in again and the attendant must wait for a drop.

Perhaps some of my brother engineers can suggest a remedy, having had a similar experience. The machines are Royal multipolar, belted to separate Corliss engines,

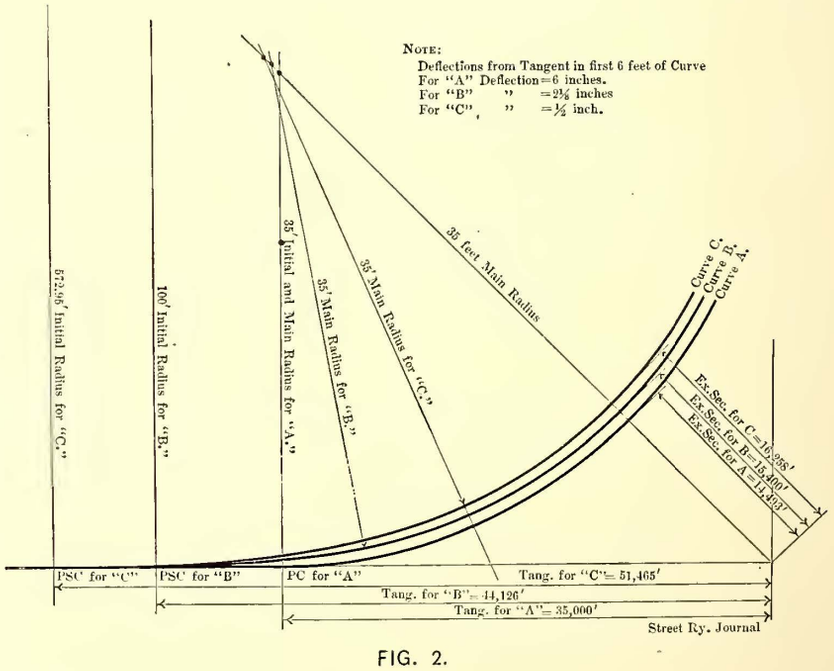


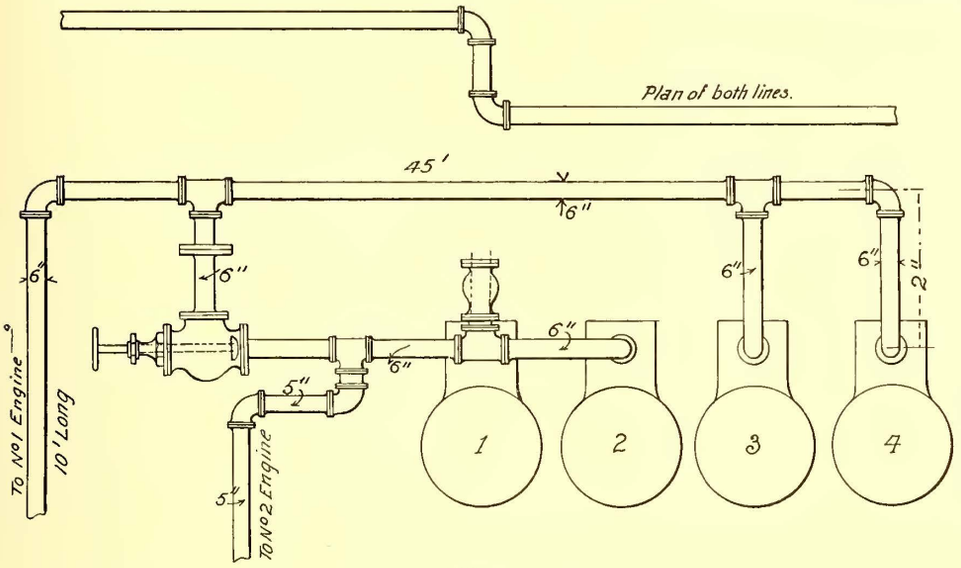
FIG. 2.

and run 500 and 600 revolutions respectively. They are connected on back of board to bus bars.

It is surprising what an amount of information is to be gotten out of some of our trade papers of to-day. For instance, the *Electrical News* advances the following: "It has been found that three drops of cylinder oil per minute is sufficient for the valves and piston of a 300 h. p. engine." Very good. I can imagine I see every engineer who reads the above and has an engine to match standing before his lubricator, watch in hand, and if his engine does not match adjust his lubricator in proportion. Can there be anything more misleading or absurd than to advise oiling engines according to horse power, when we consider that there are hundreds of oils, some good, some no good,

while some cups feed small drops, some large. Some days our large engine doing at times 400 h. p. will run on less than two drops a minute; again it will want a good touch of the pump after a long hard pull when a good share of the water in the boilers has gone through the cylinder as a result of poorly arranged piping. But I, for one, am tired of paying for such information.

Speaking of lubricators, we have one of the larger engine



FIG, 1.

or a No. 5 Seibert lubricator, and the engine room being very cool I found as winter came on there was trouble ahead to keep the lubricator feeding, using necessarily a very heavy oil. The Seibert Company recommended as a remedy that I use a lighter oil. That was entirely out of the question. The engine builders suggested covering the syphon and pipes, and I went further and covered the entire cup with asbestos. Still it was too cool.

Procuring some small lead pipe we coiled it around the cup, tapped the steam pipe, allowing just enough steam to flow through coil to keep the cup hot, and we had it. Even on days when oil would not run on the engine the cup did its work perfectly.

In regard to piping I would like the opinion (as to cause and remedy) of Mr. McCarty on a conundrum I have here. Boilers are connected as shown in sketch. Steam is on, say, Nos. 2 and 4. No. 3 is filled up and cut in and No. 2 is cut out. Shortly the pipe begins to vibrate longitudinally and to a great extent, when No. 1 engine is running. On closing angle valve it stops vibrating, but as the leg fills with water the screw joints and flange begin to leak.

If any of the readers of the Journal can suggest a remedy I shall be glad to have it.

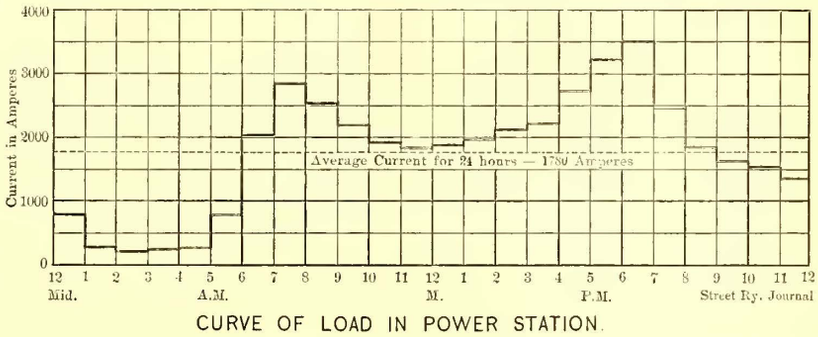
J. MAHONEY.

Power Station Records.

The following power station statistics covering the operation of an electric railway system in a large Western city for the month of April, 1896, have been received from the company. The engines are Corliss single cylinder, noncondensing, direct connected to 750 k. w. generators. The boilers are fire tube and the coal burned is soft Illinois bituminous costing $1.21 per net ton delivered. In estimating car mileage, two trail car miles are considered equal to one motor car mile.

Average number of motor cars operated daily	147
Average number of trail cars operated daily	37
Average daily mileage per motor car	120
Average daily mileage per trail car	60
Average daily I. H. P. (24 hours.)	1,648
Average I. H. P. per motor car	18.48
Average daily consumption of coal	1,898 bbls.
Average daily consumption of water	108,050 gals.
Water evaporated per pound of coal	5.94 lbs.
Coal consumed per I. H. P. hour	3.84 lbs.
Water consumed per I. H. P. hour	22.81 lbs.
Average daily run	24 hrs.
Total stops for the month	none
Pounds of coal per motor car mile	8.06
Pounds of water per motor car mile	7.80

The accompanying curve shows the average variation of load at the power station during the day, the figures being obtained from half hourly readings covering the five months ending Apr. 30, 1896.



CURVE OF LOAD IN POWER STATION.

Cheap Fuel in the West.

ANDERSON ELECTRIC STREET RAILWAY COMPANY.

ANDERSON, IND., May 11, 1896.

EDS. STREET RAILWAY JOURNAL:

We use the valvoline oil for our engines, dynamos and other machinery, made by Leonard & Ellis. We have a contract whereby our fuel (natural gas) is furnished us free of cost and we therefore have no "coal statistics."

Yours truly,

ELLIS C. CARPENTER, Sec.

New Trolley Party Car and Mail Car.

The Chicago City Railway has recently put in service a trolley party car designed and constructed in its own shops. The design is similar to the closed cars of the State Street line. The inside measurement is eighteen feet four inches, and the width nine feet. These cars have extra long platforms with hood posts and are painted with the standard colors of the line, with the word "special" on the main panel above the cove panel, which carries the name of the company. The inside finish is in green and gold and is exceedingly elaborate, rich and pleasing. The furniture consists of sixteen rattan chairs of novel design. The floor is covered with Wilton carpet of special design. The carpet extends for a foot up each side, covering the ledge. The platforms are provided with cocoa matting. The strap rail is of oxidized bronze with silk tassels in place of straps. The ceilings proper are of bird's eye maple veneer, but are decorated with relief ornaments of plastic material. The side ceilings have wreaths and loops tinted in blue and gold, while the monitor ceiling is designed in a very elaborate "Empire" piece consisting of a wreath and torch with lily shaped cups for receiving the electric lamps. This figure is fourteen feet long and four feet wide. The center is arranged for a group of five sixteen candle power ground glass lamps, while at each end are twenty-one miniature lamps. There are also relief ornaments for holding ten additional sixteen candle power lights at the end and along the sides of the deck panel. There are thus fifty-seven lights in all inside, and there are also five sixteen candle

power lamps on each platform. Switches are provided so that the different groups of lights may be turned on independently of each other. In order to deaden the noise and provide for easy riding the sill of the car rests on a continuous strip of rubber one inch thick and four inches wide. On one platform is a refrigerator and cupboard for the reception of china and glassware. There are also folding tables on the platform for the use of the guests, and an ice water tank is supported on the inside of one of the dashboards. There are small lockers for the reception of provisions and for carrying extra lamps and fuses. The interior decorations have been done under the direction of G. H. Kennerley, of the draughting department of the road.

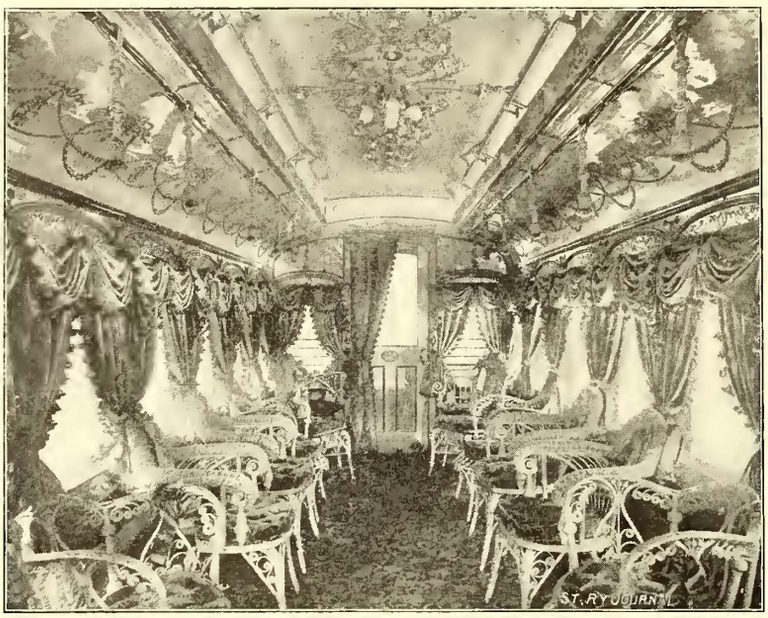


FIG. 1.—TROLLEY PARTY CAR—INTERIOR.

In Fig. 3 is shown the new and beautiful mail car built by the Chicago City Railway Company, for special suburban mail service.

A Universal Sanitary Street Car.

A new form of street car, to which the names "Universal" and "Sanitary" are very properly applied, has recently been built by the Dry Dock, East Broadway & Battery Railroad Company, of New York, from designs of C. E. Garey, master car builder of the company. The features sought were, first, better and more satisfactory seating, and second, a closed car which could easily be changed to an open car and *vice versa*. This task, as those who have designed open cars know to their sorrow, is not an easy one, and the ingenuity displayed and the success with which the problem has been solved are creditable to the designer.

The interior of the car is shown in Fig. 1. As will be seen, the seating is accomplished by twenty chairs which, instead of being parallel with the sides of the car, are so placed that the passenger sits at an angle of rather more than 45 degs. to the direction of motion. The chairs are of a unique pattern with bronzed iron backs and spring seats upholstered with leather. They are reversible by a mechanical movement, so that at the end of the line they may be turned to face in the opposite direction. The advantage of this method of seating is that passengers have free room for their shoulders, no matter what their width may be. Their feet project very little into the aisle, and there is no crowding of those seated. One passenger cannot occupy two seats, and the full seating space is always available for passengers. The room in the aisle is practically twice as great as that found in the ordinary car. The gain to the company is a very material one, as the car can readily carry twenty-five per cent more passengers. The seats themselves are set upon bracket pedestals. An arm on the shaft carrying a sector engages a long rack hidden on the top of the truss plank by a lever arrangement attached to one of the platform standards. The chairs on both sides of the car are moved simultaneously. The chair lever is seen hanging at the left of the dashboard in the exterior view. Upon reaching the end of the line the driver brings this lever into a horizontal position and changes the seats.

FIG. 2.—TROLLEY PARTY CAR—EXTERIOR.

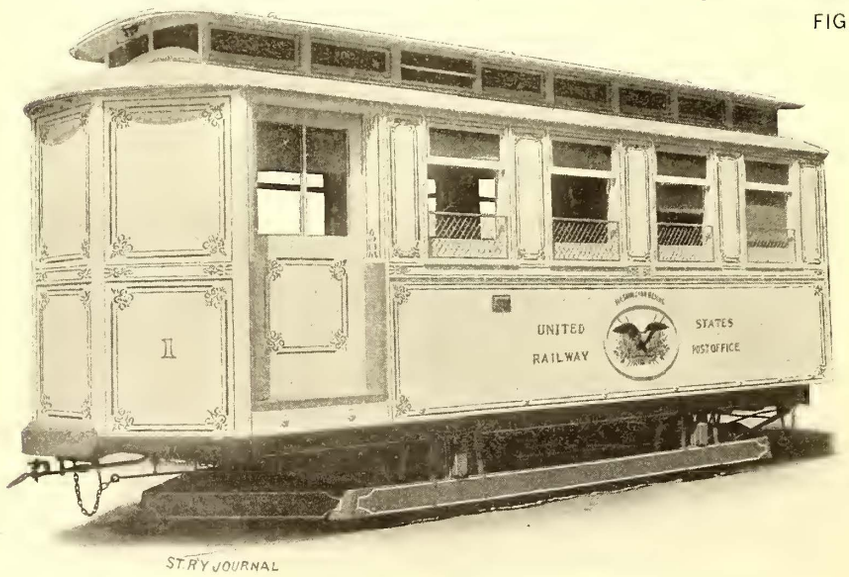


FIG. 3.—MAIL CAR, CHICAGO CITY RAILWAY CO.

The car itself has an eighteen foot body, seven feet six inches over all, and in its general appearance conforms somewhat to the style and standards of the company. The monitor is a wide one and the sides, instead of being vertical, have a flare. The angle between the monitor and the lower deck is replaced by a broad quarter round moulding which gives airy effect to the side of the roof. The windows are exceedingly large, extending from the plate to a point as low as the elbow of a person seated. When the windows are open the car is to all intents and purposes an open car, while the sides of the car, coming up nearly to the back of the seats makes it much safer for passengers than the car with the side openings. The lower or concave panel is put on in a single piece strapped in an unusually thorough

manner, and is reinforced upon the inside by what is known in steam railroad practice as a truss plank, which is screwed to every post and also to the sill. This plank, together with the inside finish which is carried up to the level of the window rail, adds greatly to the stiffness and strength of the car.

Owing to the fact that the Dry Dock line runs through the most densely crowded streets of New York City, where blocking is a daily occurrence and the rule rather than the exception, it is found that smashed panels are a heavy item in the repair bills. In designing the new car a departure from the ordinary practice was adopted, which it is thought will prove a great economy. It consists in making each individual panel of the upper belt separate, putting it on from the outside and covering the joint with the moulding. The panels are scrimmed, painted and varnished, and after they are put in, pieces of scrims are glued over the strainers on to the panel and from the panel upon the posts, thus giving all the advantage which the scrims can impart. Spare panels are kept in stock, so that a repair which ordinarily would have been the work of a couple of days can be accomplished in a couple of hours. The very large windows, which are two-thirds the height of the car, are divided in such a way that the meeting rail is above the head of the seated passenger and below the line of sight of the passenger standing. This arrangement gives a perfectly clear outlook for all the passengers whether the car be open or closed.

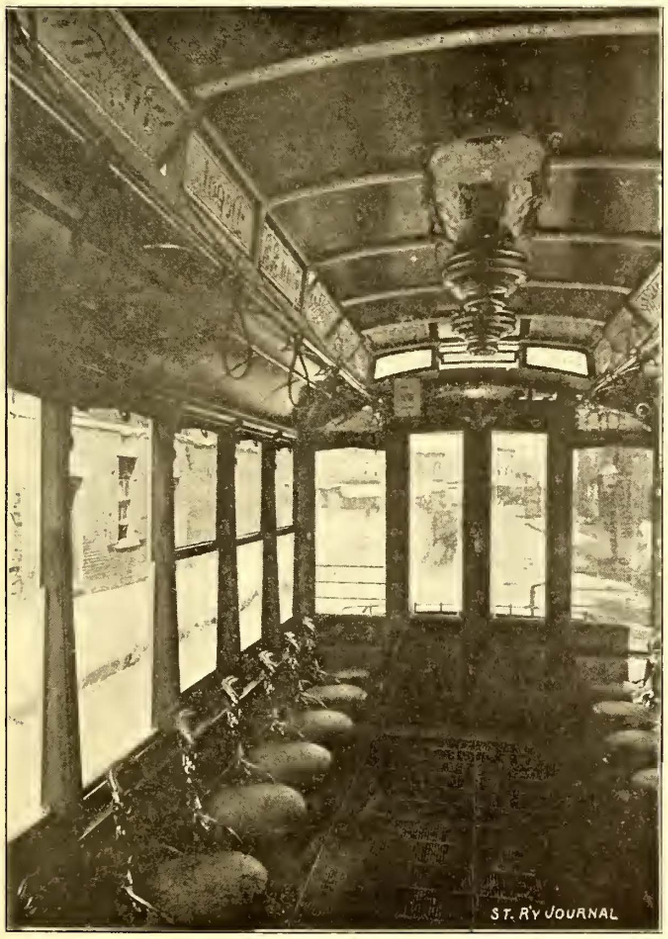


FIG. 1.—A NEW COMBINATION CAR—INTERIOR.

It would be somewhat difficult to show the detail by which the two sashes are put in place and successfully dropped below the level of the window rail. The lower sash carries the parting strip, and a long spring with a double curve serves not only to hold both sashes in their proper place when closed, but to guide the upper sash in lowering. The movement in opening and closing the windows is practically the same as that of opening and closing an ordinary street car single window and can be done in an equally short space of time. In case of storm the open car can be transformed into one which is perfectly closed in as short a time as is necessary to close an equal number of windows, perhaps less, on account of the smaller size of the individual sash.

FIG. 2.—A NEW COMBINATION CAR—EXTERIOR.

The door is of a peculiar pattern. It is a single handle, double door, and by the adoption of the handle, which stands on the center line of the door when closed, a four inch wider opening has been obtained than was possible with the ordinary pattern.

The car itself is built of unusually heavy timbers. This was done in view of the fact that the company is considering the feasibility of a change in motive power and it was deemed advisable to make the cars sufficiently strong to stand the more severe service which a power driven car receives. In carrying out this idea the car is mounted upon a truck. The truck is simply a horse car truck, but is so constructed as to be easily replaced or converted. Each wheel has a double guard. These are pieces of steel carried by steel springs an inch or two in front and behind each wheel. Any obstruction falling upon the track is caught by them and at the same moment they are driven down upon the track and against the wheel in such a way that it would seem to be impossible for the wheel to go over the object. This has been experimented with for some time and so far with perfect satisfaction.

The inside of the car is very neatly fitted up. New Haven registers are used and both registers and signal bells are worked by a rod passing through the rod which carries the straps. At each bracket is a small hand wheel of star shape. A turn of this works the register. On the opposite side the rod works the bells, a turn in one direction manipulating the bell on one platform and in the opposite direction the bell on the other platform. These bells are different in pitch, a refinement which is useful as well as pleasant. The brackets for holding the rods are of a very neat design. They are considerably longer than usual in order to make up for the increased width in the monitor roof. Ventilators are worked by a lever passing through the brackets, but entirely out of the way. Here, the end lights of the monitor top are closed, thus preventing the annoying drip of water upon passengers during windy, rainy weather, which is always found where the end and corner sash are opened all the way into the corner. There is an invisible ventilator above each door just below the mirror on the inside and the bonnet on the outside.

There are not a few novel and unique articles of inner equipment used in this car, among which may be mentioned Clark's sanitary hand straps, consisting of small manilla rope carrying a wooden handle for use of the standing passenger. This is certainly much easier on the hand than the usual strap. Another feature of the car is its brilliant lighting at night, this being accomplished by two thirty-five candle power Howard oil burners, in which the flame is practically a ball of light, and which throws a beautiful soft light to every part of the car. Steel mats are used in the car. Patents on all the principal features of the car have been applied for.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

The Effect of Surface Railroads Upon Land Damage Suits Brought Against Elevated Railroads in New York.

By a long course of judicial decisions, starting with the famous case of Story v. The Elevated Railroad, the courts in New York have maintained the right of an abutting property owner to bring an action in equity asking for an injunction against the maintenance and operation of an elevated railroad in front of his premises. They have at the same time held that public convenience prevents an injunction issuing from a court of equity, and therefore they have decreed that the damage suffered by the property owner shall be determined by the court and a decree entered granting the injunction issue unless that amount be paid for a deed of the easements.

In arriving at the damage it has been necessary to ascertain the value of the easements of "light, air and access" which have been taken, and the method of proving these has been to offer evidence of what the property is worth as it stands with the elevated structure in front of it and the trains running upon it, and then evidence of what the property would be worth without the road. In other words, what the property would be worth if the injunction order could be carried out, and the difference between this and the present value of the property is what is called "fee damage."

A vast amount of evidence has been presented on these two issues. Upon the first issue, i. e., the value of property with the road, the proof was simple and an estimate involved but little guess work, but to determine what the property would be worth without the road has been a problem which has puzzled the courts, lawyers and experts. In the well settled parts of the city, where the property involved in most of the actions is situated, and where, during the past sixteen or seventeen years, the property has not experienced any great or revolutionary change of conditions owing to the growth of the city, it was, manifestly, a very natural thing, and a very proper thing, to note the value of the property before the road was built, and if there had been a decrease since, as in most cases there was, it was manifestly due to the road, if neighboring property had not decreased in value.

In other words, the court could, in estimating what the value of the property to-day would be with the road taken away, consider evidence showing what it was at a time when all other conditions were similar, except the presence of the road.

But in a district, such as the West Side, for instance, between 59th and 110th Streets, where the land, prior to the building of the road, was altogether unoccupied, and where the streets were barely laid out, the introduction of evidence of the value of the property sixteen or seventeen years ago, did not give to the court any very valuable evidence of what the value of the property would be to-day if the road were taken down.

Strange to say, the counsel for the plaintiffs did not seem to realize this fact, but continued to introduce the evidence of these former values solely, and relied on the unequal growth of the section and the fact that benefits conferred by the road were greater to the property owners whose premises did not abut upon the road than those whose property did. This theory of trying the plaintiff's cases resulted in the dismissal of nearly all cases brought above Seventy-second Street and very many below that point.

But about eighteen months ago the cable road began to run beneath the elevated from 110th Street to 53d Street and so down Broadway to the Battery, passing by nine-tenths of all the theatres in the city, bisecting the shopping district and furnishing a far more comfortable and convenient means of access than the elevated road furnished—certainly to all points above Fourteenth Street and to many points below. Even in time the cable excels the elevated for many persons, especially those who walk any distance to an elevated station.

Seven or eight different lines of horse cars have been run through the section, so that to-day, however much the West Side may have been benefited in the past by the elevated road, it has become, and is becoming, month by month, less beneficial, while the physical damage imposed by it upon abutting property owners is greater with the running of express trains through to Harlem, which now is the great feeder of the road.

With the change in the motive power on the Eighth Avenue and Boulevard lines which is now assured, and the probable change of motive power on Tenth Avenue, still further means will be offered to this section which will derive less benefit from the elevated road, because its inhabitants will rely less upon it.

Many of the leading stores downtown now have very large and commodious branch stores above Seventy-second Street, and those who formerly relied upon the elevated road in order to do shopping find it no longer useful. It is probably true that the men who live on the West Side and who do business above Fourteenth Street, and the entire female population of the West Side use the cable road exclusively.

These facts are partly evidenced by the receipts of the cable road and by the decrease in the receipts of the elevated. The second month the cable road ran, January, 1895, showed a falling off of 116,000 passengers in three stations on the Ninth Avenue line of the elevated road, Seventy-second, Eighty-first and Ninety-fourth Streets.

In a case just decided by the Appellate Division of the Supreme Court, the fact of the existence of the street car lines and of the cable road, together with the proof of the physical annoyance and damage conferred by the elevated upon an abutting property owner, is held to be sufficient to support a judgment in favor of the plaintiff for damages alternative to an injunction against the road, and this too although the court in the same opinion acknowledges the benefit conferred in the past upon property by the elevated.

To put the whole matter in a single sentence, we may say this: that, according to this decision of the court, an elevated railroad may greatly benefit property during a period of years by building up a suburban section of the city, but when new means of rapid transit are introduced and when that section becomes partially independent or relies upon other and more convenient means of transit, it may cease to be beneficial and be wholly detrimental.

In the particular case referred to the court decided that a decree of the court below dismissing the complaint must be reversed. When we add that the plaintiff's property was situated at Ninety-eighth Street and Ninth Avenue, the importance of the decision can be easily seen.

It is not too much to say that in this way electric, cable and even horse cars, introduced into a section after it has been built up by an elevated road, may prove detrimental to it not only by decreasing its receipts, but in an even greater degree by causing the expenditure of large sums in defending land damage suits, unless it has previously taken the proper proceedings at law to condemn the easements taken. Manifestly, if the road had condemned

*Communications relating to this department may be addressed to the editors, No. 32 Nassau Street, New York.

the property before it built its structure, or within five years thereafter, it would have acquired the easements along the line from Fifty-ninth Street north for a nominal sum, compared to that which they will now have to pay if the case referred to is sustained, and if the plaintiff's actions are prosecuted with vigor. H.

(*For reviews of legal publications see page 391.*)

LIABILITY FOR NEGLIGENCE.

NEW YORK.—A driver of a wagon, in attempting to cross a cable track while a car was 150 ft. distant is not, in law, guilty of contributory negligence because a collision results through failure of the gripman to make any effort to moderate the speed of the car.—(McDonald v. Third Ave R. Co., 37 N. Y. Supp. 639.)

PENNSYLVANIA.—In an action for injuries to a child, caused by a street car, where there is testimony that the motorman at the time of the accident, because he was looking in another direction, at persons assembled at the side of the street, failed to see plaintiff and there is no question of contributory negligence, the case cannot be withdrawn from the jury.—(Harkins v. Pittsburgh, A. & M. Traction Co., 33 At. Rep. 1045.)

PENNSYLVANIA.—Failure on the part of a street car driver to comply with an ordinance requiring him to give way to the car of another company at a crossing is not necessarily negligence per se, but is merely evidence of negligence.—(Connor v. Electric Traction Co., 34 At. Rep. 238.)

MASSACHUSETTS.—In an action against an electric street railway for negligence it appeared that deceased was killed while attempting to cross defendant's tracks, an instruction that, when the motorman saw deceased was proceeding as though to cross the tracks it would be his duty, so far as he was able, to reduce the speed of his car and stop the same before reaching the point where deceased was crossing, was properly refused.—(Galbraith v. West End St. Ry., 43 N. E. Rep. 501.)

ALABAMA.—Where two wires, maintained concurrently by different parties, are so related to each other and so erected that one is likely to fall across the other and produce destructive consequences, and this danger is within the concurrent common knowledge of both parties, it is the common duty of both to abate the dangerous condition; and failing to do so, both are liable for resultant accidents.

Plaintiff's allegations that defendant railroad company was negligent in failing to protect the trolley wire and in suffering the telephone wire to remain where it had fallen, are not denied by pleas of authority to construct and operate its road; that defendant had no connection with the telephone company, and that the wire fell without any fault of defendant.—(McKay v. Southern Bell Telephone & Telegraph Co., 19 South. Rep. 695.)

NEW YORK.—In an action for personal injuries, after plaintiff has proved that the accident was caused by a sudden movement of a car from which she was alighting, it is incumbent on defendant to prove that it was not responsible for the happening of that movement.

Where a car has stopped for the purpose of permitting its passengers to alight, and is standing perfectly still, it is not negligence, as a matter of law, for a person to step off it, without retaining hold of supports.—(Martin v. 2d Ave. R. Co., 38 N. Y. Supp. 220).

NEW YORK.—Where defendant's trolley car was 150 yds. from a street crossing when the wagon in which plaintiff's intestate was riding, as the driver's guest, reached the track, and the driver drove across at a walk, the car striking the vehicle before it had cleared the track, throwing out and killing intestate, the question of defendant's liability was for the jury.

A street car has no paramount right of way at street crossings.—(Zimmerman v. Union Ry. Co., 38 N. Y. Supp. 362).

NEW YORK.—Where plaintiff, at the time of being injured by a collision with a street car, was riding in a cab driven by her son, who had his own horses, and she was riding gratuitously, in the absence of evidence that she had the right to control the movements of her son as driver, he would not be her agent, so as to charge her with contributory negligence on account of his want of care.—(Weldon v. 3d Ave. R. Co., 38 N. Y. Supp. 206).

VIRGINIA.—An electric street railway is not required to have in use the latest improvements devised to prevent collision with vehicles and pedestrians, but only to use reasonable care to avail itself of new inventions and improvements known to it.

Where, in an action against an electric street railway company for personal injuries received in a collision, defendant is, as a matter of law, guilty of negligence, an erroneous instruction that the failure of defendant to use a certain kind of machinery was negligence, if the accident could have been averted thereby, was not prejudicial

In an action for personal injuries a verdict for $1000 will not be set aside, the evidence showing that plaintiff received a severe cut upon the head, necessitating attendance from a physician for two weeks and injuries to his legs, rendering him unable to work at his trade efficiently for six or eight months.—(Richmond Ry. & El. Co. v. Garthright, 24. S. E. Rep. 267).

NEW JERSEY.—A person traveling with a horse and a vehicle on a street traversed by electric trolley cars has the right to make use of the tracks upon which such cars are propelled, whenever the necessary and customary use of the street requires or permits him to do so; and it is not, per se, contributory negligence for him to turn off one track into and upon the other track in a street to allow a car to pass, when while so doing, or while he is endeavoring to turn back again, he is struck by a car running upon the other track. The fact that he turns to the left to allow the car to pass is not, of itself, contributory negligence.—(State (Con. Tr. Co. Pros.) v. Reeves, 34 At. Rep. 128).

PENNSYLVANIA.—In an action against a street railway company, it appeared that snow thrown from the tracks and sidewalk rendered the street on both sides of defendant's double tracks impassable; that plaintiff, driving west on the west bound track, on signal from a car in the rear, turned, after he had gone a short distance, to the east bound track, on which no car was in sight; that, being prevented from turning to the west track again after the car had passed by teams following it, he drove slowly along, waiting an opportunity to turn to the west track, and had thus driven about three-fourths of block when a car on the east track, running about twenty miles an hour, ran into him, though the motorman, who could see plaintiff, endeavored to stop the car. *Held*, that defendant's negligence in running the car at a dangerous rate of speed was the poximate cause of the injuries.

The facts above recited did not show contributory negligence. Mitchell, J., dissenting.—(Harper v. Phil. Tr. Co., 34 At. Rep. 356.

MASSACHUSETTS.—An injury to a passenger in stepping off a moving street car, after it has passed a point at which the conductor had stated it would stop, cannot be considered the natural or proximate consequences of the failure to stop, and, if a contract to stop can be implied, damages for the personal injury cannot be recovered in an action for its breach.

Neither can such damages be recovered on a count for tort, it appearing that plaintiff voluntarily stepped off the car, having frequently done so before without injury.—(White v. West End St. R. Co., 43 N. E. Rep. 298.)

ARKANSAS.—In an action for the value of a horse killed by an electric car, the evidence was that plaintiff's driver was accustomed to tie the horse to the dashboard of the wagon, by tightening the reins; that on the night in question, it was tied in the usual way at the depot; that, while the driver was at the train, the horse strayed off, and went on the street railroad track. *Held*, that the question of contributory negligence was for the jury.—(Johnson v. Stewart, 34 S. W. Rep. 889.)

VIRGINIA.—A street car company, using electricity, is bound to employ the best mechanical contrivances and inventions; and evidence that a particular trolley wire has been the subject of frequently recurring accidents is admissible, as showing that the company had notice of its unsafe condition.

Under the married woman's act, the husband is still entitled to the services of his wife, and the wife is still entitled to support at the hands of her husband, and therefore, in a suit by the wife for personal injuries, she cannot recover for loss of time, or the pecuniary expenses incurred.—(Richmond Ry. & El. Co. v. Bowles, 24 S. E. Rep. 388.)

CHARTER, FRANCHISES, ORDINANCES, ETC.

MICHIGAN.—Abutting property owners may require that a street railway be built in the center of the street, if possible, as required by the ordinance granting the company permission to lay its tracks upon the street.—(Kennedy v. Detroit Ry., 66 N. W. Rep. 495.)

NEW JERSEY.—An ordinance prohibiting the placing of salt of any kind on any street railway track or other part of the street within a city, except on curves of railways leading from one street into another running at right angles therewith, is a reasonable regulation for the common use of the street for a street railway and for ordinary travel.

A street railway company formed by the consolidation of two lines, constructed under separate charters, takes the rights and franchises thus acquired subject to the original conditions and limitations.—(State (Con. Tr. Co. Pros.) v. City of Elizabeth, 34 At. Rep. 146.)

LOUISIANA.—The respondent having acquired from the city of New Orleans a franchise entitling it to construct, operate and maintain a line of street railway through certain designated streets of the city, the adjudication which contained the stipulation that all the streets through which its tracks are laid shall be maintained in first-class order between the tracks and two feet on each side of said tracks, *held*, that this covenant does not impose the additional duty of elevating the entire surface of the street on either side of its track, to the height of its roadbed.—(State ex rel. City of New Orleans v. New Orleans Traction Co., 19 South Rep. 565.)

ASSAULT ON PASSENGER.

KENTUCKY.—In an action against a street railway company for personal injuries, plaintiff is entitled to recover if, while on defendant's car as a passenger, he was abused by defendant's conductor, and if the abuse was continued to the sidewalk, and plaintiff was knocked down by the conductor, unless the jury believe that plaintiff was the aggressor, and while on the car abused the conductor, or assaulted him either on or off the car, and if more force was used by the conductor than was necessary, the company is not responsible if plaintiff was the aggressor.

Instructions denying plaintiff the right to recover if he used improper language, without regard to the provocation, if any, causing it, were erroneous.—(Wise v. South Covington & C. Ry. Co., 34 S. W. Rep. 894.)

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

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.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

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THE 1896 edition of our Financial Supplement, "American Street Railway Investments," a publication which has come to be commonly referred to as "The Street Railway Red Book," is now ready for delivery and comes this year with the stamp of official authority hardly less pronounced in its own field than that of the Government blue books in theirs. In this manual are given the financial reports of no less than 927 operating companies, 185 leased companies and 307 new corporations, together with municipal statistics of the principal cities and towns in the United States and Canada. The latter have been revised and brought up to date by the officials of the various cities, while in the matter of authoritative reports on the street railway properties we have met with a measure of success unprecedented, we think, in any financial publication of the kind. Direct information has been received by us for use in the "Red Book" from 867 street railway companies, of whom 733 have revised and "approved" the final proofs sent out to them on the eve of publication. Of the remaining 245 companies (exclusive of new corporations) from whom direct information has not been received, 150 reports have been made up from official sources, and authentic information has been obtained for many of the others either by personal correspondence with local parties or otherwise, while in all cases opportunity has been afforded to each road to correct any errors in their reports. From another point of view the showing is remarkable. Of the 1,444 reports presented, 988 have been corrected up to some month in 1896 (chiefly April and May), 305 have been corrected up to the last half of 1895, while only 151 bear a "date of information" prior to June 30, 1895.

* * * *

We confess to a feeling of satisfaction at the results of our work and influence in this financial field during the last three years. It is not alone what we ourselves have done in the way of bringing out a manual which is now an accepted standard among bankers, brokers and street railway companies, although this is perhaps a subject for just pride. But we have forced the old and conservative financial organs which have been disposed to look with contempt upon securities other than those of steam railroads, municipalities and "industrials," to recognize the tremendous importance and value of this local transportation industry, and to devote a far larger and now constantly growing space to street railway securities. In other words, the market for these securities is infinitely broader than was the case three years ago, and it is now possible for their holders to dispose of street railway stocks and bonds far more easily and at higher prices than could ever before be done. Distrust and suspicion have given place to a tendency even to overestimate the value of street railways as investments. This revulsion of feeling has been brought about, as we predicted would be the case, by simply throwing open the doors to investigation and by furnishing information freely rather than by holding it back jealously. We were criticised occasionally two or three years ago for advising street railway companies to publish without reserve their financial and operating reports, but we judge from the figures given above that the wisdom of this course is now fully and heartily appreciated by our friends.

MEMBERS of the American Street Railway Association must not forget that they have an important decision to make at the St. Louis meeting. At the Montreal meeting the Executive Committee recommended the adoption of a new constitution and by-laws which involve a number of radical changes in the plan of the association, and under the rules, consideration of the recommendations was deferred until the St. Louis meeting. The general object sought for in the proposed changes is the ability to carry on a much larger and more useful work, chiefly through the secretary's office, and a necessary feature is an acceptable scheme for raising a larger amount of money each year. The plan proposed is a combination of initiation fees and annual dues, based to a certain extent upon gross receipts. This constitution (which is given in full in the STREET RAILWAY JOURNAL for November, 1895, pages 718 and 719) should be carefully studied by every member of the association, and its delegates should be instructed as to suggested changes and as to the vote to be cast on the final question of adoption or rejection. Otherwise, many delegates will doubtless say at St. Louis, as they said in Montreal, that they are not empowered to commit their

companies to any plan of membership involving larger expense than at present. We will gladly open our columns to the discussion of the various problems raised by this proposed new constitution and by-laws in order that the atmosphere may be cleared and a general understanding of the question obtained by all interested.

* * * *

There is a duty which the officers of the association ought to perform at St. Louis, and that is to make up a list of committees for the following year in such a way as to get upon each committee the men who are best fitted to follow out the special lines of investigation proposed. There are a thousand problems, light upon which is wanted by the members and which can best be handled through committee work during the year. One of the most important of these is the question of devising some system of standard accounts which shall do for the street railways of the country what has been done by the Interstate Commerce Commission for the steam railroads. This should be made up by the best expert accountants known to the association, and it has even been suggested that it would be well to establish a Board of Accountants similar to that which has recently met in Albany to advise with the Railroad Commissioners, to which might be referred all those perplexing questions of accounts which a street railway manager has often to solve by himself without help from outside authorities. Another field for profitable study is that of the proper handling of accident claims—now so large a feature of the annual expense account of electric and cable railways. Not a few roads—notably the Twin City Rapid Transit Company, of Minneapolis, a discussion of whose accident system is found in another column—have been able to greatly reduce this burden of "contingencies" by the adoption of life saving devices and by skill and quickness of action in their legal departments.

THE folly of seeking franchises at any cost and the constantly increasing greed of municipalities are being exemplified in the daily history of the times. One peculiar case has recently come to our notice and serves as an illustration of what not to do. Some time ago two rival syndicates sought electric railway franchises in Peekskill, N. Y., a town of 12,000 inhabitants. The corporation counsel drew what is described "as a very strong franchise," undoubtedly thinking that he was carefully protecting the interests of the town. The competition between the two syndicates was such that this franchise was accepted by one and $10,000 was deposited as an evidence of good faith. The successful (?) company did some preliminary work and then discovered that the franchise had been accepted too hastily. Some of its provisions were such that it was found impossible to build the road so as to make any money. "It was universally conceded that no other franchise had ever been drawn so carefully." The enlightened Board of Trustees of the town listened to the representations of the capitalists who were trying to do the town a service, but refused to make any modifications in the franchise, preferring instead to quietly pocket the $10,000 deposit and do without a road which the citizens had voted for by an overwhelming majority. Consequently they will doubtless use the money to put up a new fire engine house or to add a wing to their town hall and will consider that they have done a sharp and shrewd thing, but we imagine that capitalists will in future fight shy of any dealings with the honorable Board of Trustees of Peekskill.

IF street railway directors are wise, conservative and far sighted they will refuse to distribute to their stockholders, whose interests they have to guard, the entire annual surplus earnings arising from the operation of their roads, but will put by into surplus or reserve account a sufficient proportion to provide against depreciation of plant and contingencies. The manager who has a fund of this kind securely invested—perhaps in the company's own bonds, bought back for the surplus fund at market prices—has far less need to look with fear and trembling upon the future than he who has, perhaps, pleased his stockholders with large dividends for the first few years of electric operation only to find later on that he must go before them and confess that large sums of money must be raised to replace worn out or defective roadbed. A few of our managers are realizing the necessity for a reserve fund, and in one case which has recently come to our notice the directors of a large street railway corporation have cut down a rate of dividend which has been paid for several years in the face of but slightly varying net earnings, simply because it was felt that the time would come when a large "nest egg" would be necessary in order to properly keep up the plant. We fear, however, that far too large a proportion of our companies are running close to the wind and are trusting too much to an increase in business to take care of the future. The temptation is sometimes great—particularly when there is any thought of disposing of a property to other interests, or when leading stockholders have their private interests to serve—to pay as large dividends as the money in the treasury will permit. Where this is done, however, the permanent value of the property almost inevitably diminishes and a company is easily thrown into trouble by such ordinary vicissitudes of its operating life as ought to be met with the greatest ease.

A MOTORMAN is a human being—in spite of the newspapers—and is subject, we presume, to the various failings, as well as provided with the virtues found in our common humanity. We doubt if he is unusually cruel in instinct, brutal in behavior or careless of human life. Even his enemies of the press represent him to be "all unnerved" and "shaking like a reed" after an accident. He often says to his friends that he "can't stand it no longer, boys" and that he has "got to quit the job." Why then, may it be asked, is it so difficult to avoid accidents not only in crowded streets, but even in comparatively small cities and towns? We wish that in some way a spirit of justice towards street railway corporations and their employes could be infused into our city councils, our magistrates and our citizens so that they could realize how often only the utmost skill, quickness and bravery on the part of a motorman saves school boys from a horrible death—how keenly school house neighborhoods are dreaded by the motorman. In almost any of our large cities, and particularly in Brooklyn where the fatalities to children have been pitifully large, the spectacle of one or more boys dancing tantalizingly in front of a moving motor car is one, not occasional, but most common. The idea of the boy is to make the motorman stop or at least to check his car,

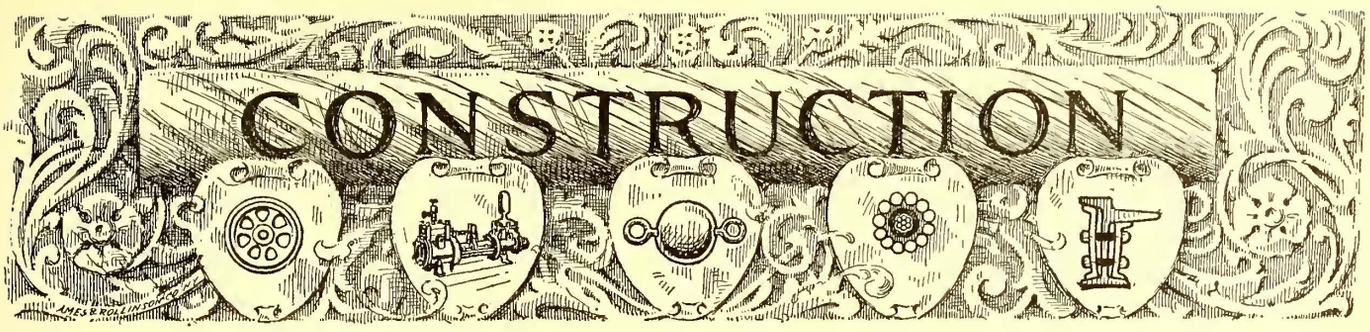
and in order to accomplish this he will stand on the track at times until the car is within two feet or less, when with a shout of glee he will jump aside and jeer at the motorman—or else miscalculate the jump and fall to death. What wonder is it that the motorman's nerves are all unstrung and that he sometimes takes chances of an accident, particularly when he is behind time and knows the value of an instant's delay. He is perfectly helpless. He cannot punish the offenders in any way, and at the least attempt to interfere with the boys' sport by physical force, he is haled before a magistrate by an indignant parent, or the demand is made of the company that he be discharged. What can be done to remedy such ingenuity of torment—to prevent such fearful danger in sport? It is hard to say, but it seems to us that one principle underlying a possible remedy would be to place in the hands of the motorman some reserve power to keep mischievous boys off the track within a certain distance ahead of the car, and that the right to use such power should be granted to a railroad company by the municipal authorities upon the strong representation of the need for such action in the protection of life. To use a homely illustration of what we mean, which will serve, perhaps, as a suggestion to skillful inventors, suppose the motorman should be provided with a "squirt gun," throwing—perhaps by compressed air, particularly if air brakes are used—a small stream of water to a distance of eight or ten feet ahead of the car. The boys would soon learn to keep away from the cars under penalty of a slight wetting. Something certainly ought to be done in this general direction. It is monstrous to mulct a railway company in heavy damages for accidents utterly impossible to avoid and due to the willful impishness of children. We will gladly print any practical suggestions looking to a cure for this evil.

Rapid Transit Plans in New York.

The proposed rapid transit line in New York City received a decided set back last month through a decision of the Appellate Division of the Supreme Court of the State, to which was referred the question of right of way along the route in default of the consent of the abutting property owners. As will be remembered, the city was authorized eighteen months ago by a vote of the citizens, taken in accordance with a preceding act of the legislature, to issue bonds to the amount of $50,000,000, and to commence and complete the construction of the road. In case the consent of the abutting property owners for a right of way could not be secured, the Supreme Court could give the necessary permit. The commissioners appointed by the latter decided in favor of construction, but this permission was reversed by the Court in the decision referred to. The opinion handed down, in which all the judges concurred, carefully reviewed the situation, and the right to construct the road, on the plans laid out, was denied mainly because, in the opinion of the Court, the road could not be built and all contingent liabilities met for the sum mentioned. According to the Constitution, the city cannot be bonded to an amount greater than ten per cent of its assessed valuation, and with the proposed issue, the debt limit would practically be reached, making the issue of more bonds for the completion of the road or for other city improvements impossible. The Court held that while the engineers' estimates were that the road, as laid out, could be completed for the sum voted, estimates of this kind are always too low, and the chances are that after that amount of money has been spent, and the property owners along the road have been subjected to great inconvenience, the work will have to be abandoned. The immediate outcome of this decision (from which no appeal is possible) is to stop, for the present in any event, all preliminary work on an independent rapid transit system. The future policy of the Rapid Transit Commission has not been outlined, but it is possible that a new system, comprising either a viaduct or deep tunnel route must be decided upon, if a rapid transit railway is to be built. In the meantime, to accommodate the urgent calls for better transit, it seems inevitable that rights be granted to the elevated railway system to make the crosstown connections and the extensions it has been anxious to build on the west side and along the western water front. The needs of the city in the way of rapid transit are constantly being intensified by the growth toward the north, and it seems impossible that any development of the elevated railway system along its present lines would fulfill the requirements for any length of time. While inadequate for a rapid transit service, the proposed elevated extensions will greatly benefit the city and will not interfere in any way with true rapid transit, as with the growth of the city there should be plenty of room for both systems.

It is an interesting commentary upon American methods of government that the execution of a project authorized by the legislature and executive, approved by popular vote and endorsed by leading citizens and engineers should have been prevented by the Judiciary for economic reasons alone. The fact, of which we have had other examples, that we have a Judiciary capable of deciding questions of expediency in opposition to the expressed wishes of a majority of the people interested, is an important one and constitutes one of the principal safeguards possessed against hasty legislation, and speculative schemes in defiance of the rights of the minority.

Another interesting feature of the decision was the statement made that the city has no business to engage in an enterprise of this kind the outcome of which is doubtful. If it could have been proven that the road could have been completed for the original estimate, and that the return to the city for its investment would have been certain and remunerative, a different conclusion might have been reached. But in any engineering enterprise, both first cost and future income are uncertain, and it is this factor which capitalists accept when undertaking a project. The risk of losing part or all of their investment, or of securing an inadequate return upon it are among the risks which they have to accept. If an enterprise should prove a failure, no one will recompense them, but if successful a demand will be made, especially if the enterprise is quasi public in character, that the public should share the benefits. In no branch of business is this probably more true than in street railways. Street railway enterprises probably return an exceedingly small percentage of profit upon the total capital invested, but where the undertaking happens to be a paying one, the municipalities, forgetting the many unprofitable lines and the chances taken by the original investors, demand that their profits should be reduced to the plane of investments where there is no risk of either capital or interest.



The Correct Location of the Trolley Wire on Curves.

By S. L. Foster.

The trolley wire is not located directly over the center of the track on curves, but inside the center line in order to reduce to a minimum the friction between the trolley wheel and the wire. Just why this is done and how to ascertain the best location has not been as clearly understood by constructors of roads as it should be, and has led to wear on wheel and wire that might have been avoided. The exact location depends on the radius of curvature of the rail curve, the wheel base of the car, the height of the trolley wire above the level of the rail, the height of bottom of the trolley pole above the rail and the length of the trolley pole.

In Fig. 2, intentionally drawn on an exaggerated scale for the purpose of illustration, A B C represents a portion of a plain curve along the center line of the track, points D and G the centers of motion of the car. These points in a double truck car are the centers of the trucks and in a single truck car the centers of the axles. F is the center of the car—the location of the trolley base—E F the projection of the trolley pole on the plane in which the trolley curve lies, I F the trolley pole projection when the wire is located at the center of the track, showing how the wear takes place between wheel and wire on account of the wire lying diagonally in the wheel. M F is the trolley pole projection when the wire is properly located. M F is seen to be a true tangent to the curve, X Y W, the curve of proper location of trolley wire, when the wheel can pass without causing any friction other than that of rolling. M K represents the distance inside the center of the track the wire should be located for least friction. R is the radius of the track curve, R^1 radius of correctly located trolley curve at the middle of the curve.

In triangle O F G $OF = \sqrt{\overline{OG^2} - \overline{FG^2}}$ or calling D G D and F G $\frac{D}{2}$

$$OF = \sqrt{R^2 - \left(\frac{D}{2}\right)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

In triangle O F M $OM = \sqrt{\overline{OF^2} - \overline{MF^2}}$ or calling M F, the projection of the trolley pole, P and substituting form (1) the value of O F

$$R^1 = \sqrt{R^2 - \left(\frac{D}{2}\right)^2 - P^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$MK = R - R^1 = R - \sqrt{R^2 - \left(\frac{D}{2}\right)^2 - P^2} \quad \ldots\ldots (3)$$

What is meant by and how to ascertain the length of the projection of the trolley pole, P, is shown by Fig. 2.

Evidently $P = \sqrt{L^2 - H^2}$ . . . . . (4)

Substituting in (3) this value of P

$$MK = R - \sqrt{R^2 - \left(\frac{D}{2}\right)^2 - L^2 + H^2} \quad \ldots\ldots\ldots (5)$$

Now if a system of trolley roads has been laid out so that the height of the trolley wire is the same on all curves, and cars of the same wheel base are always used, the part of equation (5) $\left[\left(\frac{D}{2}\right)^2 + L^2 - H^2\right]$ is always the same and may be expressed

$$K = \left[\left(\frac{D}{2}\right)^2 + L^2 - H^2\right] \quad \ldots\ldots\ldots (6)$$

and we get for our final equation

$$MK = R - \sqrt{R^2 - K} \quad \ldots\ldots\ldots\ldots (7)$$

All measurements have been in feet. To get results in inches the formula should be

$$MK = 12\,[R - \sqrt{R^2 - K}] \quad \ldots\ldots\ldots (8)$$

This gives the distance inside the center of the track curve that the trolley should be located for about one-third of the curve at the middle, decreasing to zero gradually both ways to the ends of the curve.

Where cars of different wheel bases are used the most economical location will depend on the relative frequency of the different cars. Take, for example, ordinary condititions in San Francisco and using (6) and (8).

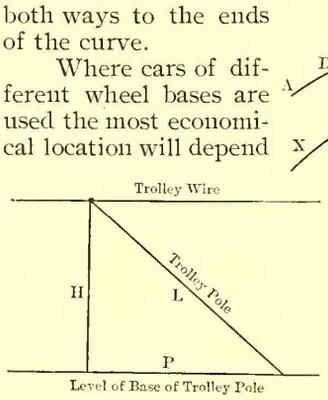


FIG. 1.

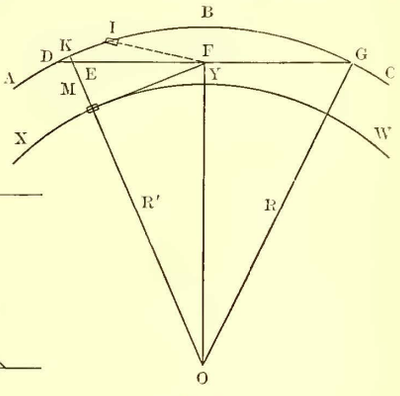


FIG. 2.

In the case of single truck cars exclusively D (wheel base) = 6.5, L (trolley pole) = 13, H (height of trolley wheel above base) = 8.583, R (radius of rail curve) = 60.

Then by (6) $K = \left[\left(\frac{6.5}{2}\right)^2 + \overline{13^2} - \overline{8.583^2}\right] = 105.894$

Then by (8) M K, $= 12[60 - \sqrt{\overline{60^2} - 105.894} = 10.68$ or $10\frac{5}{8}$ ins.

In the case of double truck cars exclusively D = 22 L = 13, H = 8.583, R = 60.

Then by (6) K = 216.332, M K = 21.972 or $21\frac{15}{16}$ ins.

If the double truck cars are run as regulars and the single trucks only as extras the best location for the trolley wire would be 22 ins. inside. If the reverse was the case, 10½ ins. would be the place for it. If the car mileage was equally divided between the two types of cars, the wire would be most economically located midway between these two points or $16\frac{5}{16}$ ins. inside.

If the trolley wire is judiciously located and abnormal speed is not permitted, there should be but little more wear on the wire on curves than on the straight track.

Great accuracy on transition curves would prescribe calculating the location of each car on a curve separately, but the engineer seldom has time for this and the work would probably prove too laborious for the average line foreman.

Light Railways in Great Britain.

By Alex. McCallum.

It is hardly possible to attach too much importance to the action of the present British Government in the matter of what are called light railways. The last Government made a futile attempt to move in the subject, but the Queen's present advisers, having the advantage of an enormous majority behind them, promise to act with more effect. The president and the secretary of the Board of Trade recently inspected the light railway systems in various countries on the continent of Europe. They returned convinced that great good might be done to the languishing industry of agriculture in England if a system of light railways similar to those in Belgium could be encouraged. In prosecution of this view the Government recently introduced a bill into Parliament to facilitate the construction of such railways. It is well within the knowledge of Americans that the great bar to the extension of railways and tramways in the less densely populated districts of England and Scotland has been the enormous expense of obtaining Parliamentary powers, and of track and signal construction under the stringent requirements of the Board of Trade. These requirements are necessary and suitable enough in the case of steam lines doing a large business, but the universality hitherto of their application has simply smothered enterprise in very many districts.

In the United States there have been no such universally applied regulations, and suburban and rural steam and electric railways of a comparatively cheap type of construction are plentiful. Efforts are now being made in certain states to extend the electric railways into the purely agricultural districts which are at present unserved. But to do this in England requires a special Act of Parliament, and hence the necessity for the present Light Railways Bill. This measure at one sweep abolishes, so far as these lines are concerned, the whole costly machinery of application to Parliament for powers to construct, and also abrogates many of the existing railway Acts relating to safety, signaling, stations, continuous brakes, etc. The heavy type of track construction hitherto compulsory will not be insisted upon. A Light Railway Commission is to be established and to it application has to be made for orders authorizing light railways. The applicants may be county or borough councils, individuals, corporations, or companies. The councils may undertake themselves to construct and work or may contract for the construction or working. They may also advance to a light railway company either by way of loan or as part of the share capital of the company any amount authorized by the order. The Treasury may also agree to make an advance to the company by lending it any sum not exceeding one quarter of the total amount required. In circumstances where the railway would not pay, but where it is found that it is for the benefit of the district and where an existing railway company will agree to construct and work the line, the Treasury may make special advances as free grants. In such cases however the land owners must give the land gratis. The total amount advanced by the Treasury is not at any time to exceed £1,000,000.

The Commissioners are only to grant an order after hearing all parties and satisfying themselves that certain reasonable requirements have been fulfilled. The order will then be submitted to the Board of Trade for confirmation, and after confirmation it has the same effect as an Act of Parliament. It can incorporate a company, give powers for construction and working, and provide for all other details. The present law as to ordinary steam railways remains unaltered. The bill applies to Scotland as well as to England, but Ireland will be dealt with under a separate measure.

While these are the bare outlines of the legislative proposal, it is interesting to note what some of the probable results will be. Details as to individual lines are, of course, at present more or less hazy, as the bill has not yet reached the committee stage in Parliament when all the pros and cons will be thrashed out. There seems to be no doubt however that these light railways will, wherever practicable, be run upon the high roads, but close in to one side. In cases where they go across country it is anticipated that the land owners will gladly give the land for nothing. Indeed it is in their interest to do so. In very many instances the carriage of agricultural produce to market and of farmers' necessities from the towns will form the greater part of the traffic. Junctions will be made with existing steam railways and probably many of the great companies will gladly undertake the working of the new lines. For this reason standard gauge ought to be adopted so as to avoid the necessity of changing cars at junctions. Nothing definite has yet been said as to the method of traction, but it is probable that on routes where only a few trains per day are required light steam locomotives will be employed, while on busier lines there ought to be a good field for electric traction with the overhead wire.

Should this bill pass into law as there is every prospect that it will, it will be interesting to see whether interurban road tramway schemes, mainly or wholly designed for passenger traffic, will be sanctioned under the bill without the necessity of special Acts of Parliament. Should this happy result be attained there ought to be a great development of electric railways running between town and town in a manner analogous to that which exists in the United States. Some competition of the kind is urgently needed to waken up the steam railway companies in many localities where the local service given to the public is of a very unsatisfactory character.

I have not the slightest doubt that whether the present bill passes in the shape it now possesses or not, some such legislation cannot be long delayed. The attention of the people of England is being thoroughly roused, not only to the great advances already made in the United States in the matter of interurban and rural communication, but also to the rapid progress of conservative European countries in the same direction. It is quite certain that they will not allow existing legislation to bar the path of progress much longer. It is equally certain that, as soon as light railways with electric traction come in the country districts, we shall find their influence at work in the towns. The reign of urban electric street railways will thus be hastened.

Experiments With Automatic Mechanical Stokers.*

By J. M. Whitham.

Stokers in General.—The recognized *advantages* of mechanical stoking are:

1. Adaptability to the burning of the cheapest grades of fuels.
2. A forty per cent labor saving in plants of 500 or more horse power when provided with coal handling machinery.
3. Economy in combustion, even under forced firing, with proper management.
4. Constancy and uniformity of furnace conditions, the fires being clean at all times, and responding to sudden demands made for power. This should result in prolonged life of boilers.
5. Smokelessness.

The *disadvantages* are:

1. High first cost, varying from $25 to $40 per square foot of grate area.
2. High cost of repairs per annum, which, with some stokers, is as much as $5 per square foot.
3. The dependence of the power plant upon the stoker engine's workings.
4. Steam cost of running the stoker engine, which is from $\frac{1}{5}$ to $\frac{2}{5}$ of 1 per cent of the steam generated. This is about $50 a year on a ten hour basis for 1000 h. p. when fuel is $2 a ton.
5. Cost of steam used for a steam blast, or for driving a fan blast, whenever either is used. This, for a steam blast, is from five to eleven per cent of the steam generated by the boilers, and from three to five per cent for a fan blast. This amounts to about $1000 a year for a steam blast, and $500 a year in fuel for a fan blast, for 1000 h. p. plant on a ten hour basis, when fuel is $2 a ton.
6. Skill required in operating the stoker. Careless management causes either loss of fuel in the ash, or loss due to poor combustion when the coal is too soon burned out on the grate, thus permitting cold air to freely pass through the ash.

*Abstract of paper presented at the St. Louis meeting (May, 1896) of the American Society of Mechanical Engineers.

7. The stoker is a machine subject to a severe service, and like any other machine, wears out and requires constant attention.

This paper is intended to show the performances of the Wilkinson stoker, and the use of steam in combustion; the operation of the Coxe stoker using a graduated fan blast, and of the Babcock & Wilcox stoker under a strong natural draft. The Coxe is designed for use with buckwheat and rice grades of anthracite coal; the Wilkinson stoker is adapted to both anthracite and bituminous coal, while the Babcock & Wilcox stoker is used only with bituminous coal.

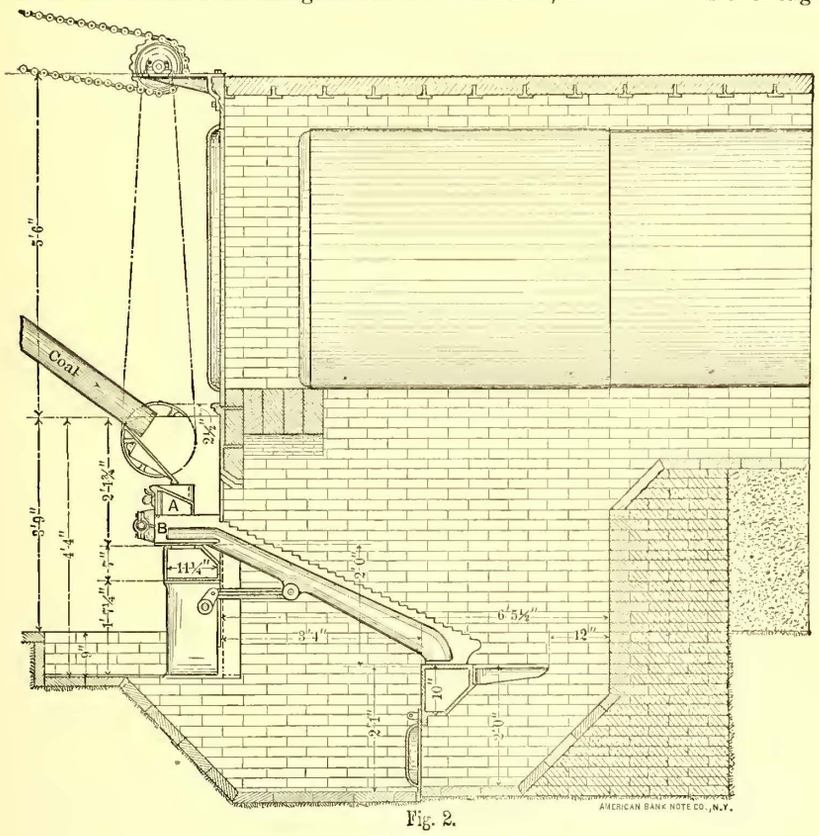


Fig. 2.

FIG. 1.—WILKINSON STOKER.

THE WILKINSON STOKER.

General Description.—This stoker is shown in longitudinal section in Fig 1. It consists of hollow bars, set at an angle of about 25 degs. with the horizontal, with open ends The top of the bars is stepped, and tuyere-shaped openings, about ¼ in. × 3 ins., are provided in each riser.

The bars are carried at their ends on hollow boxes. The lower box, or bearing bar, has finger grates, about fifteen inches long, secured to its rear face. The bars are four inch centers, so that practically the air openings are restricted to the risers, already noted. Adjacent bars move in opposite directions by a system of toggles controlled by a compound spur gearing, which is driven by the stoker engine.

The feeding is accomplished by the motion of the grates, no feed roll or pusher being required. The wedge shaped gate, shown at *A*, is removable, thus affording access to the grate when desired. A small observation door is provided near each end of the hopper, through which a slice bar may be passed to cut away any side wall deposit.

Steam jets at the open upper end of each bar force into the fire the air needed for combustion. There is one jet to each bar, having an opening of about $\frac{3}{32}$ in. (see *B*). This stoker is specially well adapted to the burning of small sizes of anthracite coal, and is also used with bituminous coal.

Stoker Trials.—Six trials of this stoker with various anthracite coals and various boilers, have their results summarized in the table on p. 371. The results are all good and indicate that this stoker is nearly as economical when working with forced as with gentle fires. The range of the rate of combustion varied from 14.8 to 45.4 lbs. of dry coal an hour per square foot of grate.

Effects of Steam on Combustion.—Steam in passing through a bed of burning coal must extinguish the fire or become decomposed. The steam, in practice, acts upon the coal as in a gas producer, and the combustion chamber is filled with burning gases. With natural draft and anthracite coal the flame is seldom longer than from eight inches to thirty-six inches, yet a steam blast will make a flame forty feet long if permitted to do so. The effect of the steam, then, is to gasify the coal. This results in a more uniform distribution of the effective heating surface of the boiler, reduces local injury, gives a more uniform expansion to the parts of the boiler, but is apt, if not properly controlled, to cause a loss of heat in the stack.

Steam prevents the formation of clinkers, thus prolonging the life of the bars and furnace linings.

Steam used by the Wilkinson Stokers.—While conducting trials 253, 254, 290, and 291 separate trials were made on an auxiliary boiler supplying the steam jets and the stoker engine. The exhaust from the stoker engine was condensed, so that the amount strictly chargeable to the jets would be known. In trial 253, when burning Lykens Valley rice coal the boiler horse power used by stoker engine was 1.42 and that by stoker jets was 73.21 making the total per cent of power developed used to operate the stoker 10.80.

In trial 254 air was suppled by a fan driven by a small slide valve engine. The air was led to the hollow posts carrying the front bearing bar or box, from whence it entered the hollow grate bars and passed into the fire. The open ends of the grate bars were closed, the steam jets being removed. Clinker formation was prevented by turning the fan engine's exhaust into the air conduit, and also by bleeding so much live steam into the bars as was necessary to protect them. Burning Lykens Valley rice coal, we found that about the same percentage of the steam generated was required when running with the fan as when using the steam blast, while this stoker can be pushed harder with the steam blast.

It is therefore evident from these and other tests that this stoker uses from 7.8 to 10.8 per cent of the total steam generated, when the boiler is driven from twelve to sixty per cent above its rating, providing the rate of combustion is from twenty to forty-five pounds of dry buckwheat an hour per square foot of grate. An inspection of the table shows that this stoker is largely independent of the natural chimney draught. A steam or fan blast develops its own furnace draught (which is that useful for combustion), and the chimney draught is useful only in carrying the gases away from the furnace. If the chimney draft is inadequate for this light duty, then the blast comes to the rescue and pushes the gases away. In this latter case there is a positive pressure in the furnace.

Summary Regarding the Wilkinson Stoker.—1. Small grades of anthracite coal pack closely upon the grate, and offer much resistance to the introduction of the air supply. They require a strong blast.

2. With the same draft, natural or otherwise, the rates of combustion and costs of small grades of anthracite coal are about as follows:

RELATIVE RATES OF COMBUSTION AND COSTS OF SMALL SIZES OF ANTHRACITE COALS.

Grade.	Size of Coal (round holes, punched plates)	Relative rates of combustion for same draft.	RELATIVE COSTS.	
			At Mine.	On Cars, Philadelphia.
Pea	Through ⅞ in. and over $\frac{9}{16}$ in.	100	100	100
Buckwheat.	" $\frac{9}{16}$ " " $\frac{5}{8}$	85	57	72
Rice	" $\frac{5}{8}$ " " $\frac{3}{16}$	70	37	61

3. A steam blast, in general, will use from five to eleven per cent of the steam generated in the boiler. The Wilkinson stoker blast is no exception.

4. The efficiency of the Wilkinson steam blast is less than that of the other forms of steam blowers noticed in this paper; yet, for a given combustion rate, no more steam is used, because this stoker has a more perfect diffusion of the air through the fire than is possible with flat grates, and can secure a good evaporation with less air for dilution than any other system of burning coal known to the writer.

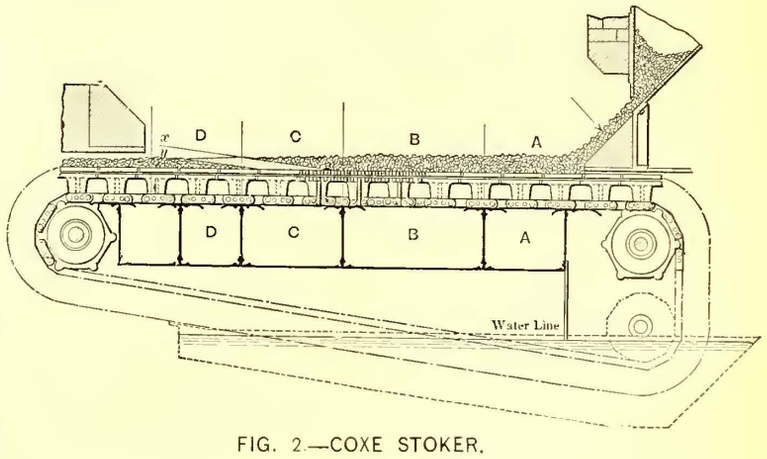


FIG. 2.—COXE STOKER.

5. Most anthracite coal of inferior sizes clinkers badly if the fire is forced. Such clinkers freeze to the sides of the furnace and to the grates. This is specially true for fan blasts. But the effect of a

steam blast is to chill the grates and non-combustible material against them, so that a clinker cannot form. The result is a prolonged life of bars and furnace linings.

6. In plants subject to extreme fluctuations in power demands, the bars of this stoker are subject to a severe service. When an intensely active combustion has been required for a time and the demand ceases, the steam jets are shut off and the fire is, as it were, banked until the demand is resumed. In this case no air or steam, practically speaking, is given to protect the bars, and the white-hot coal against them may cause damage.

THE COXE STOKER.

General Description.—Fig. 2 is a longitudinal view of this stoker. It consists of a traveling chain grate with a fire on its upper surface. The coal is fed by the motion of the grate at the front. There are four blast compartments, *A*, *B*, *C* and *D*, under the fire, connected by dampers or registers, so that the intensity of the fan blast may be varied in each compartment. Compartment *A* receives a gentle blast to ignite the coal. The ignited coal receives a heavy blast over compartment *B*, which burns out the volatile gases and partially burns the fixed carbon. Over *C* the coal is nearly burned out, while a gentle blast at *D* reduces the fuel to ash.

The trials in the table on p. 371 were in one of two double deck Babcock & Wilcox boilers, 375 h. p. each, equipped with the Coxe stokers. The general dimensions were:

Size of bed of fire	7 ft. 3 ins. × 9 ft. 6 ins.
Grate area	68.9 sq. ft.
Air openings in grate	18.8 p. c.
Air openings, width	in.

One 30-in. Sturdevant fan blower to each stoker.
One 7½ in. × 7 in., 390 r., 25 h. p. Westinghouse standard engine for two stokers and two fans.

The sides of the furnace are protected by wrought iron water backs, D shaped in cross section, along the flat of which the coal is dragged and through which water circulates under a slight pressure. On the trials the water was discharged into a tank and used as a boiler feed. The extent of the heating of the water depends upon the quantity supplied.

Trials of the Coxe Stoker.—These were conducted in accordance with the methods advised by this society, on one boiler and one stoker.

The engine horse power used to run the stoker and its fan blast varied with the manner of operating the stokers, but averaged about 10.8 h. p. This, for a Westinghouse engine 7½ ins. × 7 ins., must have called for about 20 boiler h. p. In this event, the boiler developing about 500 h. p., four per cent of the steam generated would be charged to the Coxe stoker. This is an expression of the writer's best judgment, rather than a statement of facts, as the stoker engine was not indicated until after the tests.

The table shows excellent results. Each test covers a double column, the first part referring to the boiler only and the other to the boiler and water back combined. Assuming the four per cent. charge for operation to hold, we must deduct it from the apparent results to get the net results. The results previously found with the Wilkinson stoker, trial No. 290 (next page), will now be compared with the Coxe stoker, trial No. 332, sheet No. 4, both referring to a 375 h. p. Babcock & Wilcox boiler, using P. & R. C. & I. Co.'s buckwheat coal, the boilers being run in each instance to secure best economy, i. e., to develop near their rated power. This comparison is made in the table in the next column.

This table shows that there is no practical difference between the net economic results obtained with either form of stoker, when operated so as to develop about the rated power of the boiler. The Coxe developed the greatest capacity, as seen by comparing trial 333, sheet No. 4, with trial 291, sheet No. 1, because it had much advantage in the extent of grate area.

Summary Regarding the Coxe Stoker.—1. The stoker engine and fan blast use about four per cent of the steam generated in the boilers.

2. There was no clinker formed during the trial, as the coal was what is known as "white ash." It is probable that the clinkering would not be serious with even Lykens Valley coal.

3. The fires resembled a puddling furnace. The furnace temperatures must have been nearly 2800 degs. F. over the two central blast compartments. Analyses of the flue gases proved that the combustion was good.

4. A most annoying and peculiar deposit of ash, etc., rapidly collected against the water tubes, due to the intensity of the blast in the two central compartments of Fig. 2. This deposit is not readily removed by a steam blast, but comes off with ease when scraped. The particles clinging to the tubes appear to have been fused. They much resemble the formations observed on boilers burning blast furnace gases.

COMPARISON OF NET RESULTS OF ECONOMY TRIALS MADE WITH THE COXE AND WILKINSON STOKERS.

ITEMS.	COXE STOKER, TRIAL 332.		WILKINSON STOKER, TRIAL 290.
	Water back neglected.	Water back included.	
Per cent. of ash in coal	17.2	.....	19.5
Moisture in coal, per cent.	0.7	.....	4.5
Pounds dry coal burned per hr., per sq. ft. of grate	19.8	.....	32.5
Total furnace draught, in. of water	0.34	.....	0.90
Total draft, in. of water	0.37	.....	1.08
Boiler h. p. developed, per boiler	370.4	378.0	420.2
Boiler h. p. available, per boiler	355.6	362.9	387.3
Corrected evaporation, from and at 212° F., per lb. of dry coal, pounds.	8.87	9.17	9.12
Corrected evaporation, from and at 212° F., per lb., of combustible, pounds	10.72	11.07	11.32
Pounds of dry coal an hour per available boiler h. p. developed	3.84	3.76	3.78
Pounds of combustible per hour per available boiler h. p. developed	3.18	3.11	3.05
Ratio of heating to grate surface	61.3	.....	93.9

5. The water box furnace lining is an advantage when used in connection with an open feedwater heater, like the Webster, Hoppes, etc. Too much water for boiler feed purposes was circulated on the test. If a water box is a necessity (the writer thinks it is not), it should be made strong enough to stand the boiler pressure and to receive the feedwater just before it enters the boiler. In this event pipes should be provided for an induced circulation when not feeding the boiler.

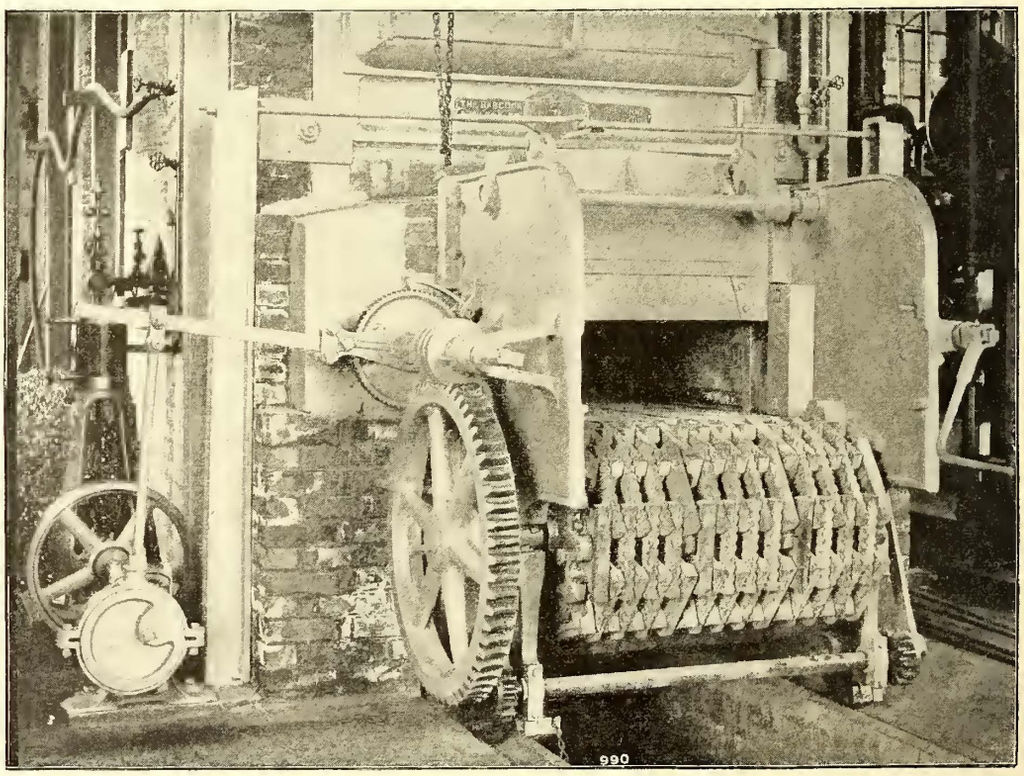


FIG. 3.—BABCOCK & WILCOX STOKER.

6. The stoker will quickly respond to sudden fluctuations in power demands.

7. The economic results obtained on the trials were good.

8. Crowding the fires produces but little reduction in the economy.

9. About three-fourths as much capacity can be developed with rice as with buckwheat coal, under like conditions, with this stoker.

10. More than ordinary care and skill is required in operating this stoker, on account of the graduated air blast used. This is specially true for a plant receiving mixed coal, i. e., buckwheat coal from different mines, or from different levels from one mine. Any inattention may result in too much or too little air being supplied

over the last two, i. e., the burning down and burning out compartments, or *C* and *D* of Fig. 2.

BABCOCK & WILCOX STOKER.

General Description.—Like the Coxe, this stoker is of the chain grate type. It is useful only for burning bituminous coal. It differs from the Coxe in many constructive features (see Fig. 3).

As used on the tests below in the table, the Babcock & Wilcox stoker had an active grate 78 ins. × 84 ins., with twenty-one per cent air openings for the boilers described in the sheet. The ratio of heating to grate surface was 60.6 for the trials 330 and 331. The fires were carried 5½ ins. thick in front. The speed of the grate varied from 2⅜ ins. to 2⅞ ins. per minute. Only natural draught was employed, and that was indifferent on trials 330 and 331.

2. Each stoker gives ideal economic results when properly handled.

3. Stoker engines use from one-fifth to two-fifths of one per cent of the steam generated.

4. Fan blasts use from three to five per cent of the steam generated.

5. Steam blasts use from five to eleven per cent of the steam generated.

6. A defect, common to each of the stokers named in this paper, is a too scanty air space in the grate.

7. Neither stoker will develop as much capacity as will hand firing with stationary grates, having the same draught and coal conditions. Stokers however are not only more constant in the power developed than is a hand fired grate, but are more responsive to fluctuations in the power demands. The stoker is always in the condition that a hand worked fire is in just after its cleaning, i. e., always clean and "ready for a pull."

TABLE.

		WILKINSON STOKER.				COXE STOKER.		BABC'K & WILC'X STOKER.	
TRIALS MADE FOR		ATLANTIC OIL REFINERY, PHILADELPHIA.		MARSHALL BROS.' ROLLING MILLS, PHILADELPHIA.		PHILADELPHIA TRACTION CO.		WARREN PAPER MILLS CUMBERLAND.	
No. of boiler trial.		Test 254	Test 253	Test 298	Test 337	Test 290	Test 291	Test 330	Test 331
Dimensions and proportions,	Units.								
1. Type of boiler		Double Deck Hor. Tubular.		National.		Double Deck Babcock & Wilcox.		Babcock & Wilcox.	
2. Number in use		4		1	2	2	1	1	1
3. Total water-heating surface per boiler	Sq. ft.	1,286		3,850	3,850	4,225		2,758	
4. Grate surface per boiler	"	24		62	62	45		45.5	
5. Area of stack	"	28.3		9.62	19.42				
6. Height of stack above dead plate	Ft.	88		115	115	Mechanical Dra't.		133	133
7. Steam pressure in boiler by gauge	Lbs.	101	98.7	80	102.1	130.4	129.9	87	87
8. Force of chimney draught, in inches of water	Ins.	0.30	0.40		0.75	0.60	1.00	—0.13	—0.40	0.41	0.51
9. Sum of blast and vacuum, or total draught	"	0.88	1.64		1.23	1.08	1.68	—0.37	—0.83		
10. Dry coal actually burned per sq. ft. of grate surface per hour	Lbs.	14.8	27.0	31.9	26.3	32.5	45.4	19.32	32.9	18.4	23.9
12. Water evaporated from and at 212° F. per hour per sq. ft. of grate surface	"	147.5	248.4		251.10	322.1	424.1	185.5	293.6	196.8	264.0
13. Water evaporated from an at 212° F. per hour per sq. ft. of water-heating surface	"	2.75	4.63	4.79	4.04	3.43	4.51	3.03	3.77	3.25	4.36
14. Per cent. developed (+) above or below (—) rating	Per cent.	—4.1	+61.4	+52.6	+27.4	+12.0	+47.5	—1.3	+55.0	8.1	45.1
15. Dry coal burned per hour per boiler h. p. developed	Lbs.	3.45	3.75	3.71	3.64	3.48	3.69	3.68	3.98	3.23	3.13
Kind of coal used		Lykens Valley Rice Coal, Anthracite.		Nanticoke Buckwheat.	Shamokin Buckwheat.	R. C. & I. Co.'s Buckwheat.		P. & R. C. & I. Co.'s Anthracite.		Columbian, W. Va.	

Stoker Trials.—The table above contains the results of two trials made on this stoker, by Daniel Ashworth, of Pittsburgh, and the writer. The economic results are ideal.

The general items of interest were as follows:

Items.	Test 330.	Test 331.	Test 278.
Furnace draft, in inches of water	0.26	0.34	0.61
Stack flue draught, in rear of boiler, inches of water	0.41	0.51	1.16
Kind of bituminous coal burned	"Columbian" from W. Va.	"Columbian" from W. Va.	Connellsville, Pa., slack.
Pounds of dry coal burned an hour per square foot of grate	18.4	23.9	33.2
Per cent of ash and refuse in coal	9.24	9.70	10.16
Temperature of gases in flue in rear of boiler, degrees F.	365	389	538
Square foot of heating surface to one developed horse power	10.61	7.95	5.94
Commercial result, or pounds of dry coal burned an hour per boiler horse power developed	3.23	3.13	3.22

Summary Regarding the Babcock & Wilcox Stoker.—1. This stoker is smokeless when run as in the tests. It did not form a clinker, nor require the use of a firing tool.

2. It readily responds to fluctuating boiler demands, where the stack draught is good.

3. It, like the other stokers named in this paper, requires a strong draught, either natural, induced, or forced. The air openings in the grate are but one-half of the extent usually found with stationary grates, hence a stronger draught is required than with hand firing.

4. A remarkable feature of the tests is that the boiler develops almost ideal economy when forced to develop an evaporative horse power on six square feet of heating surface. This is never realized with hand firing. The writer's experience is that when a boiler, rated on ten to twelve square feet to the horse power, is forced to develop a horse power on less than 8.5 sq. ft. of heating surface, the economy rapidly drops.

5. No charge can be made against this stoker for steam used, other than from one-fifth to two-fifths of one per cent for driving the stoker engine.

GENERAL SUMMARY.

1. Each stoker seems well adapted to the conditions for which it was designed.

Ascending Grades by Electric Force.*

BY S. L. FOSTER.

The problem of climbing grades by devices other than the cable has been approached very cautiously by street railway men. In the old days of horse cars a six per cent climb called for an extra or "hill" horse and sometimes for the interference of the Humane Society. With the advent of electricity the problem was made easier, but was still hindered by the fact that early street railway motors were designed of too small capacity. Steam road practice also influenced the early constructors a good deal and the maximum safe attainable grade was considered to be somewhere about six or eight per cent.

In 1892 railway men and motor builders began to realize that heavier motors were needed; the forerunner of the latest series parallel controller appeared on the scene and the cost per car mile was brought down to a more reasonable point. These powerful motors rendered feasible grades that it would have been unwise to operate with the old equipments. The toothed armature cores, instead of smooth cores, and the protected field spools reduced the item of motor repairs, and a large amount of power formerly wasted at starting was saved by the new controllers.

San Francisco has had her round of experience with electric traction on grades, from the fifteen horse power motors with rheostatic control on eleven per cent grades to the latest twenty-five and thirty horse power motors with series paralled controllers on 14½ per cent grades. Roads were thus equipped where franchises included a few steep grades with much level track. The only two systems of traction available were cable and electricity. The light traffic and numerous curves rendered the expense of the cable construction prohibitive and either electricity had to be tried or the line abandoned.

*Read at the first annual meeting of the California Street Railway Association, Apr. 21, 1896.

In order to climb these unusual grades two twenty-five horse power motors on each single truck car were decided to be necessary. These twenty-five horse power motors are far in excess of what is required to propel the cars on the level, and we thus see already that some of the penalties for operating electric cars on heavy grades are the necessity of transporting heavier motors than are needed on the level, the attendant lower average car efficiency and the increased rail joint abuse.

It is hardly necessary to note that single truck cars have been found to be better than double truck cars for heavy grade work as in the former the motors are given the benefit of all the adhesion the weight of the car can give, while in the latter some of this weight is supported by the four wheels that do not act as drivers for the car. It, of course, requires more power to propel a car over a steep grade than over the same distance on the level. By power is meant the product of the force by the time. It not only requires more force in the form of amperes multiplied by the volts, but this force has to be exerted for a longer time to cover the same distance on a grade.

There is however a misconception in some minds as to the power that is really required by an electric car on a grade. The formula used in determining the force required to propel a vehicle shows that when on a grade this force increases rapidly with the grade when the speed remains the same. But the speed of an electric car does not remain the same on a grade as on the level. The motors are only capable of a certain effort and as on a grade the car not only has to be advanced horizontally, but also raised vertically at the same time, the work to be done is increased and the car speed decreases until it is within the power of the motors.

Diagram Fig. 1 shows how the speed decreases and the power consumed increases from the level to a 14.54 per cent grade under

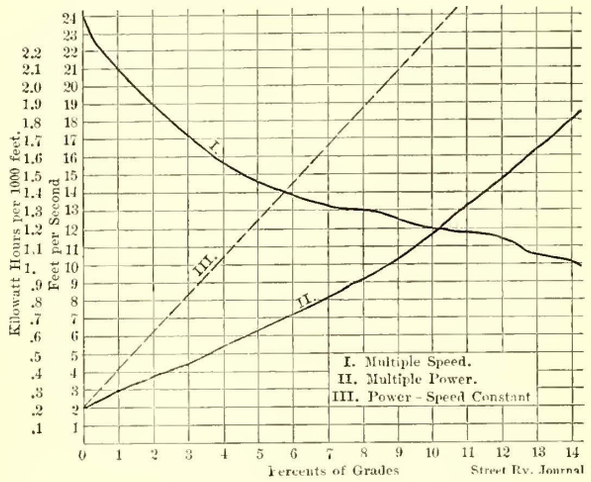


FIG. 1.

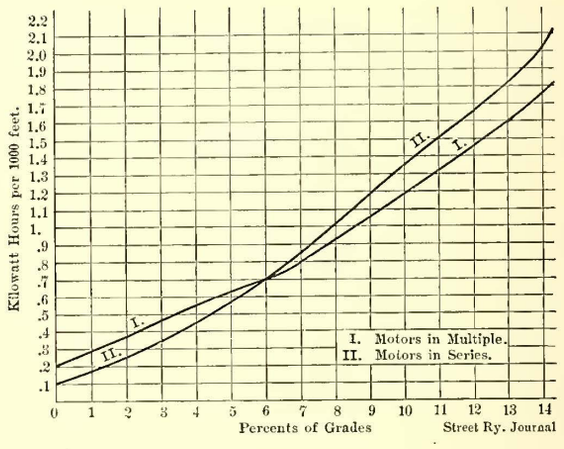


FIG. 2.

practically constant voltage. The dotted line shows how the power would have been expected to increase had the speed remained the same.

Another feature of grade climbing—the freedom from wagon interference is often overlooked. On a road where heavy grades prevail very little wagon traffic is met and the slow running and frequent stops and starts so prevalent on a level line and so wasteful of power are absent. When a car starts up a grade it has an uninterrupted run to the end and its short pieces of level track are usually clear. The result of these compensations is that the average amount of electrical energy absorbed on 1000 car miles covering seven consecutive days on a level city line is but fifty per cent less than the average on 1000 car miles on a city line in which several ten and twelve per cent grades exist. The level line is 24,000 ft. long where there is a total rise of but 142 ft. and the other was 16,000 ft. long and comprises two hills. The line rises 186 ft. to the top of the first hill, descends 92 ft. and rises to the second hill top 143 ft. The same style of cars and motors was used in both cases.

When the new series parallel controllers came out instructions were given to use only the series notch on heavy grades as it was more economical to run the motors in series than in multiple. Let us see what the basis of this advice was and its value. On grades over six per cent about two times as much current is used and over twice the speed is attained by the car when the motors are run in multiple as when run in series. This excessive flow of current causes an increase in sparking at the brushes, sends the armatures to have the commutators turned sooner and the greater speed on the grade wears the bearings and gearings more rapidly. From the standpoint of the repair shop, the series combination is thus seen to be the cheaper.

From the standpoint of the power house engineer, too, it is better for cars to be run up hill on the series notch as the power plant can handle twice as many cars that are running on the series notch as if the cars ran on the multiple notch. The lines containing heavy grades are the bugbear of the engineer on account of the abnormal fluctations in load due to the cars climbing the grades on the multiple notch. Where the plant is nearly loaded, this sudden occasional call for four times the normal current often results in the whole line being cut out in order to assure current for more important lines.

From the standpoint of the investor, the series notch is preferable, as when cars are run up the grades with the motor in multiple the system must be not only equipped with boilers, engines, generators and feed wire, of double the capacity that would be required if the series method of running the motors were used, but this double capacity must be running and ready at all times, as it is not a case of a load coming on at 7 A. M. and 5 P. M., but it appears at regular intervals through the day and must be provided for.

From the standpoint of the watts per car mile or the coal pile however the multiple notch is found to be slightly cheaper. On grades over six per cent under ordinary conditions, single truck cars equipped with two twenty-five horse power motors were found to require, when the motors were run in multiple, from nothing to fourteen per cent less expenditure of power than when the motors were run in series.

The current will be more when in multiple, but the time will be less than in an inverse ratio to the current or, what is the same, the speed will be more than in a direct ratio to the current. For example, on a given grade two times the current is absorbed and 2.6 times the speed is attained. Thus the power is less at the multiple notch. This saving however is not worthy of consideration, as it is undoubtedly more than counterbalanced by the loss at the generators, due to inefficient running at under load most of the time. This saving on a 14½ per cent grade amounts to 1¼ k. w. hours per mile of grade run.

In other words, as roads are usually built with but few and short heavy grades and the rest of the lines more nearly level, the use of the multiple notch involves a slight saving for a few moments of each trip and a waste in the form of interest of money and unnecessary coal burned for inefficient generators for the rest of the time.

On the line where most of the tests were made the saving was for 6.2 per cent, and the waste for 93.8 per cent of the running time. The series notch is thus seen to be the more economical. Ordinary mechanical reasoning teaches us that the amount of power required to propel a car up a grade is independent of the speed. If the speed is slow the force required is less, but the time during which it is exerted is longer. If the speed is rapid the force is greater and the time less, so that the result is the same in either case. The explanation of this disagreement between theory and the facts is found when we consider the relative car efficiencies at the two notches. The efficiency is higher at the multiple notch on a heavy grade because the work done by the motors approaches more nearly their rated capacity where their efficiency is a maximum.

This greater economy at the multiple notch held good under the conditions of the tests made, only on grades above six per cent. On about a six per cent grade the power consumed is the same at the series as at the multiple combination, while on lesser grades and on the level the series is the more economical notch at which to travel a given distance. The tests were made under ordinary conditions of load and voltage. Of course, every railroad manager must decide according to his local conditions which is the larger, the value of the coal saved by the use of the multiple notch, or the extra expense for repair work on armatures due to the quadrupled flow of current, plus the interest on the additional station capacity rendered necessary in order to safely handle the sudden heavy calls for current made by the hilly lines, plus the interest on the extra amount of feeder wire needed to keep up the voltage when from three to four times the current usually used on the level is called for. There is still another expense to set against the saving in coal and that is the item of lamp breakage. If feeders of sufficient size are run to the hilly portions of the line so as to hold up the voltage for the few moments during which the cars are climbing at the multiple notch, these feeders will be too large for the line the rest of the time when the cars are not climbing, and the voltage will rise and as the lamps will be running up over normal candle power most of the time, their life will be shortened considerably.

The question of requiring more cars when the series notch is used on grades in order to secure the same headway will not come up unless the line is run with no layover at the ends. On the line tested comprising 33,000 ft. of single track and having five heavy grades each way, 1½ minutes only would be lost each one-half trip by changing from the multiple to the series method of climbing heavy grades or three minutes to be made up in fifty, the time of a round trip. Diagram Fig. 2 shows how the power curves for the series and the multiple notches converge and diverge as the car goes from the level to a fourteen per cent grade.

It is frequently asked what the steepest grade is that can be ascended by an electric car, and the question is as often left unanswered because the questioner can not state the exact coefficient of friction between the car wheels and the rails.

It is easier and fully as much to the point to tell of what steep grades have been climbed and to call attention to the fact that it is not a question of how steep a grade can be climbed, but how steep a one can be safely descended. In San Francisco cars are operated successfully both ways on a 14.54 p. c. grade and on the Piedmont road in Oakland on a 14¼ p. c. grade up and down. In Seattle, Wash., on Rainier Avenue, by the help of sand a single truck car climbed a 16.85 p. c. grade 300 ft. long, but in this case it is not dared to allow a car to descend without an outside check on its speed.

The problem of ascending grades is a simple one for the motorman. He turns his controller handle and the motors do the work. When a grade is to be descended however there is a demand made for brains from the engineer of the car. There have been a few accidents on steep grades in San Francisco and in almost every case it has been shown that the motorman become excited; that he failed to do what he should have done, or worse in some cases, he did what he should not have done. Flat wheels are made frequently while descending grades and if the true cause were known, it would be found in most cases to be due to the fact that the car was allowed to

FIG. 3.—CAR ON 25.54 PER CENT GRADE—SAN FRANCISCO.

attain an unsafe speed at the top of the grade before the brakes were applied. If a car is brought to practically a dead stop at the top of a grade and then let down the hill at about six or eight miles an hour, the danger of a runaway or flattened wheels is very slight. If the track is slippery sand can be used. Should the brake mechanism fail now, or an unexpected obstruction call for a sudden stop, at the low speed the motorman would be better prepared to make an emergency stop before damage was done than if his car was running at fifteen or twenty miles an hour when the trouble occurred.

That the exercise of due diligence on the part of the motorman renders it perfectly safe to descend quite heavy grades with electric cars is shown by a consideration of the fourteen per cent grade on Harrison Street from Third to Hawthorne. The wagon traffic on Third Street at the foot of the hill is the heaviest in the city and yet cars have been descending this steep grade 600 ft. long for four years without an accident.

Some motorman have devised a method whereby they can come down heavy grades rapidly, have the brakes on fairly hard and yet not slide the wheels. This result is produced by putting the controller on the series notch while the brakes are set. The maximum braking effect has been found as the result of an elaborate series of tests made by European engineers, to be produced by applying the brake shoes at a pressure just under the skidding point. In case the wheels slide, the brake shoes should be released at once, the wheels allowed to revolve and be then gripped again. The motormen referred to have found that by the use of the motors, they can hold the car braked at that point of maximum retardation just short of skidding and can keep the car wheels free from slipping, while maintaining a higher rate of speed than is possible when not using current in conjunction with the brakes. The idea of using power while descending grades however is just the reverse of what all street railway men have been seeking to realize, namely, how to recover, while descending, some of the power consumed while *ascending*. It also seems most dangerous for motormen to get into the habit of using current while descending a grade, lest in case an emergency arise, they continue to advance the controller instead of throwing it back to "off" before reversing. When at the series notch it is impossible to reverse the motors. The controller handle must first be thrown to "off." If the controller is on, it necessitates one more operation before the car can be stopped, and in an emergency the time occupied for this extra move is extremely valuable

It can perhaps be plausibly argued that a car can be stopped more quickly by causing sliding wheels to rotate than by leaving them sliding, from a consideration of the tests mentioned above. Here it was found that the pull per ton required to tow a car with the brakes set decreased from forty-two pounds to five pounds as soon as the wheels slipped. Conversely it might be claimed that if the wheels were turned when slipping the car speed would be checked. It would be a good deal cheaper however to make these wheels turn by slacking off the brakes than by trying to do it by using current.

The problem of ascending grades where electricity forms only a portion of the power required for the work is solved in this locality in three typical ways—at Mt. Lowe near Pasadena, Cal., in San Francisco on the Fillmore Street grade and on Rainier Avenue in Seattle, Wash.

At Mt. Lowe two cars are permanently attached at opposite ends of a cable that passes around a winding drum in the power house at the top of the grade. The force of gravity on the descending car aids the ascending car in its ascent. The track construction is three rail with a turnout at the center of the route where the cars pass each other. The system is controlled entirely from the power house above. A positive difference in loads is made up by a stationary electric motor actuating the winder, and a negative difference is offset by a brake on this winder. Here grades as high as sixty-eight per cent are surmounted. It is really however more like a mining proposition than a street railroad one.

On Fillmore Street, in San Francisco, we have a practical double track street railroad proposition. The descending car assists the ascending car on the same principle as at Mt. Lowe. The positive difference between the loads of the two cars and the friction of the gearing, cable, etc., is made up by the use of the motors on one car; any negative difference being controlled by a band brake on the tail sheave on the hill top. When each of the two cars ends its upward or downward course, it is quickly released from the cable and proceeds on its trip. The grade here is 25.54 per cent and about twenty-five horse power is used to work the whole mechanism including both cars. In this case two cars—one descending and one ascending—are essential for the working of the device.

At Seattle the line is single track while under it is a second track in a conduit. The passenger car runs above and a load of pig iron as a counterbalance below. A descending car pulls the car of iron up to the top of the hill on to a bit of level track where it stands. The next ascending car by starting up and pulling on the cable, which is endless, starts this counterbalance car down and receives assistance from its descent in climbing the seventeen per cent grade.

Here one car only is needed at a time, but it must be always going in the right direction.

Long Distance Transmission of Electric Power.*

BY T. A. W. SHOCK.

The Sacramento Electric Power & Light Company was the pioneer of the world to transmit power in large units over a long distance. Thirty years ago the idea of building a dam across the American River for irrigating and power purposes was thought of by H. G. Livermore, the father of H. P. Livermore, the present general manager. The work has been continued under Albert Gallatin and H. P. Livermore, and to-day at Folsom may be seen one of the most extensive hydraulic works in the world. The dam contains 37,000 cu. yds. of masonry. It is fitted with a shutter operated by five hydraulic rams, and when shutter is raised reservoir back of the dam is formed holding 13,000,000 cu. yds. of water; thrust of dam, 1911 tons; stability, 7979 tons. A canal 50 ft. × 40 ft. × 8 ft. conducts the water from the dam to the power house, distance 1¾ miles.

The power house is a substantial brick structure, built on granite foundations, and contains four 1200 h. p., horizontal McCormick turbines, coupled direct each to a G. E. 750 k. w., three phase generator. The generators are excited by 30 k. w., 500 volt multipolar generators which are direct coupled to their individual wheels. The Faisch & Piccard water governor is used, and on a test regulated within four per cent from no load to full load. The generators at full speed of 300 revolutions run at a pressure of 800 volts. which is raised to 11,000 volts through step-up transformers. There are nine step-up transformers in the station, of 560 k. w. capacity each.

The power is transmitted to Sacramento over two pole lines. The poles are forty foot, round Washington cedar set six feet in the ground, and a large standard General Electric porcelain insulator is used, which has a factory test of 30,000 volts before shipping. Each pole line has six wires, and each set of three wires has a capacity of 1000 h. p. The necessity of a double line has often been demonstrated, as the service during the twenty-four hours cannot be interrupted. By means of switches at Folsom and Sacramento the power can be thrown to any line or any set of transformers, so that in any event an interruption to the service can only be a matter of a few seconds. The line has stood the severe gales of the past winter, only a few minor repairs having to be made.

At the substation in Sacramento the current is transformed down through step-down transformers of 125 k. w. and 40 k. w. ca-

*Read at the first annual meeting of the California Street Railway Association, Apr. 21, 1896.

pacity to 1000, 500, 230 and 115 volts for power and incandescent lighting.

In this station are three 325 h. p. synchronizing motors, which are coupled by means of friction clutches to a countershaft, to which are belted one M. P. 200, an M. P. 90 and two Edison 80 k. w. 500 volt generators for operating twenty miles of street railway owned by the company and four small 500 volt motors. To this countershaft are also belted three 100 light Brush arc machines and two 125 light machines of the same type for city and commercial lighting. The company has in operation 234 city lights, 117 commercial arcs and 3000 incandescent lights, 150 h. p. in small direct current motors and 100 h. p. in small three phase induction motors, also operating twenty-two regular cars on its street car system. Electrical machinery is now being placed in the Buffalo brewery, Phœnix mills and other institutions, and recently a contract was closed with the Southern Pacific Company for electric power for its shops. The plant both at Folsom and Sacramento is duplicated throughout, thus avoiding any possibility of a shutdown.

The low tension distribution is laid out on the standard four wire "Y" system, the three wires of the three phase and neutral system for incandescent lighting and small motor work. Motors can be operated successfully on this system without any apparent change of voltage to the lamps. In addition to the low tension distribution for incandescent lighting a 1000 volt line is run, stepping down to 104 volts at the transformer for residence lighting and outside motor work.

The plant commenced operation July 16, 1895, and has been operating constantly ever since. This proposition is the pioneer for similar propositions in this state, which are now being installed, and prove to the world that it is a success electrically and financially. To commemorate the coming in of electric power an electric carnival was given on the night of Sept. 9, 1895, which in splendor could not be beaten the world over. Ten thousand incandescent lights, in the form of circles, towers, Maypole and signs, were burning on that night, and those who saw it will have the satisfaction of knowing that they were able to see one of the grandest exhibitions of the nineteenth century.

Another achievement in the electrical field, and which is coincident to the entrance of electrical power, is the successful operation of a long distance telephone over a pole line carrying 10,000 volts.

A test of the power plant showed ninety-seven per cent efficiency of tranformers, ninety per cent in the line, and the water wheels eighty per cent. All the machinery has come up to guarantees and in the case of transformers and generators have exceeded the guarantees one and two per cent.

The Effect of Retarders in Fire Tubes of Steam Boilers.*

By Jay M. Whitham.

The trials were conducted on a one hundred horse power horizontal tubular boiler at the Sutherland Avenue station of the Philadelphia Traction Company, Philadelphia. The purpose of the trials was to ascertain under what conditions, if any, retarders in the fire tubes would add to the efficiency of the boiler.

*Abstract of paper presented at the St. Louis meeting (May, 1896,) of the American Society of Mechanical Engineers.

DIMENSIONS AND PROPORTIONS OF BOILER AND SETTING.

Boiler shell . . . . . 60 ins. × 20 ft.
Tubes (44) . . . . . 4 ins. × 20 ft.
Grates—stationary, herring-bone pattern, air openings ⅜ in. wide, or 46 p. c. of grate.
Grate . . . . . 5 ft. 4 ins. × 5 ft.
Grate surface . . . . . 26.7 sq. ft.
Water heating surface . . . . . 1,137 sq. ft.
Boiler rated at . . . . . 100 h. p.
Ratio of heating surface to grate area . . . . . 42.6 to 1.
Steam drying surface in top of shell . . . . . 150 sq. ft.
Liberating surface in boiler . . . . . 83.3 sq. ft.
Distance from grate to under side of boiler shell . . . . . 18 ins.
" " top of bridge wall to under side of boiler shell . 10 ins.
Boiler set with a return pass over the top.

Ten of such boilers are connected to a brick stack 10 ft. diameter by 175 ft. high. During the tests from four to seven of these boilers were run in connection with the boiler tested. On certain tests retarders were ussd in the tubes. These were made of loosely fitting strips of No. 10 sheet iron, running the whole length of the tubes, and twisted to a pitch of ten feet, or making two entire convolutions in the length of the tube.

The accompanying table gives the principal results secured from seventeen tests:

CONCLUSIONS.

1. Retarders in fire tubes of a boiler interpose a resistance varying with the rate of combustion.

2. Retarders result in reducing the temperature of the waste gases, and in increasing the effectiveness of the heating surface of the tubes.

3. Retarders show an economic advantage when the boiler is pushed, varying in the tests from three to eighteen per cent.

4. Retarders should not be used when boilers are run very gently, and when the stack draught is small.

5. It is probable that retarders can be used with advantage in plants using a fan or steam blast under the fire, or a strong natural or induced chimney draught, when burning either anthracite or bituminous coals.

6. Retarders may often prove to be as economical as are economizers, and will not, in general, interpose as much resistance to the draught.

7. Retarders can be used only with fire tubular boilers.

8. The economic results obtained on the boiler tested are ideal, showing that it was clean, the coal good in quality, and the firing skillful.

With retarders the tubes are more effectively cleaned than without their use.

9. The tests prove that the marine practice of using retarders is good, and that the claim, often advanced, that they show from five to ten per cent advantage, holds, whenever the boiler plant is pushed and the draught is strong.

Conversion of Cable Lines to Electric in Pittsburgh.

One of the conditions of the lease recently made by the Citizens' Traction Company is that the Fort Pitt Company will, prior to Nov. 1, 1897, completely reconstruct the present cable lines of the Citizens' Company with the most improved electric system and equip them by electricity.

TABLE.

Condensed table showing principal results of a series of trials on a 100 h. p. horizontal tubular boiler, run at various capacities, burning "Henrietta Mine," Clearfield Co., Pa., run-of-mine bituminous coal, to determine the value of retarders in the tubes.

H. P. developed.	With or without retarders in tubes.	Draught in Inches at			Temperature of waste gases, °F.	Moisture in steam, part of one per cent.	Pounds of Water evaporated from and at 212 °F. per lb.		Per cent. of ash in dry coal	Lbs. of dry coal burned an hour per h.p. dev'l'p'd.	Lbs. of water 212 °F. per sq. ft. of heating surface.	Lbs. of dry coal burned an hour per sq. ft. of grate.	Sq. ft. of heating surface to one h. p. dev'l'p'd.
		Furnace.	Front connection.	Boiler damper.			Of dry coal.	Of combustible.					
52.4	Without	0.07	0.12	0.16	371	0.34	10.43	11.38	8.33	3.30	1.59	6.49	21.70
52.4	With	0.07	0.12	0.15	351	0.21	10.44	11.43	8.72	3.30	1.59	6.49	21.70
Saving of fuel by use of retarders, 0.0 per cent.													
74.6	Without	0.13	0.18	0.21	414	0.45	10.70	11.38	6.04	3.21	2.25	8.89	15.24
77.3	With	0.13	0.24	0.28	361	0.12	10.72	11.57	7.42	3.21	2.34	9.33	14.71
Saving of fuel by use of retarders, 0.0 per cent.													
99.7	Without	0.17	0.28	0.33	444	0.00	10.58	11.29	6.15	3.25	3.03	12.13	11.37
104.2	With	0.17	0.27	0.31	412	0.95	10.92	11.56	5.55	3.15	3.16	12.30	10.91
Saving of fuel by use of retarders, 3.2 per cent.													
125.3	Without	0.19	0.31	0.36	470	0.10	10.44	10.99	4.93	3.30	3.80	16.35	9.09
127.5	With	0.20	0.32	0.38	424	0.59	10.86	11.53	5.81	3.18	3.87	15.18	8.92
Saving of fuel by use of retarders, 4.0 per cent.													
150.0	Without	0.24	0.37	0.42	455	6.19	10.65	11.20	4.93	3.24	4.55	19.20	7.58
148.6	With	0.23	0.43	0.49	436	0.01	11.00	11.60	5.06	3.14	4.51	17.45	7.65
Saving of fuel by use of retarders, 3.3 per cent,													
169.6	Without	0.25	0.42	0.51	506	0.20	10.71	11.27	4.96	3.22	5.25	20.87	6.70
169.1	With	0.24	0.47	0.53	447	0.11	11.09	11.53	5.76	3.11	5.13	19.73	6.72
Saving of fuel by use of retarders, 3.6 per cent.													
199.7	Without	0.36	0.57	0.65	526	0.33	10.26	10.76	4.63	3.36	6.06	26.55	5.68
197.3	With	0.24	0.63	0.71	490	0.45	10.68	11.30	5.49	3.23	5.99	23.86	5.76
Saving of fuel by use of retarders, 4.1 per cent.													
217.4	Without	0.30	0.54	0.62	551	0.24	9.84	10.29	4.43	3.51	6.59	30.10	5.23
226.1	With	0.34	0.78	0.86	523	0.00	10.69	11.19	4.53	3.23	6.86	27.32	3.03
Saving of fuel by use of retarders, 8.6 per cent.													
239	Without	0.32	0.64	0.67	646	0.12	9.03	9.43	4.25	3.82	7.26	34.30	4.76
Saving of fuel by use of retarders, comparing tests 355 and 381, 18.4 per cent.													

SCIENCE · ENGINEERING · INVENTION ·

New Motor Truck.

Fig 2 illustrates the No. 3 pivotal bolster motor truck, manufactured by the American Car Company, which possesses a number of novel features, the principal one of which is in the support of the car body. The aim of the manufacturers in its design was to secure an easy riding truck and one that would give as extended a spring base as possible, thus doing away with the oscillation of the car body, and at the same time to produce a truck of simple construction and having few parts. The spring base in Fig. 2 is 13½ ft. and wheel base 6½ ft.

FIG. 1.—PIVOTAL BOLSTER TRAIL TRUCK.

The car body is supported at two points only, i. e., on the heavy bolster at each end of the truck, and this is carried, as shown, on four powerful spiral springs. The side frame is essentially a bridge truss consisting of four members. Of these the two end pieces are substantial castings with pockets for the springs at one end and for the journal box at the other. The upper member connecting these two castings is a wrought iron rod 3 ins. × ⅞ in., and the lower member, which is in compression, a 3½ in. hydraulic pipe. The two side bars are connected at each end by brake cross irons, and at the center by two steel channel irons for the support of the motors. The method of support by center bearings at the ends of the car, it is claimed, produces ease and grace of motion, similar to that of the best riding railroad coach.

Fig. 1 shows a trailer truck built by the same company on similar lines. It has the same action as the No. 3, and can readily be changed to a motor truck by the introduction of channel irons for the support of the motors and the removal of the diagonal cross brace channel for stiffening the truck, which would be unnecessary with the two lower braces.

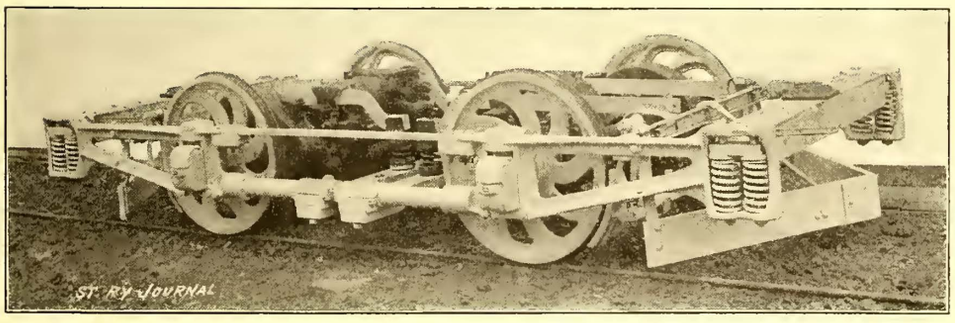


FIG. 2.—PIVOTAL BOLSTER MOTOR TRUCK.

The brake gear is simple and effective.

The trucks have been used with success on the Southern Electric Railway and Missouri Railway, of St. Louis, as well as in other cities, and are said to be giving good satisfaction.

The Overhead Electric System for Belfast, Ireland.

The Corporation of Belfast, Ireland, appointed some time ago a deputation of its members to visit various cities and towns in Great Britain and on the Continent for the purpose of studying electric traction in its latest developments. This committee has recently reported on the systems of Dublin, Bristol, London, Havre, Paris, Brussels, Hanover, Hamburg, Berlin, Dresden, Vienna, Budapest and Birmingham. Its general conclusions are that overhead electric traction under certain conditions is best suited to the wants of the public and requirements of the city of Belfast. The objectionable features in connection with steam or gas as motive power are too great to allow them to be recommended in any known form. The difficulties of introducing an underground conduit system in Belfast are so great that its adoption was not recommended, though very fair results have been evidenced in connection with the running of cable tramways where traffic is heavy. The deputation finds that the mechanical features of the cable system are such as to render extreme accuracy in the time of the tramway service so problematical that the adoption of the cable system cannot be recommended. With regard to accumulator cars it has very carefully weighed the question of introducing these into the central portions of the city and believes that the necessary transfers would not give public satisfaction. It finds that all practical objections to the overhead system have been surmounted and that the system has been so improved in its general appearance that it has no hesitation in recommending it with certain stipulations regarding its construction. These stipulations do not vary from those ordinarily required in American cities, having reference chiefly to the determination of all questions of obstruction, etc., by the corporation officials. The corporation of Belfast is empowered to purchase the electric plant of the company at the end of the present fourteen year franchise at its then value without any allowance for compulsory purchase, good will or other consideration.

Electric Launches at Pleasure Resorts.

The operation of electric launches as auxiliaries to electric railway systems at pleasure resorts along the line of route seems to be meeting with growing favor. The popularity of these launches at resorts of this character is great and in a number of cases they have been found to take in the greater part if not all of their first cost the first year. The current for charging the storage batteries in launches, in cases where they are operated in connection with a railway system, is taken from the trolley current and as no high skill or intelligence is required for this work, the cost of maintenance is light. Charging is usually carried on at night or at some other time when the station load is small.

Among the companies which have been operating launches of this character is the Altoona & Logan Valley Electric Railway Company, of Altoona, Pa., which has one launch. Four other launches were in operation last season at Ludlow Lagoon, the pleasure resort of the Cincinnati, Covington & Newport Railway Company, and according to the management of this company, proved to be one of the best paying investments on the ground. Three others were in service last summer on the Milwaukee River taking current from the lines of the Milwaukee Street Railway Company, and Mr. Rau, the manager of the launch service, states that they made 1750 trips at a cost of eighty cents per trip, including all expenses. Two more have been ordered for this service in Milwaukee, making a total of five. Two others are in operation at Jamaica, Mass., charged with current from the wires of the West End Street Railway Company.

Among other companies that are to install electric launches this year are the Portland Railroad Company, of Portland, Me., and the concessionary of the Prospect Park boating privileges in Brooklyn, N. Y.

A New Street Car Controller.

In spite of the general business depression, the past three years have witnessed a remarkable increase of the application of electricity to railway work. Keeping pace with this increase there has been a constantly growing demand for apparatus that will successfully stand up to the exacting requirements of the service. There is probably no other class of apparatus that has to operate with as little attention and under as much abuse as that employed in the operation of street cars. It is very necessary that this fact be borne prominently in mind in designing machinery for such service.

The controller is one of the most important elements of a railway outfit. Controllers that two years ago were operated satisfactorily under the general run of service, would now prove inadequate on account of the increased requirements. With these facts in mind the Walker Company has, during several months past, built and experimented with a number of different forms of controllers with a view to determining the most practical and simplest form to place upon the market.

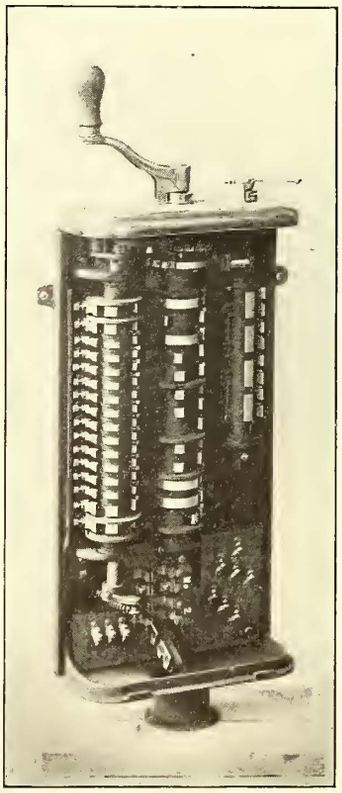


FIG. 1.—A NEW MULTIPLE SERIES CONTROLLER.

Thus far there has been no successful method devised of breaking a circuit of high self induction such as that in the motor circuits in railway work without the formation of an arc, and various methods have been devised for opening such a circuit with the least destructive effect to the terminals or other elements of the circuit. It is a fact well known to electricians that it is much safer in breaking a circuit in which there is high self induction to do it slowly, drawing a long arc, than to make a quick break, blowing the arc out at once. The more slowly the circuit is opened (consequently the longer arc made) the greater time is allowed for the counter electro-motive force produced by the circuit itself to die down gradually, so as to produce less danger of injury to the insulation or to the breaking terminal s on account of the induction "kick."

Among other methods considered, several forms of controller with a magnetic blow-out were tested by the Walker Company; but without complete satisfaction. Besides the danger of rupturing the insulation by the quick blowing out of the arc, there are other features connected with the magnetic blow-out that were considered unsatisfactory and liable to give trouble in the controller. It was found that in case the circuit is opened very slowly the magnetic field on which the blowing out of the arc depends is quickly lost, leaving the arc still unbroken, except at a very few contacts. Under such circumstances the arc is liable to spread and cause short circuiting between contacts of the controlling cylinder, or it may even cause a complete grounding of the circuit, resulting in a serious injury to to the contact rings of the controlling cylinder and the contact fingers. Furthermore, it appeared to be necessary in a device of this kind to provide separating partitions of some non-combustible insulation material to guard against the spreading of the arc and these partitions would naturally interfere quite seriously with the inspection of the controller, causing defects that are beginning to be developed to be easily overlooked. It is also necessary to provide a magnetising coil to produce the magnetic field and this coil, owing to the small amount of room available for the purpose, was apt to become overheated so as to burn out or ground, thus rendering the blow-out feature non-effective entirely.

After a large number of practical tests it was found that the principle of drawing a long arc with a relatively slow break gives the most satisfactory and reliable results. Consequently this principle has been adopted in the design of the new controller recently brought out by the Walker Company. In this controller the circuit is broken by a special switch placed in the controller for the purpose, in which the action is relatively slow and the circuit is broken at twenty-eight points, thus very easily rendering the most severe arc that can be formed in practice entirely harmless both as to spreading to other contacts and as to its effect on burning the breaking contacts themselves.

Another novel feature readily appreciated by practical operators has been adopted, which consists in entirely separating the operation of breaking the circuit from the controlling cylinder itself. The controller consists of two switches each having its own separate function to perform. The controlling cylinder proper is used simply to make the different combinations required to obtain the proper regulation of the speed of the car. The second switch is also of a cylindrical form, but is used for no other purpose than the complete breaking of the circuit whenever such is required. By reference to the cut it will be seen that the breaking switch, which is shown at the left, has its circuit so arranged that the main-current passes first through this switch, before going to the controlling cylinder. In the four lines of contacts shown, the first and third constitute the cylindrical portion of the switch and are in metallic connection each with the one horizontally opposite to it. The second and fourth rows represent the fingers bearing upon the cylinder contacts. It will be seen by tracing out these connections that when the switch is closed the upper contacts shown in outline are short circuited, the current simply passing from top to bottom and then direct to the controlling cylinder. As this switch is opened the fingers leave the lower contacts, shown solid, first throwing the main current through the upper breaking contacts in the series, so that when the fingers leave the cylinder contacts the arc is broken up into as many parts as there are breaking fingers.

The mechanism of the breaking switch is so arranged that with a movement of the controlling handle one quarter of an inch backward, the circuit is completely opened by means of this switch, leaving the controlling cylinder itself entirely dead. The circuit cannot be again closed until the controlling handle has been brought back to the off position. After the circuit has been once opened by this slight backward movement of the handle, the controlling cylinder can be moved backward and forward into any position without producing any effect, and it is absolutely necessary to go back to the off position before the switch can be again closed. This feature of the controller makes it impossible to drop back from one notch to another in such a way as to put in or take out resistances in the circuit. This is a point that has always heretofore been carefully covered in the instruction to motormen, but at the same time it has been found that such instructions are often disregarded, it being much easier in many cases, if a decreased speed is wanted, to drop back one or two notches as the case may be instead of first cutting off the current completely.

There is another point of considerable advantage in the quickness with which the circuit can be opened in case of an emergency. A very slight movement of the handle entirely cuts off the current from the car, thus leaving the motorman free to attend to his brake promptly, with both hands if necessary.

A very simple and effective interlocking device has been adopted in this controller in which the pawl that indicates the various running positions of the controlling cylinder acts at the same time as a lock between the controlling cylinder and the reversing switch. The controlling cylinder is locked when the reversing switch is in any other position than either forward or back, and the reversing switch is locked except when the controlling cylinder is at "off" position.

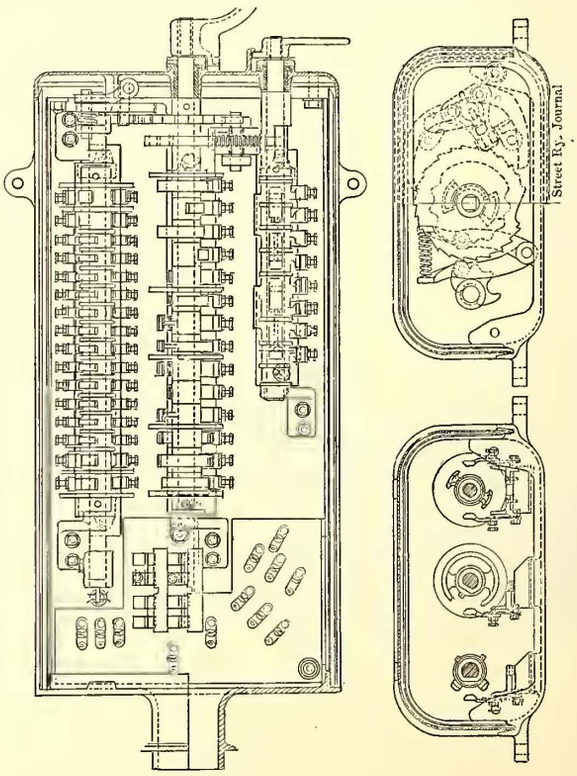
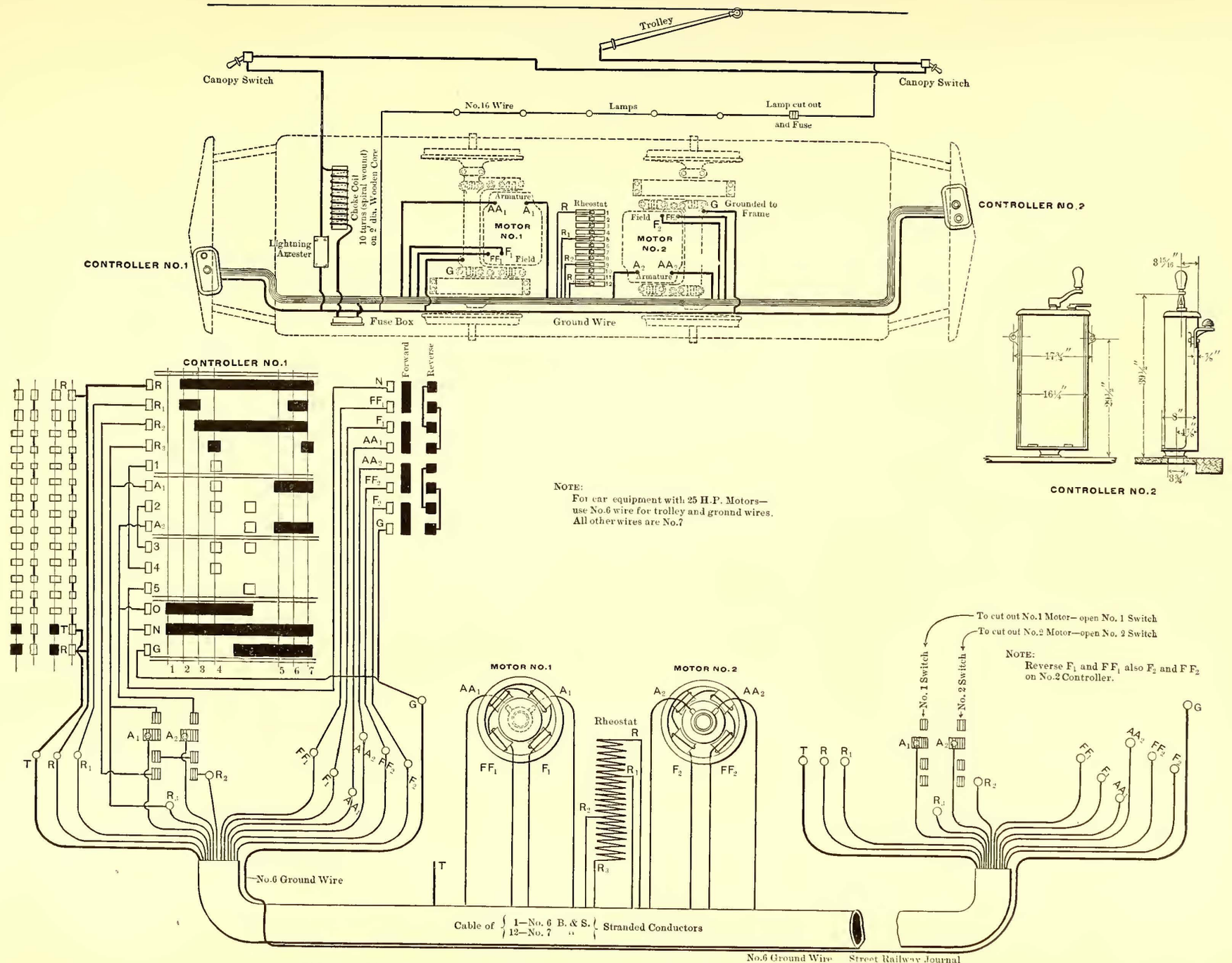


FIG. 2.—DESIGN OF NEW CONTROLLER.

The internal wiring of the controller has also been very much simplified, and as will be seen from the cut, the wiring is entirely open so that it can be easily seen and gotten at. With this efficient method of breaking the circuit it has been found that separators between the various contacts are entirely unnecessary, consequently the same have been done away with. In fact the arcing in this controller under the severest conditions of practice is so slight that it is scarcely noticeable.



NOTE:
For car equipment with 25 H.P. Motors—use No.6 wire for trolley and ground wires. All other wires are No.7

NOTE:
Reverse F_1 and FF_1 also F_2 and FF_2 on No.2 Controller.

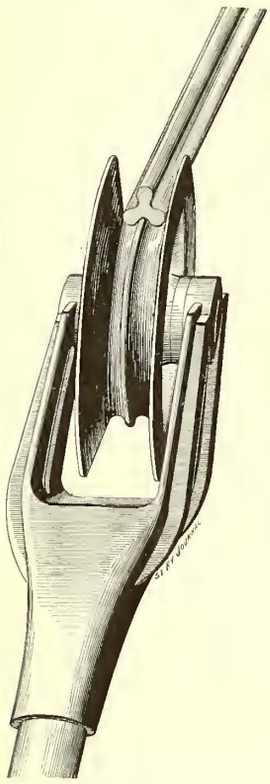
FIG. 3.—DIAGRAM SHOWING CONNECTIONS BETWEEN MOTORS AND CONTROLLERS.

The controller casing is sufficiently protected from the entrance of moisture, and the cover instead of being hinged is arranged so that it is entirely removed and can be set one side out of the way when it is desired to get at the internal portion of the controller.

One of the important features of the controller is the ease with which all the parts can be reached when necessary. The breaking cylinder is so designed that when from continued use the contacts have become worn, the cylinder can be turned end for end and the opposite edges of contact brought into service, thus practically completely renewing the cylinder itself. A large number of these new controllers have now been put into practical service, and it is found that they are giving the best of satisfaction in every respect.

Trolley Wire for High Speed Lines.

The accompanying engraving shows a new type of trolley wire for high speed lines recently brought out by H. R. Keithley, the inventor of the well known "Chicago" rail bond, manufactured by the Washburn & Moen Manufacturing Company. The wire, as will be seen, is symmetrical in cross section about its axis, and consequently can be kept straight and smooth when reeled or unreeled for line construction as easily as round trolley wire. When reeled the wire coils with the groove on its under side, resting on the upper rib of the coil underneath. This prevents lateral waves and kinks. For similar lengths and weights the wire is claimed to have twice the line of contact as the well known figure 8 wire, while the upper rib can be clamped to the ears without interfering with a smooth underrunning surface.



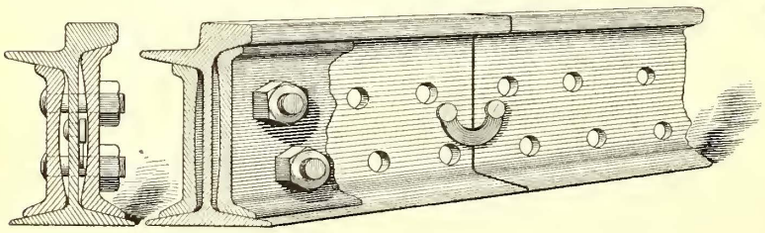
TROLLEY WIRE FOR HIGH SPEED.

The trolley wheel used with this wire can be turned with either a double groove to fit the under surface of the wire, or with a broad groove. The wire does not necessitate the purchase of a special trolley wheel, as the ordinary trolley wheel is wide enough so that it can be turned down to fit the new wire without a material loss of metal. Another advantage of this wire, due to the fact that its bearing surface is not at the center, but at each side, is that there is no tendency to turn over on account of the upward pressure of the trolley.

During line construction the wagon upon which it is mounted is usually fitted with a triangular former, about ten inches long, through which the wire is drawn as it is being unreeled. The object of this is not to take out any kinks in the wire, as there is no tendency to kick, but to take out the curvature necessarily caused by its curved position while on the reel.

New Rail Bond.

J. M. Atkinson & Company are manufacturing and putting on the market a new form of rail bond which seems to possess some first class features. It is very short, six inches or less in length, and is made flexible. It goes on the rails under the fishplate, and consequently is protected from the earth's action and all outside interferences, cannot be cut off by wagons nor stolen when used on exposed track. The bond, being U-shaped, has been named the

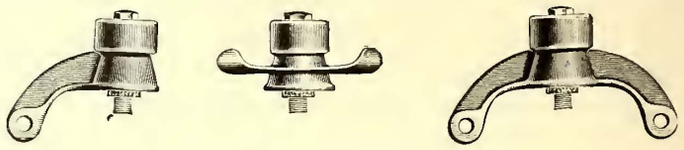


NEW RAIL BOND.

"Horseshoe" bond. It is formed of several laminations of flat soft copper wire, the number of laminations varying from four to ten as may be desired. The ends are firmly imbedded by means of drop forging process in drop forged copper terminals. The method of connection with the rails is to put the terminals of the bond through holes near the rail ends and to then expand the metal within the hole by means of a screw clamp. The manufacturers state that they have already received a number of good orders.

Improved Insulating Bolt.

A new design in the well known West End type of trolley line hanger has been brought out this spring by the H. W. Johns Manufacturing Company. The new feature consists in the use of a special tightening nut on the insulated plug, by which the ear can be attached or detached without removing the cap. This device avoids the difficulty often experienced when the cap, owing to rust or other



HANGERS WITH IMPROVED BOLT.

causes, cannot possibly be removed. The hanger is so designed that the plug ha sample bearing and at the same time gives an unusual length of insulated surface.

The manufacturers say that orders already received on the new hanger are sufficient indication that they have hit upon a design more than ordinarily satisfactory to engineers and electric street railway companies.

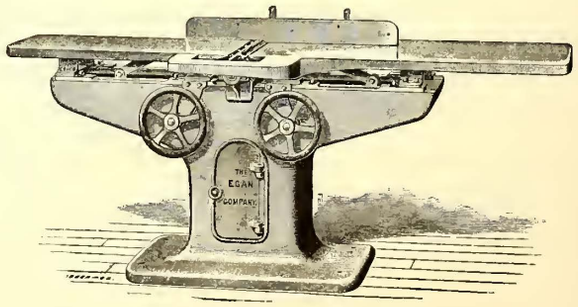
New Bonding Device.

A new bonding device for rail joints has recently been put on the market by John Herr, of Philadelphia. It can be used with any size of wire from No. o to No. oooo and insures fifteen times the area of the wire for contact. It consists essentially of a short, slotted, hollow tapering bolt. This is set into a hole drilled in the web of the rail slightly smaller in diameter than the maximum diameter of the bolt. The bond wire is then threaded through the bolt, after which the latter is driven in until its head comes flush with the web of the rail. In doing this the bolt will be compressed tightly around the bond wire. A nut is then screwed tight on the threaded end of the bolt up to the web of the rail. After this the shank of the bolt, which projects through the nut, is upset by the use of a special tool. This forms a lock for securing and holding the nut in place. As will be seen, the device permits the use of an ordinary wire for bonding purposes and in this way the rail ends can be connected by lacing the bond wire back and forth as many times as may be desired—an important point.

New No. 2 Hand Planer and Jointer.

This new hand planer and jointer made by the Egan Company and shown herewith has special advantages not usually found on machines of this class and does a great variety of work, such as making glue joints (either concave or convex), planing out of wind, cornering, chamfering, beading, grooving, gaining, rabbeting, and a general run of work. The column is one complete casting, cored out, using the inside for a tool box. The top is planed true, giving a solid and reliable foundation for the incline plate to work on. The journal boxes for the cylinder are also part of the main column, insuring a steady running head. The tables are over seven feet long, planed true, having a rabbeting table connected, which supports the stock, either for cutting across or with the grain of the wood, using the long straight knives for this purpose, thereby saving time and money. The cylinder is of solid hammered steel. Two sides are made plain to receive the long knives, and the other two sides slotted for putting on beading, moulding and any other shape of knife to suit the work to be done. This is a very convenient arrangement.

The patent bevel fence is very simple in construction. One clamp operated by a single screw will hold the same to any desired angle. The face is planed perfectly true, and suitable provision is



HAND PLANER AND JOINTER.

made for using the fence at any point across the table. The new arrangement for raising and lowering each table independent of each other is also very complete. The tables can be raised or lowered rapidly the full extreme, to give access to the knives, or they can be adjusted the smallest fractional part of an inch to suit the work, accomplished by spiral gears and screws operated by hand wheels at the side of the machine handy to the operator.

The National Electrical Exposition.

The Electrical Exposition held in the Grand Central Palace, Forty-third Street and Lexington Avenue, New York, during May, was attended by a large number of persons, many of whom came from out of town to attend as well the meetings of the National Electric Light Association and the American Institute of Electrical Engineers, held in the same building. The exhibition was not only interesting to the general public, but to engineers as well, and afforded the best means of learning the present status of electrical development. Below is given description of some of the most interesting exhibits from a street railway standpoint :

THE CLONBROCK STEAM BOILER COMPANY had an attractive exhibit which attracted much attention, illustrating the construction of its well known boilers.

THE PARTRIDGE CARBON COMPANY showed a variety of carbon brushes for motors and generators as well as other specialties made of carbon manufactured by it.

THE GOLD CAR HEATING COMPANY had a small but interesting exhibit of the different makes of electric heaters manufactured by it. J. Ward was in charge.

THE BONTA MANUFACTURING COMPANY showed parts and photographs of the Bonta automatic danger stop for railway equipments illustrated in the May issue of the STREET RAILWAY JOURNAL.

THE ASHCROFT MANUFACTURING COMPANY and the CONSOLIDATED SAFETY VALVE COMPANY occupied the same space and showed a full line of pressure vacuum recording gauges and safety valves.

THE STANDARD UNDERGROUND CABLE COMPANY occupied a space among the other wire manufacturers and showed samples of its standard wires and cables for underground work arranged on racks and tables. Cables for general electrical purposes were also exhibited.

THE FOREST CITY ELECTRIC COMPANY was represented by W. B. Cleveland and J. C. Dolph. The company showed a panel upon which were mounted samples of roll drop and drop forged bars, also single bars, some of which were made up in the form of commutators.

THE NILES TOOL WORKS had a large space in the main hall and showed a variety of heavy machine tools operated by electric motors. These included horizontal and radial boring machines and other tools suitable for street railway repair shops. E. D. Becker represented the company.

THE OKONITE COMPANY'S booth was artistically draped in yellow and attracted much attention. Among other interesting objects shown was an immense piece of crude rubber nearly 700 lbs. in weight. Capt. W. L. Candee, G. I. Mason and R. Mace represented the company.

THE FUEL ECONOMIZER COMPANY, whose economizers are regarded with such favor by steam engineers, exhibited some of the parts in the construction of its economizers such as tubes, headers, etc. Plans and prints of complete economizers were also shown. W. Downs and W. E. Cryer were present.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY was represented by H. B. Cutter, E. A. Newton, W. E. Harrington and S. L. Nicholson. The company showed a variety of its automatic

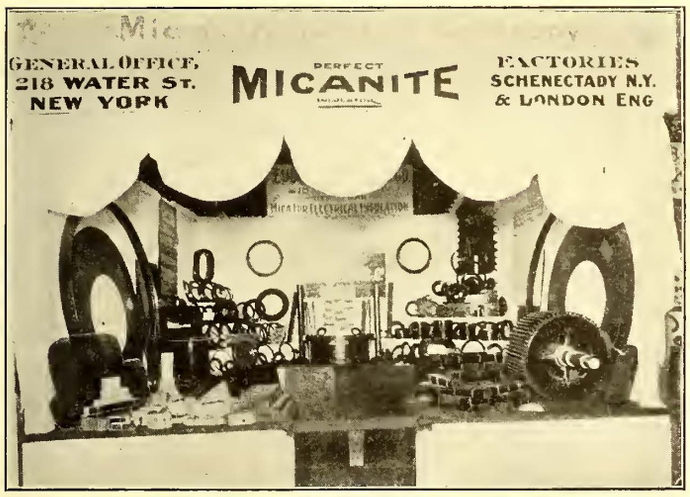


EXHIBIT OF MICA INSULATOR CO.

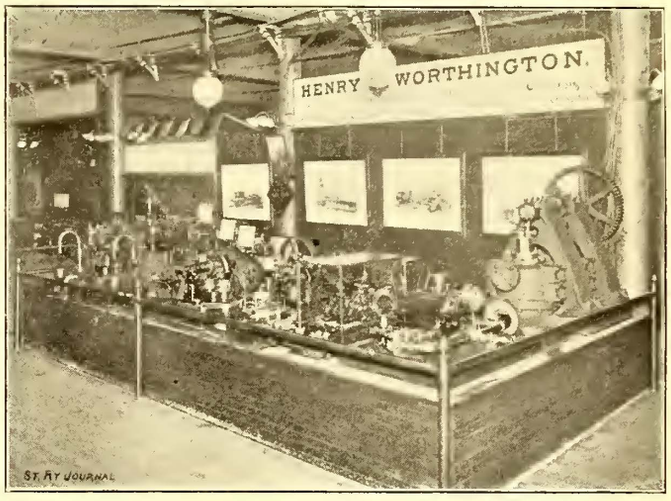


EXHIBIT OF HENRY WORTHINGTON.

THE BISHOP GUTTA PERCHA COMPANY showed the process of the manufacture of its Bishop wires by means of samples of rubber in various stages of manufacture, as well as a line of completed cables.

THE INDIA RUBBER & GUTTA PERCHA INSULATING COMPANY, manufacturer of the well known Habirshaw wire, had an attractive exhibit in charge of J. W. Godfrey, F. W. Harrington and J. B. Olson.

THE MICA INSULATOR COMPANY occupied a tastefully arranged booth in which were shown samples of micanite in its various forms, including two five foot moulded micanite rings, and an armature with micanite insulation.

THE FIBERITE COMPANY had a space in the generator room, near the exhibit of the Warren Electric Company, and showed Medbery station switches and overhead line material for street railway work. The exhibit attracted no little interest.

THE WALKER COMPANY had on exhibition a dynamo in the power room. This machine was equipped with the company's new type of brush holder and attracted much attention. The company's representatives present were Messrs. Crafts and Issertel.

THE TAUNTON LOCOMOTIVE MANUFACTURING COMPANY had an exhibit of the well known Wainwright feedwater heaters. In this company's exhibit were corrugated copper gaskets, expansion joints, etc. The company was represented by B. F. Ager.

KEASBEY & MATTISON had two exhibits, one on the main floor and the other on the generator floor. They showed models of boilers protected by their covering, also sections of magnesia pipe covering. The exhibit was in charge of C. Leitz and E. M. Griffiths.

THE HEINE SAFETY BOILER COMPANY occupied a portion of the generator room and was represented by H. L. Van Zile and R. T. Walker. The principal object shown was a carefully constructed model of a Heine boiler showing arrangement of the pipes and other features.

cut-outs for cars and stations and the exhibit as a whole elicited most favorable comments.

THE BABCOCK & WILCOX COMPANY occupied a large space in the generator room and exhibited portions of its well known water tube boilers which have achieved such excellent records in street railway power houses and for the generation of steam. The space was attractively arranged and was a center of interest to the electrical men present.

THE ADAMS-BAGNALL ELECTRIC COMPANY had an interesting exhibit of its new arc lamps which are adapted to all conditions of service. In front of the company's exhibit were two large letters forming the initials of its name and composed of varicolored incandescent lamps. The exhibit was in charge of L. H. Rogers, A. D. Dorman, A. B. Caldwell and E. J. Bagnall.

THE C. W. HUNT COMPANY had one of its noiseless coal conveyors in operation to supply the coal necessary for the Abendroth & Root boilers which supplied steam for power purposes. The characteristic feature noticeable with these conveyors was the entire absence of noise when they were doing their work as well as the neatness and despatch with which the coal was handled.

THE ELECTRIC STORAGE BATTERY COMPANY had one of the largest and most attractive exhibits on the main floor. In the center of the exhibit was an electric launch equipped with storage batteries ready for operation. At one side was a horseless carriage operated by storage batteries. At the rear of the exhibit were rows of the different types of batteries manufactured by the company.

THE PECKHAM MOTOR TRUCK & WHEEL COMPANY occupied a good sized space on the main floor and showed one of its Standard trucks ready for equipment. E. G. Long had charge of the exhibit. As Peckham trucks, under Lexington Avenue cars, were passing in front of the building every half minute or so, all persons who attended the exposition had an opportunity to judge of their merits.

THE LOANDO RUBBER COMPANY, manufacturer of rubberized

asbestos insulation and hard rubber showed its material made up into a variety of different forms. Rubberized asbestos, it is claimed, is fireproof even under the powerful heat of the arc lamp and is consequently especially adapted to electric railway work. Mr. Scribner president of the company, explained the merits of the company's products.

One of the most interesting exhibits among the boilers in the generator room was that of the Stirling Company. Here were shown a standard Stirling safety water tube boiler of one hundred horse power erected and ready for use with the exception of the brickwork. The arrangement of the boiler was clearly visible, and the simplicity of the general design and few working parts were favorably commented upon.

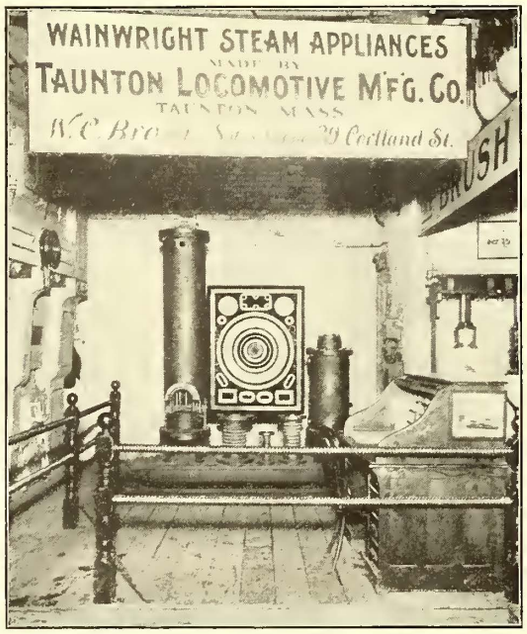


EXHIBIT OF TAUNTON LOCOMOTIVE MANUFACTURING CO.

The Shultz Belting Company had an attractive exhibit of its belts including also a model in motion of the well known Shultz trademark showing the earth belted to the moon. The company also supplied the twelve inch raw hide belt coupling the Warren alternator to the Weston engine, and the twelve inch sable raw hide belt connecting the Crocker-Wheeler alternator to the New York Safety Steam Power Company's engine.

The U. S. Mineral Wool Company exhibited corrugated copper gaskets showing samples which have been in use for ten or twelve years in the plant of the New York Steam Company, also mineral wool for different purposes. This material is a nonconductor of heat, fireproof and will not harbor vermin. It has been extensively used in building construction and for pipe coverings. The exhibit was in charge of H. Frenz and F. A. Lutters.

The Standard Paint Company occupied a tastefully arranged section of the main hall. The space was devoted, of course, to showing samples of the company's well known P. & B. preservative paints and compounds and other specialties. These were arranged in glass cases or built up in pyramids. The company's representatives present were F. S. DeRonde, R. L. Shainwald and J. N. Richards, who were kept busy explaining the merits of P. & B.

H. R. Worthington had a large space in the main hall devoted to the well known pumps bearing his name. These were both for steam and electric driving, and the exhibit attracted very much attention. The Worthington exhibit in the generator room was also of interest. A boiler was shown of the water tube type, so designed that it can be fired at the end or side. The grate and fire box were lighted up with incandescent lamps to better show the arrangements.

The Safety Insulated Wire & Cable Company had one of the largest exhibits of any of the wire manufacturers. Samples were shown of cables for both electric light and power purposes, for telegraph, telephone and submarine lines. Along the side of the company's booth were attractive signs and pictures arranged to be lighted up at night by electric lamps. The representatives present were L. F. Requa, L. K. Clark, Jr., I. W. Henry, L. F. Requa, Jr., and H. T. Richards.

The Westinghouse Electric & Manufacturing Company occupied space fronting the main hall, and it was devoted mainly to an exhibit of the company's lighting and long distance power transmission apparatus. A large number of converters of various types were shown as well as two phase motors and single phase self starting motors, and Shallenberger metors. The company's interests were in charge of C. F. Scott, W. F. Zimmerman, Lemuel Bannister and E. H. Heinrichs.

The steam for the engines was generated by two improved Root water tube boilers of 500 h. p. each, these being the only working boilers at the exposition. The boilers were fitted with Wilkinson automatic stokers supplied with coal by a Hunt conveyor and fed by a Worthington electric pump. An interesting feature of this exhibit was the fact that the entire charge of the boilers was taken by Mrs. Walten, demonstrating the fact that with the stokers and boilers employed, but little attendance is required.

The Jewell Belting Company presented for inspection a variety of belts for electric railway service. These included a four-ply seventy-nine inch belt, one inch thick, for use by the Washburn & Moen Manufacturing Company, a three-ply sixty-nine inch belt, sold to the Norwich Electric Light Company, and a forty-eight inch belt, for use in the station of the Passaic Electric Light Company. The company's representatives present during the exposition were C. E. Newton, C. E. Ainsworth and C. L. Tolles.

Joseph Dixon Crucible Company exhibited a line of its different lubricants, including passenger car grease, which has given good results on electric cars, and cylinder graphite oil. A number of electrical devices made of graphite were also shown, such as resistance rods, links, coils and blocks. In one corner of the exhibit was a piece of commercially pure graphite, the largest ever mined. It was also shown at the Paris and Chicago Expositions, and weighs 280 lbs. The exhibit was in charge of John H. Baird.

One of the most popular exhibits in the main hall was that of the American Heating Corporation. This company showed a great variety of cooking and heating appliances, the uses of which were explained by the courteous representatives present. Of course, street railway heaters of various forms were shown and the excellent records made by this company's heaters during the past winter on electric roads made these appliances of particular interest to street railway men. L. L. Parsons had charge of the company's interests.

The New York Carbon Works had a most interesting exhibit of granulated carbon and carbon dust, carbon plates, cylinders and motor brushes. The company has made a specialty of the manufacture of the latter which it is supplying in large numbers for electric railway work. The brushes are self-lubricating, require no attention, and are said to eliminate the sparking, heating, humming and scratching common with ordinary brushes. The brushes are manufactured in three quantities, soft, medium and hard, and of any desired size.

The J. G. Brill Company occupied a prominent position in the main hall and exhibited a complete No. 21 truck. At each side of this truck were statements that the No. 21 F truck was running under open cars on the Broadway, New York, line and was in use under several closed cars and that the No. 21 C truck was in use on the Brooklyn Heights Railway and the lines of the Consolidated Traction Company, of New Jersey. Also that "more than 14,000 Brill trucks of the different styles have been supplied to American electric railways."

EXHIBIT OF BRADFORD BELTING CO.

John A. Roebling's Sons Company made no extended attempt to exhibit the various appliances which it manufactures for electrical work, but had a handsome parlor which its friends found most comfortable and convenient. It was fitted with rugs, curtains and comfortable easy chairs and decorated with views of the company's works. There were also samples of the different kinds of wire cables supplied by the company. The representatives of the company present were A. N. Whitaker, G. Swan, M. R. Cockey, F. J. Newbury, Joseph Cory, J. H. Janeway, Jr., and W. L. Doyle.

The Goubert Manufacturing Company had its headquarters in the generator room and exhibited models of its heaters and separa-

tors. The steam plant of the building was also fitted with a Goubert heater in operation and Stratton separators were also in use on the engines. Several large pictures of installations made by the company were also shown. An interesting feature of this exhibit was the method of indicating the name of the company at the back of the booth. This was by letters on glass disks of different colors which were held by wire brackets in front of incandescent lamps, making a very brilliant show at night. The exhibit was in charge of A. C. Larkin.

THE R. D. NUTTALL COMPANY had as usual an excellent exhibit and the appliances shown attracted much attention from the street railway men present. They included gears, pinions and trolleys. Among the latter was the "Union Standard" spring trolley with seven inch base. This trolley, it is stated, has been adopted as standard by the Westinghouse and General Electric Companies. The company also showed a fine line of bearings and aluminum and brass trolley heads including "Eureka" and "Eclipse" types. Among the pinions was one recently turned out of cast steel for a Westinghouse 800 h. p. motor and designed for high speed work. The company was represented by F. A. Estep and T. J. Lord.

THE WASHBURN & MOEN MANUFACTURING COMPANY'S exhibit was one of the most tasteful and attractive on the main floor, and showed the immense facilities which the company has for the manufacture of wire of various forms and sizes. A large reel of 500,000 c. m. feed wire for street railway work, which is both weatherproof and lead covered, occupied a prominent position in the exhibit. Prominent features of the exhibit from a street railway service besides this were the Chicago rail bond, manufactured by the company, sections of new type of trolley wire for high speed work, "Crown" wire for underground purposes, and samples of feed wire as large as 2,000,000 c. m. The ability of the company to manufacture wire of the smallest size was clearly exhibited by some samples of copper wire of as small diameter as ¼ of .01 in. The company's exhibit was in charge of C. W. Bassett, H. C. Willis and D. P. Fitzgerald.

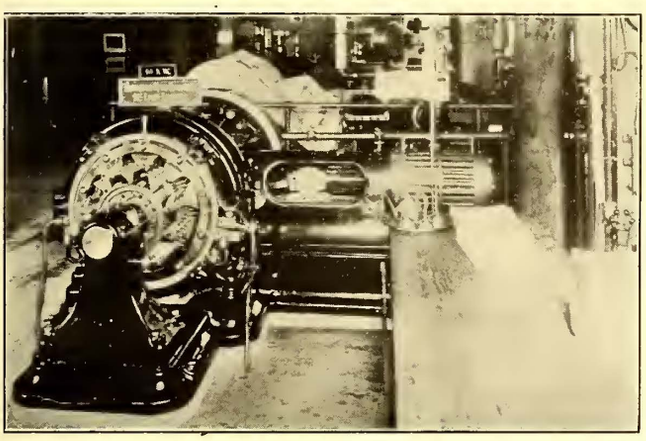


EXHIBIT OF J. H. McEWEN MFG. CO.

THE CRANE COMPANY had a very elaborate exhibit of valves. In the center of its space was a twenty-four inch valve with by-pass. This valve was tested to 800 lbs. pressure and was designed for a working pressure of 250 lbs. The company also showed 16 in., 8 in., 6 in., 4 in. and 2½ in. valves, all taken from stock, as well as extra heavy globe and angle valves from eighteen inches downwards to one inch, blow-off valves for high pressure and Crane's new brass globe and angle valves. These have one peculiar feature, being able to use hard brass disks, Crane patented tin disks or composition disks in the same valve. Another important feature of this disk holder is that it is so constructed as to take any size of disk. The company also showed check valves, noiseless check pressure valves, pop safety or water relief valves, mocking bird steam whistles and patent low water valve, also extra heavy unions with metallic disk and heavy cast iron fittings from eighteen inches down. The exhibit was in charge of Fred. Mitchell.

THE GENERAL ELECTRIC COMPANY occupied one of the most prominent positions in the hall, fronting the center space on the main floor, and the exhibit was devoted mainly to illustrating the company's extensive line of appliances in the lighting industry. The decorations were very tasteful and were made up largely by artistic groupings of lamps, one of which gave the name of the company; another was in the form of a sun; a third showed an eagle surmounting a shield. There were also two attractive illuminated pictures, one entitled "Mischief Brewing" and the other "Homeward Bound." The former represented a woodland scene with witch and gnomes, and the latter a ship on the ocean under full sail. The company's extensive railway interests were not neglected, however, as photographs were shown of some of its most important installations, such as of the Baltimore & Ohio electric locomotive, and of the Portland and Sacramento power transmission plants. Some of the company's representatives present during the exposition were: S. D. Greene, J. R. Lovejoy, W. R. L. Emmett, H. C. Wirt, J. Kirkland, and J. M. Andrews, of Schenectady; C. T. Hughes, John McGhie, T. Beran, C. G. Davenport, of New York; C. B. Davis and F. B. Kimball, of Boston, and A. D. Page and M. K. Eyre, of the Harrison Lamp Works.

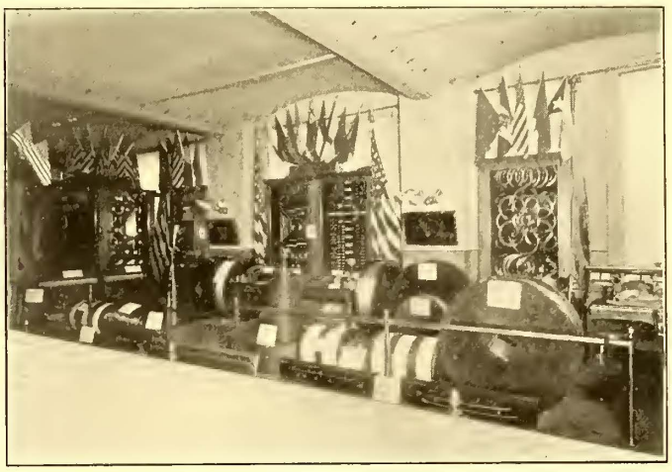


EXHIBIT OF WASHBURN & MOEN MFG. CO.

AN EXHIBIT that attracted an unusual degree of interest was that of the Bradford Belting Company. The Monarch insulating plant of this company has been on the market for the past three years, and while its sale has not been pushed as the goods deserved the Bradford Belting Company, which has now secured exclusive control of it, is meeting with a wonderful success in its sale. The paint is a mineral production containing quick drying natural oil and is intended for every kind of electrical work where perfect insulation and great durability are required. It is impervious to acids, salt or alkali and is not affected by climate changes. Wood, paper and other inflammable material dipped into the paint are made absolutely fireproof and when asbestos was brought to a white heat the paint was not affected. A piece of iron coated with the paint was laid in a flamable torch until the iron became exceedingly hot, when it was found the paint was not effected; the iron direct from the flame was inserted in a pail of water and cooled off; the paint was found still intact, retaining its beautiful gloss and was not blistered. The exhibit was in charge of Elmer P. Morris and O. M. Hubbard. The company also exhibited its celebrated brand of (Bradford) Monarch and leather belting, both of which are well known. In connection with the exhibit a phonograph entertained visitors with songs and music and at intervals spoke of the merits of the Monarch paint and Bradford belting.

THE POWER PLANT.

Probably the most interesting part of the exhibition to the street railway men present was the power plant, where were grouped a large variety of engines and generators in active operation generating power for the exhibit. The following is a list of the engines shown:

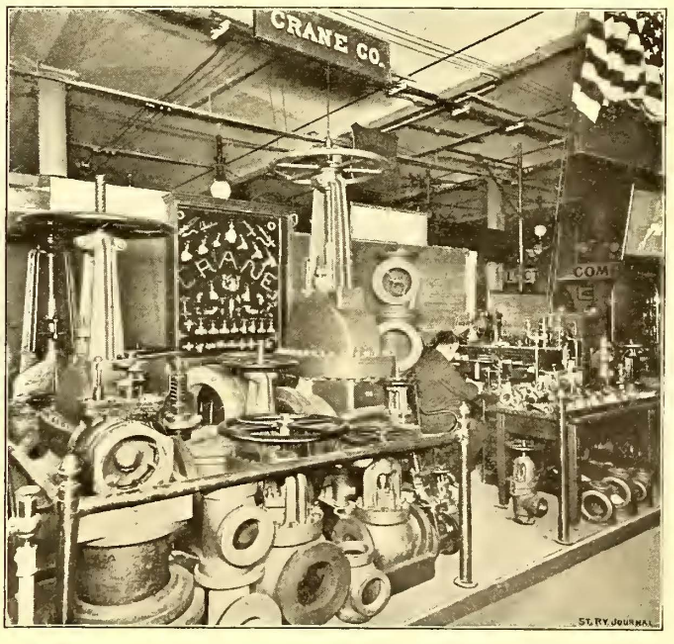


EXHIBIT OF CRANE CO.

One Dick & Church, 11 in. × 17 in. × 12 in. tandem compound, direct connected to a Walker 80 k. w. generator.

One Ball & Wood, 14½ in. × 16 in., direct connected to a Siemens & Halske 100 k. w. generator.

One Straight Line, 15 in. × 30 in., direct connected to a General Electric 75 k. w. generator.

One Ideal, 12 in. × 12 in., direct connected to an Eddy 40 k. w. generator. This couple while operating at 300 r. p. m. was supported on three points without fastenings of any kind to show the absence of vibration while running.

One Watertown, 10 in. × 12 in., direct connected to an Eddy 30 k. w. generator.

One Shepherd vertical engine direct connected to an Eddy 10 k. w. generator.

One Payne, 10½ in. × 12 in., direct connected to a Card 25 k. w. generator.

One McEwen, 10 in. × 10 in., direct connected to a Thompson-Ryan 40 k. w. generator.

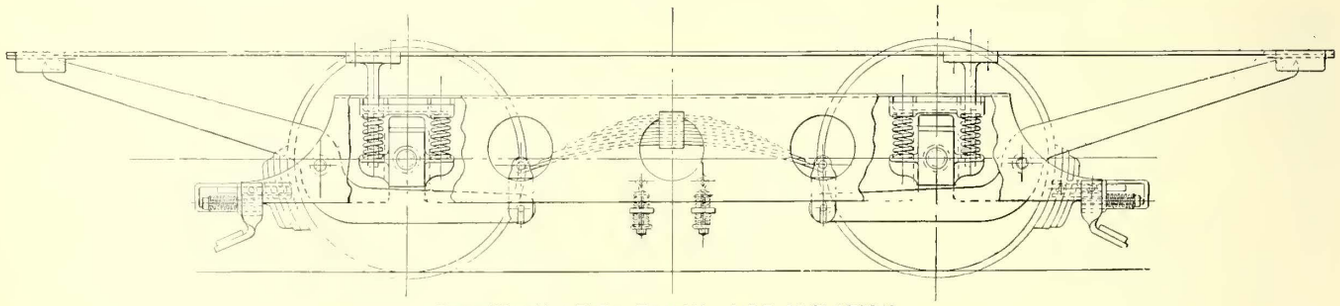
One Woodbury, 10 in. × 12 in., operating a Fort Wayne lighting generator.

One New York Safety Steam Power Company's engine, 13 ins. × 12 ins., belted to a Crocker-Wheeler 55 k. w. generator.

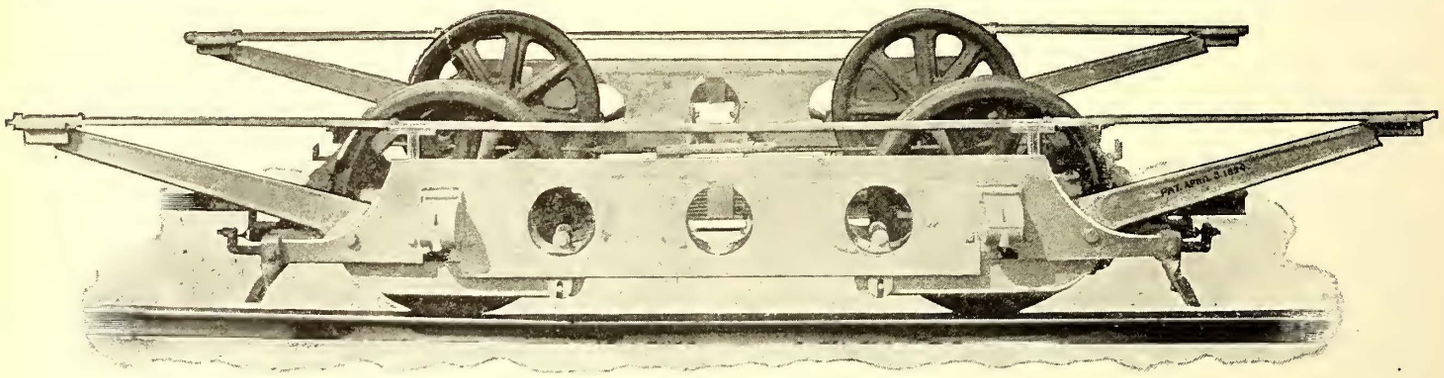
One Weston (Imperial), 12 in. × 13 in., belted to a Warren alternator.

Extension Lever Truck.

The accompanying engravings show the Hardie & Leary extension lever truck for cable and electric cars manufactured by Bell & Company. As will be seen the truck is of novel construction. One striking feature is the use of solid plate steel as side frames. The frames are, of course, free from bolts and rivets, making this part of the truck simple in construction. From the side frames project the extension rods and levers for supporting the ends of the car, and the arrangement of springs used is claimed to make the truck exceedingly easy riding, with freedom from lateral or longitudinal oscillation or tectering.



EXTENSION LEVER TRUCK—SIDE ELEVATION.



GENERAL VIEW OF EXTENSION LEVER TRUCK.

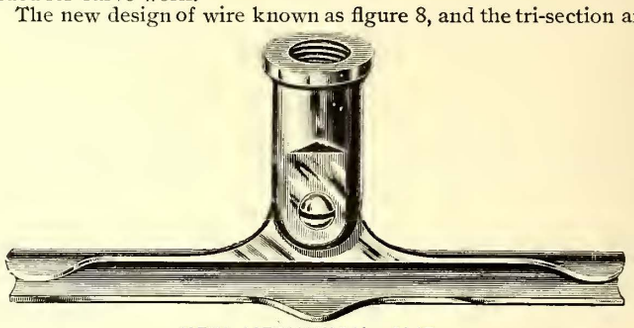
The brake gear is also of novel construction, positive in action, and durable. The truck shown has a wheel base of six feet six inches and spring base of seventeen feet.

New Mechanical Clip.

One of the latest efforts in the direction of a mechanical clip is made by the railway department of the Central Electric Company and is shown in the accompanying illustration of the Central Company's flexible clip. This the company is making in seven inch and fifteen inch lengths either flexible or rigid to fit ⅝ in. and $\frac{7}{16}$ in. studs. They are very quickly placed in position. The intention is to overcome the objectionable features of rigid construction and permit expansion and contraction of the trolley wire without drawing the clip out of line so that it would offer an obstruction to the trolley wheel which would cause pounding.

The "Central" clip is perfectly straight under running. The groove for this clip has a small incline from the end towards the center, not sufficient to kink the wire, but just enough to prevent the hanger from crawling. It can be placed in position without the removal of screws or the use of special tools. The rigid clip is intended for curve work.

The new design of wire known as figure 8, and the tri-section are



NEW MECHANICAL CLIP.

receiving considerable attention from railway builders. The Central Electric Company is preparing a special line of overhead material designed to be used in connection with this new wire. The company reports that business in all branches of its railway department is constantly improving.

Electric Headlights.

In these days, when the public demands increasingly rapid transit in both city and suburban travel, railway managers are required to give much closer attention to points of safety than was necessary under the older system. This necessity has led to the special consideration of fenders, air brakes and headlights. As speed of travel has increased the necessity has arisen for a standard of illumination of the roadway approximating that given by the locomotive headlight and the conditions grow more nearly identical as cross country roads seek more and more to approach the schedule time of their steam rivals.

To supply this demand the Wheeler Reflector Company, known by the variety of reflectors and lighting specialties manufactured by it, has produced a new headlight possessing several features which especially commend it to railway managers. The headlight is equipped with a parabolic reflector 10½ ins. in diameter, giving a brilliant illumination to the roadway. It is made for attachment to the front of the dashboard or vestibule as a permanent fixture, being equally adapted to both. Its outer case is of malleable iron and projects but 4½ ins., therefore is protected from end collision by the bunter. Its weight complete is ten pounds. It is well ventilated, yet substantially proof against dust and water. The economy of maintenance of electric, as compared with oil headlights, is in favor of the former, while the pleasure and comfort of patrons and motormen are two additional points of advantage in favor of the electric.

STREET RAILWAY NEWS

Annual Convention of the California Street Railway Association.

The annual meeting of the Street Railway Association of California, was held Apr. 21, 1896. The meeting was called to order at 1.30 P. M. in Maple Hall, Palace Hotel, San Francisco, by C. F. Crocker, president of the association and president of the Market Street Railway Company.

The following persons were present: Col. C. F. Crocker, president; S. B. McLenegan, vice-president; J. E. Morris, secretary and treasurer; E. P. Vining, M. D. Stein, A. W. Barron, G. H. Fairchild, H. A. Iddings, J. C. Skinner, C. J. Kaighin, F. A. W. Shock, E. N. von Frank, G. A. Loring, G. Gustafron, Walter Tiffany, S. L. Foster, J. P. Burke, H. A. Greene and E. O. Vandercook.

The first paper presented was by Mr. Foster and was entitled "Ascending Grades by Electrical Force." This is given in full on p. 371, and following pages.

MR. MCLENEGAN: In going down the Fillmore Street grade do you use your motors with the brakes set?

MR. FOSTER: None of my men have done that; but I am aware that by putting on the brakes part way and turning the current on they can prevent the wheels from sliding.

MR. MCLENEGAN: On the road to which I am attached we operate a very heavy funeral car, and very frequently it is very difficult to keep the wheels from sliding. In a case of that kind the motorman has avoided flattening his wheels by setting up the brakes with the current on and it has saved us a great many flat wheels.

Mr. Vining then read a paper upon the subject of "Transfers."

After reading the paper Mr. Vining continued:

MR. VINING: One remedy which has been tried is to have the transfer check identify the passenger by some kind of a description, but it would not work. The travel is so great that it would be impossible for the conductor to issue so many transfers and stop to punch each one separately in the limited time he has. Then, of course, there is a liability of error in punching these transfers. If 99,999 transfers were handled without an error and the 100,000th has an error this would enable the holder of the 100,000th transfer to get large damages. Therefore that method of handling transfers seems to be impracticable where they are issued by millions. The best way is to limit the time very closely. The closer the time can be brought the better it is; the less negotiable they are. An agent stationed at a place where transfers are given out can do a great deal to break up the illicit traffic which exists in these checks. We have tried that and the result has been so encouraging that we shall soon try it at other points. But this, of course, is very expensive and it takes a great many nickels to pay the salary of the man who is employed in that way, and to pay all the incidental expenses. But this much would be accomplished. The men would give us the benefit of their knowledge and observation in breaking up the evil which now exists.

MR. MCLENEGAN: I suppose all this will be remedied when we have to carry passengers for 2½ cents.

Speaking upon that subject I will say that I saw an article in a railroad journal which introduced a report made by the railroad commissioners of Massachusetts. They gave a long list of the expenses of operating over the different railways of the state, and with the exception of some three or four roads, and these of little importance, there were none in the state which do not pay out in expenses three cents for every passenger carried. In some cases four cents or more were paid out. On many of these lines the men did not receive over $1.25 per day. We pay just about double that price, so that if they scheme to reduce the fare it will be found even more impracticable here than it was in the East. It has been declared impracticable by the railroad commissioners of Massachusetts. They presented to the legislature a report showing that almost without exception (and these only three or four) the actual cost of operating is over three cents, in many cases running over four cents and in some cases five cents.

MR. SHOCK: Have you had any trouble from an exchange of transfers between your employes, or from a traffic in transfers by your men?

MR. VINING: We find that it has existed to some slight extent among the employes, but the system of supervision that is used makes it very likely to be detected.

MR. MCLENEGAN: It seems to me that under the present system it is very hard to limit the time very closely, and that as transfers are now arranged with a chance to hold them over at least a half an hour, there will always be opportunities to trade them off. It seems to me that the only salvation is to limit them to a very much shorter time. There is one road in San Francisco using a different transfer; that is the Sutter Street line, which uses a continuous transfer. I suppose it is more economical in the matter of printing, but it seems to me that it affords employes an unlimited opportunity to give them to their friends or to anybody that may be disposed to accept them.

MR. VINING: We find it pretty difficult with a car loaded with passengers whom it is necessary to provide with transfers in a limited time to punch the check more than twice. There can be only one punch to indicate the time. Therefore it is necessary to indicate the hour and minutes on the ticket. We formerly had tickets which were limited to the hour and half hour. They now have twenty minutes on one side and forty minutes on the other. With a car loaded with passengers it is impossible for a conductor to do more. Where transfer agents are located, however, it is quite possible to punch the five minutes limit because the agent has more time in which to do it.

Mr. McLenegan then read a paper upon the subject of "Registration of Fares and Transfers."

MR. STEIN: Referring to that portion in relation to legal tender, a passenger in New Jersey was recently put off the car because the conductor refused to take a $20 piece. Suit was brought in the United States Court and it was decided that the conductor should have changed the money.

MR. VINING: In a case reported in the California reports, the Supreme Court of California held that a conductor was under obligation to use all reasonable means to endeavor to make change for a $5 piece which had been tendered. It was said that the passenger must tender a reasonable sum and that the carrier must accept such tender and must furnish change to a reasonable amount. It was held that it was necessary on both sides to use all proper efforts, one to accommodate the other and it was decided that the conductor might have made further efforts, that he might have stopped a car going in the opposite direction, that he might have asked the passengers, that he might have done something more than he did to secure change for the five dollar piece.

MR. SHOCK: What do you consider the best portable register?

MR. MCLENEGAN: We are using one that was manufactured in San Francisco. I think it is called the San Francisco register. It is light and good for the purpose, but if I were going to start out afresh I would prefer to have a stationary register over any other kind.

MR. SHOCK: I like the stationary register the best. We are using a St. Louis register which is very good.

MR. BURKE: What would you do in a case where a $20 gold piece had been tendered by a passenger who had several small coins in his pocket, but who insisted that the $20 gold piece be accepted?

MR. MCLENEGAN: I would let the conductor keep the coin, and make the passenger go to the office for his change.

MR. VINING: I presume the decision to which I referred would cover the case, in that it was held to be the duty as well of the passenger as of the conductor to use all reasonable means to make the change.

MR. MCLENEGAN: I do not think that a case of this kind, if carried to the court, would find any favor. It would be evident that the passenger had intended to harass and annoy the conductor, and I do not think he would have any standing in court.

Mr. Shock then read a paper upon "Long Distance Transmission of Power." It is published on p. 373.

The next paper read was one by Mr. Stein on the subject of "Fenders."

MR. VINING: Some little time ago I received from the Board of Supervisors a pamphlet advertising a fender in use in an Eastern city not nearly as large as San Francisco. During the fif-

teen months in which the fender had been in use the result was as follows: One hundred and twenty-six people were knocked down by the fenders, four of these people were killed and nine were seriously injured. According to the makers' own statement ten or twelve more were more or less seriously injured, and still more were somewhat injured. So you see that even according to their own statement there were about twenty killed or seriously injured, while there were one hundred more who were knocked down and more or less injured.

Now, during the same time, in San Francisco, with roads running through more crowded streets, during the first fifteen months of the operating of our electric system, only one-sixth of that number of accidents occurred; of that number four were killed. We had altogether sixteen accidents where they had 126. I think the comparison of these statistics shows very much in our favor. We know that it is the practice of all men when they see a car coming to calculate whether they can cross ahead of it or not. Almost every one rushes across ahead of the car, just barely in time to escape, and the adoption of a fender projecting beyond the front of the car is liable to cause six times the number of accidents that would otherwise occur. The accidents that we have had have all been either with small children who were too young to have been permitted to cross the street alone, or else with people who were not in the full possession of their faculties, owing sometimes to old age, infirmity or disease, but owing more frequently to intoxication.

Mr. Stein: There is no one of the fenders that we have tried which in my opinion equals the simple common pilot board attached to the truck.

Mr. McLenegan: I believe that more accidents occur if there are fenders on the cars. Most motormen think that their cars are equipped with a device which will prevent accidents and hence grow careless. I would like to ask the gentlemen who are connected with the Market Street Railroad what their experience has been with the electric brake.

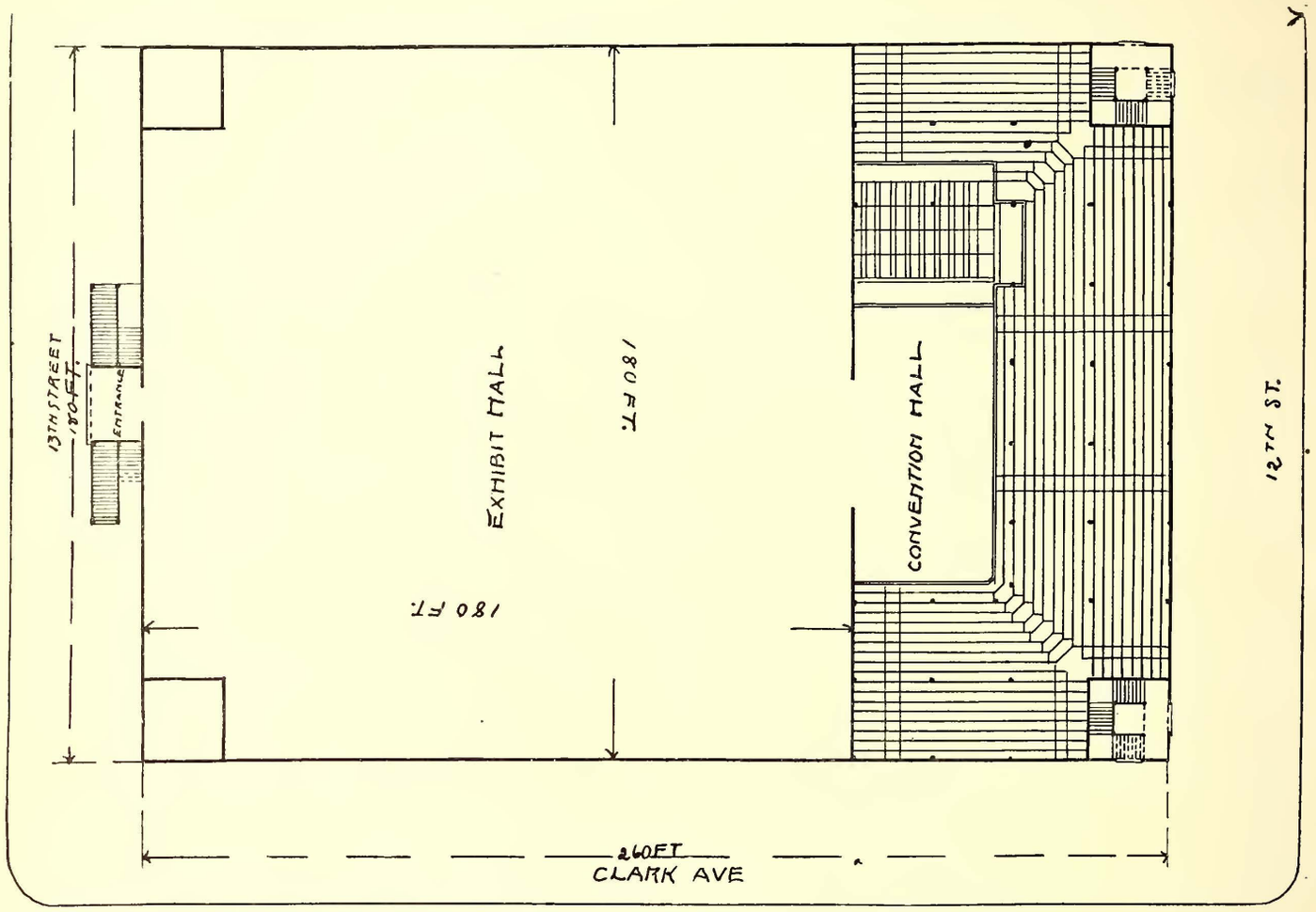
Mr. Stein: We have been running it only about two or three weeks, but to give it a fair trial it should run six months at least, before we could really determine its efficiency and usefulness. So far no defects have developed.

The meeting adjourned *sine die*.

Exhibits at St. Louis Meeting A. S. R. A.

In addition to the information given last month about the plans of the Committee on Exhibits, the circular issued by the Committee to manufacturers, which bears date of May 5, states that the price of space has been fixed at ten cents per square foot, no less than one hundred square feet to be assigned. The proceeds of the sale of space will go to the American Street Railway Association and checks should be made payable to T. C. Penington, secretary and treasurer A. S. R. A., 2020 State Street, Chicago, and should be sent in on or before Oct. 1, 1896. Applications for space, however, should be made to Mr. George W. Bauuhoff, chairman Committee on Exhibits, Park and Vandeventer Avenues, St. Louis, and must be received by him on or before Aug. 15. Assignments will be made as promptly as possible after that date and exhibitors notified of their location.

Possession of the hall can be had on Friday, Oct. 16, and it is earnestly requested that all exhibits shall be in place and the work finished by Monday, Oct. 19, which is the evening before the opening of the convention. Watchmen will be in charge of the premises so that exhibits will be safe.



INTERIOR OF THE NATIONAL REPUBLIC CONVENTION AUDITORIUM ESPECIALLY REMODELED FOR USE OF THE AMERICAN STREET RAILWAY ASSOCIATION CONVENTION.

A New Conduit Electric Railway in New York.

The Amsterdam Avenue extension of the Third Avenue Railroad Company of New York, the construction of which has been fully described in the Street Railway Journal, commenced regular operations on May 16. The line is equipped with the Love electric traction system and at present some six cars are in regular service in connection with the cable cars.

The Paterson Railway Company (Paterson, N. J.) has obtained the right of way from Garfield to Lodi and will probably extend its lines to that place. Application will be made to the Passaic and Bergen County Freeholders for permission to cross the Garfield Bridge, but it is likely that a new bridge will be built.

Annual Report of the Atlanta Consolidated Street Railway Company.

The Atlanta Consolidated Street Railway Company in President Hurt's annual report dated May 11, 1896, makes a remarkable showing for the year ending Apr. 30. In order to show this to the full extent, a comparison with the previous three years is given herewith. It will be seen that the company's earnings from operation are just double those of last year and its net income is $118,888 in stead of $23,588. This great increase in gross and net is due, of course, largely to the Cotton States Exposition, which was exceedingly profitable to the company.

Year ending Apr. 30,	1893.	1894.	1895.	1896.
Gross receipts from passengers	$351,568	$299,311	$292,467	491,379
Gross receipts other sources	510	329	2,378	6,911
Gross receipts total	352,078	299,640	294,845	497,290
Operating expenses	249,258	205,119	169,029	245,201
Earnings from operation	$102,820	94,521	125,816	a52,089
Deductions from earnings				
Interest charges		97,524	92,520	} 133,201
Taxes		14,066	9,708	}
Miscellaneous		7,974		
Net income		* 25,043	23,588	118,888
Per cent. op. exp. to total receipts	70.7	68.3	57.3	49.5

*Deficit.

BALANCE SHEET.—Dated Apr. 30, 1894.		1895.	1896.
ASSETS.			
Road and equipment*	$4,392,925	$4,384,775	4,385,468
Cash assets	22,624	6,838	4,828
Material	4,658	5,215	5,352
Bills and accts. receivable	758	9,835	2,400
Miscellaneous	798		5,520
Stock and bonds		25,000	97,000
Construction and equipment		70,478	
Total	$4,421,763	$4,502,141	$5,400,568
LIABILITIES.			
Capital stock	$2,000,000	$2,000,000	2,000,000
Bond account	2,153,000	2,178,000	2,250,000
Income bonds	212,000	212,000	106,000
Accrued interest	29,363		
Bills and accts. payable	20,094	88,552	144,568
Reserve	7,306		
Profit and loss (surplus)		23,589	
Total	$4,421,763	$4,502,141	$4,500.568

* Including profit and loss, $121,127.

It is worthy of note that the stockholders of the company have never received a dividend upon their stock. Only within the last two years has it been possible for the company to show any profit from its business and all of these profits have been used in paying the company's debts and increasing its transportation facilities. In spite of this and of the fact that the entire proceeds of the company's operation have been turned back to promote the city's growth, the company has been met with rather more than the usual amount of opposition from the citizens of Atlanta, who have been so greatly benefited by the enlightened policy pursued by President Hurt and his associates.

The car mileage for the year was 2,137,847, and the cost of operation per car mile was $.114. This item includes all repairs and renewals, but does not include the item of depreciation.

An Amusement Company.

The Street Railway Park Amusement Company is the title of a new corporation organized in Chicago, whose object is to supply street railway parks with amusements of different kinds. The managers of the company are said to have had an extensive theatrical experience, and with the rapid increase in number of street railway parks and the growing importance of this department of street railway operation, the field which this company will aim to cover is an important one. A number of contracts have already been made with street railway companies, and the firm is said to have secured a number of excellent drawing attractions.

The Lombard Oil Brake.

On May 25 a test was made on the Richmond Hill division of the Brooklyn Heights Railroad Company, of the Lombard oil brake. This brake was described in the STREET RAILWAY JOURNAL for December, 1895, but some improvements have been made which better adapt it to street railway work. The car upon which the tests were made was a long car mounted on Brill maximum traction trucks, and weighing about 16,000 lbs. The oil used is under 220 lbs. air pressure, and some very quick stops were made with the car running at a high rate of speed.

The Milwaukee Strike and Boycott.

A most peculiar condition of affairs is found in Milwaukee today. In the early part of April the street railway employes of the Milwaukee Electric Railway & Light Company struck for an increase of wages to twenty cents per hour instead of nineteen, the present rate, which was the result of a rise granted by the management some time ago. The demand was refused, the men were discharged, other men were obtained from outside cities and the cars are now running on regular schedule time.

But the citizens of Milwaukee are not riding, at least on the street cars. Old omnibuses, express wagons, drays and conveyances of all kinds have been chartered by sympathizers with the strikers and are running on the railway company's streets. A boycott has been declared against the company. Citizens who ride or whose wives, sisters or remote relatives ride, find their business quietly dropping away. Many local societies have formally pledged themselves not to use the street cars until the strike is settled. The new men employed by the company cannot find boarding or lodging houses among the people, but are housed and fed in camps at the various street railway barns, the provisions being obtained from Chicago with cooks, stewards, etc.

There has been not a little violence in the city, particularly since it is seen that General Manager Wyman is a man of determination and that there will be no compromise whatever with the strikers. The new men and the police officers have been attacked and the strikers have even gone so far as to pelt the cars with bottles containing sulphuric and muriatic acids, so that the clothing of the few passengers who were riding has been ruined. The Merchants' & Manufacturers' Association has passed resolutions declaring that the people are under a "reign of terror unlike anything in our history "and the mayor has issued a proclamaiion urging all persons to aid in restoring former conditions.

The ultimate outcome of the strike is not doubtful because the company will not under any circumstances yield to the strikers, but meanwhile there will be heavy loss of traffie until the people become tired of "cutting off the nose to spite the face." It appears that the company is unpopular with the people, chiefly because of the fact that its ownership is vested largely in the East and the people, as usual, forget the enormous sums of money which have been poured into the city by outside capitalists without the return as yet of a single penny in the form of dividends on stock.

New Brooklyn Bridge Contracts.

The trustees of the Brooklyn Bridge have awarded contracts for the equipment of the new power house and motors which are intended to operate the switching plant on the bridge. The Walker Company secures the generators—two 400 k. w. direct connected machines; Pullman's Palace Car Company will build the twenty passenger cars; the McGuire Manufacturing Company the trucks; the General Electric Company has the contract for motors; the Southwark Foundry & Machine Company the contract for two 600 h. p. engines; and the Babcock & Wilcox Company the contract for two 400 h. p. boilers.

The Walker 400 k. w. generators which are to be used in this plant were fully described and illustrated in the January number of the STREET RAILWAY JOURNAL.

Expected Lease of the Madison Avenue Line in New York City.

It is probable that a lease of the Madison Avenue line of the New York & Harlem Railroad Company, which is owned by the Vanderbilt interests, will be made early in June to the Metropolitan Street Railway Company, which has been for the last two weeks in negotiation with the owners. This line is part of the general railroad system of the New York & Harlem Company and cannot therefore be sold, as it has no capital stock apart from the stock of the main company. If a lease is made the lessee will undoubtedly equip it with some improved motive power.

The Efficieney of a Steam Boiler.

An interesting paper on this subject was presented by William Kent at the St. Louis meeting of the American Society of Mechanical Engineers. There has been much criticism in the past on the usual methods of obtaining the value of "combustible" from coal. This is from analysis of samples by a chemist, but Mr. Kent cites various examples showing that this method is far from satisfactory, as well as an instance where calorimeter tests varied eighteen per cent. in the same sample.

For these reasons he believes that the present determination of efficiency in boilers to be unreliable for a commercial standard.

THE Sterling Supply & Manufacturing Company reports such a large increase in its business that it has been obliged to add to its manufacturing facilities, and has recently taken in an additional floor at its works. A new department will be added shortly, that of the manufacture of overhead line material, and the company has secured a new insulation, for which excellent claims are made. In the register department the company has several hundred orders ahead.

San Francisco Notes.

The principle of centralization so well understood and extensively applied in the East has met the approval of a number of street railway men in Oakland, Cal. There are a number of electric roads whose power houses are located in the suburbs of Oakland, and the extreme end of whose systems converge at this city's business center. Coal has to be hauled to these distant power houses by wagon and their condensing facilities are not of the best. The Oakland Gas Light & Heat Company, controlling all the gas producing business of the city and most of the electric light business and whose large power house is located on the Oakland estuary where coal can be unloaded from the ships and unlimited qualities of condensing water can be procured, has decided to equip itself with some railway generators and supply current to many of these electric railways. The Highland Park & Fruitvale road has signified its intention of getting its power from the Gas Company as has the East Oakland road. The Haywards road and the Alameda road are expected to agree soon. The gas company by running large triple expansion condensing engines can sell power at a profit for less than these roads can produce it, for with their small high speed engines, many run noncondensing. Especially is this true of the portions of their lines in Oakland near the gas company's power plant and distant from their own and consequently subject to a heavy time loss.

Work on the Market Street Company's Folsom Street line is being rapidly finished. This work consists in changing from horse to electric traction a double track line four miles long and running through a thickly populated part of San Francisco and connecting the mission with the ferry terminus.

When this is finished the Fourth Street line is to be changed from horse to electricity. This line will be continued with the reconstructed cable line on Ellis and will run from the Southern Pacific Railroad depot at Third and Townsend out into the Western Addition.

The Alameda, Piedmont & Oakland Railway Company is rapidly pushing the work in changing its steam line to Laundry Farm to electricity. A line of bracket poles is being used to support the latest form of figure 8 trolley. The three wire system recently tried in Oakland has been given up. The lines so fed had many steep grades upon them and the loads on the two sides of the three wire system were continually getting out of balance. The larger portion of the lines were run on the two wire system. As the part run on the three wire system had but a few cars on it, one side of the three wire system was run on the regular two wire bus bars and the other side by a separate generator. When the line became so out of balance as to overload this one generator the whole system failed with the shutdown of the overloaded side.

S. L. F.

Graphite Bushings.

Self lubricating bushings are one of the many conveniences enjoyed by modern power users. While unsuitable under some conditions their use is so general that one does not often realize how much trouble and time they save. The tendency is toward their extended use especially in light high running journals and toward improvement in the line of their manufacture.

Graphite naturally suggests itself for this service, and the bearings of the Graphite Lubricating Company are making an excellent record. In trolley bushings they have given excellent results and the manufacturers have a letter from A. & J. M. Anderson stating that after careful consideration of various makes the latter had decided upon the graphite and bronze bushings of the Graphite Lubricating Company and had no reason to regret the choice. The last order given by the Anderson Brothers was for 5000 graphite and bronze bushings. Other manufacturers who use these bushings in certain parts of their machinery are the Ball & Wood Company, Ames Iron Works, Ball Engine Company, Shaw Electric Crane Company, American Engine Company and the Jeffrey Manufacturing Company. The Graphite Company was the originator and patentee of this method of lubrication and has never sold or given any rights to manufacture its bearings.

The bushings have done exceptionally well in trolley harps as they require no oil, are durable, and graphite aids the flow of current instead of hindering it.

Motors in a Freshet.

The qualities of an electric motor are best shown in the ability of the device to withstand the extraordinary conditions to which it may be exposed.

On Mar. 1, 1896, a very heavy freshet flooded the streets of Derby, Conn. and superintendent B. W. Foster thus describes the performance of one of his cars. "In order to bring out employes, who live on the east side to the car barn so that they could take the cars out on scheduled time, it was necessary to run the car across the causeway. This car had to proceed through water that was twenty-two inches deep for a distance of six hundred feet. After getting them over we continued the operation of this car on regular scheduled time for two hours, making eight trips, until we could get one of our old summer cars to be drawn by horses. At the end of each trip the cars were taken into the barn and carefully examined, the botton plugs being taken out to allow the water that was in the motors to drain off. This amount was very slight. The power was used on the last notch of the series connections. The wave caused by the motion of the car was sufficient to come up under the bumper and wash across the front platform, so that during one half of each round trip the resistance boxes were practically submerged."

Appreciation of American Hospitality.

The Dublin United Tramways Company has sent to a large number of street railway companies and individuals in the United States and Canada a card of acknowledgment for courtesies rendered to the members of its Board of Directors who recently made a tour of investigation in this country. The card reads as follows:

DUBLIN UNITED TRAMWAYS COMPANY.

At a meeting of the Board of Directors held on Tuesday, Nov. 12, 1895, it was resolved that the Board desire to express their acknowledgment of the courtesy, hospitality and universal kindness which the deputation from the company received during their recent visit to the United States and Canada.

Signed on behalf of the Board

Wm. Carte,
Wm. Anderson.

The card is stamped with the official seal of the company and is certainly a pleasant way of expressing the gratitude of the deputation for the many favors received by it in this country.

It is only fair however to say that while such courtesies are always freely accorded by Americans to all who have any official right to expect them, it is nevertheless true that they were given with even more heartiness and generosity than usual to the deputation which represented the Dublin United Tramways Company, because of the genial personality and high character of the gentlemen composing that delegation, who were cordially and thoroughly liked and respected from the moment they stepped upon American soil.

Meeting of the National Electric Light Association.

The nineteenth annual convention of the National Electric Light Association was held May 5, 6 and 7, at the Grand Central Palace, New York. There was a large attendance and a number of interesting papers were read. The following officers were elected for the ensuing year: president, Frederick Nicholls, Toronto; first vice-president, Henry Clay, Philadelphia; second vice president, J. J. Burleigh, Camden, N. J., Executive Committee, A. J. DeCamp, Philadelphia; John A. Seely, New York, A. M. Young, Waterbury, Conn., and H. A. Wagner, St. Louis, Mo.

One of the most interesting features of the convention was the opportunity afforded delegates and others to attend the Electrical Exposition held in the same building during May.

Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers was held May 19, at New York. The following officers were elected: president, Louis Duncan; vice-presidents, Charles P. Steinmetz, Harris J. Ryan, Wilbur M. Stine; managers, John W. Lieb, Jr., F. A. Pickernell, William L. Puffer, L. B. Stillwell; secretary, Ralph W. Pope; treasurer, George A. Hamilton.

Street Railway Contracts Abroad.

A contract for the construction of twenty-four miles of eable railway line in Edinburgh has just been placed with Diek, Kerr & Company, at a cost of about £205,000, this figure covering machinery and general construction. The same firm is also building cable tramways in Douglas, Isle of Man, at a cost of from £35,000 to £40,000, and will probably contract to reconstruct the present horse lines in that city this fall at an additional expense of about £40,000. Orders for cable and other tramway material have also been received from South Africa and other points in the British Isles and on the Continent, and these contracts, in connection with a very large pressure of work in the rail department, have loaded up the firm's extensive works in Kilmarnock to such an extent that delivery on contracts booked now cannot be promised earlier than August.

A good deal of interest is felt by foreign tramway companies and manufacturers in the results of the experiments in underground conduit work in New York and Washington, and it is felt that if these shall prove that a good conduit system can be devised that will work as economically as the overhead system, tramway work on a large scale will be undertaken in London, Manchester, Liverpool and elsewhere. British manufacturers feel that it is almost hopeless to expect that the large cities will permit overhead construction in the business streets, though they will doubtless have no objection to it in the suburbs. In a number of places however steam dummies are

being used, and it is thought that local authorities will welcome a change from these to the overhead electric system.

The fact that so much interest and uneasiness are being felt by British tramway managers regarding the future is significant as indicating that some change to better methods of propelling street cars is surely to come within a comparatively short time, and it is probable that the educational influences of the actual construction work which is being done in Great Britain will be greater, and the possibility of overcoming the prejudices of the British public against innovations will be more quickly demonstrated than is now believed possible by the more conservative manufacturers and promoters.

Fender Records.

Opinions upon the real value of fenders as protective devices differ so widely among street railway managers that specfic records of their performance in different cities will be of interest. Below is given the experience of the Union Depot line, of St. Louis, and that of the Consolidated Traction Company, of Jersey City, N. J.

The former has in daily service an average of 150 motor cars, all of which are equipped with Providence fenders. During eight months the number of persons that have been in imminent danger of being run over by these cars is fifty. Of these two were lying down, three were on bicycles and forty-five were on foot Of the two that were lying down one was an epileptic who had fallen with his head just outside the rail. Had the motorman not dropped his fender the man's head would have been cut off, for when the car stopped the wheels had passed him. He was not hurt. The other was a boy who fell in front of the car before the fender reached him. He was not hurt. The three bicyclists were rescued unhurt. In all three cases the speed exceeded five miles. Of the forty-five pedestrians, all but five were rescued unhurt, or with only insignificant scratches or bruises. Of the five that were hurt one threw himself under the car behind the fender and was instantly killed. It was the second time within a few days that the same man had attempted suicide in a similar manner. The other fatal case was that of a drunken man who reeled against the side of the fender and fell upon it, but rolled off and went under the car. A third case was that of a little girl who was successfully caught and carried till the car struck a curve, when she was thrown off in such a manner that her foot was crushed. The fourth case was that of a man who struck the east side of the fender and fell so that his feet went both under the pilot. None of these four persons was hurt before going under the car, and it is possible that had the car been provided with an automatic wheel guard they would have been seriously hurt. The fifth person had his ankle broken.

The report also shows that three horses and one mule have been picked up and carried some distance without injury to the animals. It is also stated that the fenders have sensibly lessened the damage to cars by acting as a buffer in cases of collision with other street vehicles. Whenever a motorman finds he must strike a vehicle in front, he drops his fender and thus accomplishes two objects; first, he lessens and frequently entirely prevents damage both to his car and to the other vehicles; second, he insensibly acquires the habit of instantly dropping his fender even more promptly than he can shut off his current or apply his brake. Those who object to giving motormen anything to do to avert personal accidents will appreciate the increased efficiency secured by making the man on the front platform responsible for so much of his employer's property.

The record made on the road of the Consolidated Traction Company of Jersey City and Newark by the same fender is even better.

From Oct. 1, 1894, to Dec. 31, 1895, there were 124 accidents with cars equipped with the fenders. The number of persons struck by the fender was 126.

Number rescued uninjured	85
" " slightly injured	19
" injured not seriously	6
Seriously injured	3
Degree of injury not given	9
Fatally injured	4
	126

Investigation has shown that the three persons reported seriously injured and the nine persons reported as injury not given, have all recovered, so that the record stands: 126 lives placed in jeopardy and 122 lives saved.

Since 1896 thirty-eight human beings have been struck by cars equipped with the fender. Thirty-seven of the persons were rescued uninjured. There was one fatal accident. A little boy four years of age was picked up by the fender, but before the car could be stopped, he rolled off from the side of the fender and in some unknown way was struck, probably by the journal box and was fatally injured.

In many of the smaller places like Staten Island and Hartford, Conn., where the fender has been in service a shorter period of time several lives have been saved and not one person killed by a car equipped with the device. The Providence Company has very strong letters from the general manager of the Consolidated Traction Company of Newark, of the Union Depot Railroad Company, and of other roads speaking in highest terms of the fender.

Use of Twin Rails on Crossings.

In reference to a statement which appeared in our columns last month regarding the use of twin rails on crossings, the Weir Frog Company writes to us that the statement is misleading, inasmuch as the Weir Frog Company is the owner of patent No. 249,707, granted Nov. 15, 1881, the fourth claim of which, it is asserted, broadly covers such use of supplemental or twin rails. It is also claimed that this patent secures the right to notch the flangeways of the running rails of the track mostly used, thus getting the full strength of the base, web, and in some cases a large portion of the head of the rails.

A Large Factory Output.

W. E. Cooke, general manager of the Peckham Motor Truck & Wheel Company, who has been giving his entire time of late to the problem of increasing the production of trucks at the Kingston factory so that it shall keep pace with orders received, has succeeded in making a record for the month of April, having actually turned out and shipped 290 trucks. Mr. Cooke has greatly systematized the work in the factory, and believes that he will be able to even exceed these figures of output from month to month. So far this year, over one thousand trucks have been shipped, and the company is still far behind in its orders, over four hundred trucks being down on its books for immediate delivery.

The Peckham Company has recently filled a number of foreign orders, shipping trucks for use in Yokohama, Japan; Melbourne, Sydney and Brisbane, Australia, and London. The American orders recently received call for trucks in Salt Lake City, Pueblo, Staunton, Va., Richmond, Va., St. Louis, Alton, Ill., Terre Haute, Ind., Gloucester, Mass, Worcester, Mass., Beverly, Mass., Woonsocket, R. I., Boston, Rockford, Me., Philadelphia and New York.

Mr. Peckham, who has been taking a well earned vacation in California for some two months past, is expected back in about a month and will be cordially welcomed by his many friends in the East.

Compressed Air Motors for New York.

The Metropolitan Traction Company has decided to test the value of compressed air motors for traction, and ten cars will soon be in service on one of its lines at the upper end of the city. The motive apparatus will be supplied by the American Wheelock Company, at whose works in Worcester, Mass., the equipment of the cars is now being carried on. Owing to the ample capital of the Wheelock Company and the engineering ability of its engineers, the test promises to be most interesting and one which will determine the value of compressed air for this class of work.

Standard Air Brakes Abroad.

The Standard Air Brake Company is in the front rank of those American companies which are receiving orders from abroad for the equipment of European electric railways. This portion of its business has not been neglected by the energetic general manager of the company, E. J. Wessels, and aided by the high reputation earned in this country by the brakes, they have enjoyed an excellent sale abroad. In the city of Leipzig alone the company has sold 215 brake equipments, while in other cities the brake has been extensively adopted. In the antipodes as well, the Standard air brake has gained an excellent reputation, as renewed shipments to Australia testify. Mr. Wessels states that their use in this country is also increasing, and that street railway managers are regarding this air brake with increased confidence and favor.

Excellent Boiler Results.

Dean & Main, mechanical and milling engineers, of Boston, and D. P. Jones, M. E., of Chicago, recently made a test on three Stirling boilers at the Waltham Bleachery & Dye Works at Waltham, Mass., which gave such excellent results that they are worthy of record. The percentage of moisture in the steam generated was only 0.58; water evaporated per pound of dry coal from and at 212 degs. F. 12.44 lbs., equivalent per pound of combustible from and at 212 degs. F. 13.03 lbs.

Thomas H. McLean.

Thomas H. McLean, who has been for over twenty years a prominent figure in American street railroading, has been engaged by the British syndicate of bankers and capitalists which has recently purchased the street railways of the City of Mexico, to undertake the reconstruction and management of that property, and after a brief trip to London, made during the past month, has departed for his new field of action. The selection of Mr. McLean by the syndicate was a high and well deserved tribute to his unusual ability as a manager and to the absolute confidence which can be placed in his honesty and judgment under the difficult conditions which he will have to meet.

Mr. McLean's record as a street railway manager is an interesting one. He entered the field in 1877, as secretary and manager of the Twenty-third Street Railroad Company, of New York City, which position he held for sixteen years, until June, 1893, when he became for a short time general manager of the Houston, West Street & Pavonia Ferry Railroad Company, which was then the lessee corporation of the properties now controlled by the Metropolitan Street Railway Company. During his connection with the Twenty-third Street line, he handled with consummate ability and entire success that portion of the great labor troubles of 1885–86

which affected his property, and achieved a reputation for stern determination and "grit" which has since stood him in good stead. In August, 1893, Mr. McLean was engaged as general manager of the Citizens' Street Railway Company, of Indianapolis, which position he held until early in the present year. Immediately after his arrival at Indianapolis in 1893, he was called upon to cope with another great labor struggle, which he did, again with entire success, breaking up a most powerful combination of labor unions which had for years made street railroading in Indianapolis an enterprise of great financial risk. In spite of these difficulties with his men, Mr. McLean has always been able to obtain the confidence and good will of his employes and associates, and this is particularly true in Indianapolis, where his departure is felt as a most serious loss.

The street railway conditions which Mr. McLean will find in the City of Mexico are, of course, very different from those in this country. The District Railway Company, which owns all the lines reaching from the heart of the city to various suburban districts, has 149 miles of single track road, of which 65 are in the city proper and the remainder in the suburbs. The road has 300 cars and 2800 mules, together with a large number of dummy engines. The cars have second and third class compartments (no first class), and the average fares amount to $.075 in Mexican silver, equivalent to about $.035 in United States money. The population of the city proper is about 344,000 and of the suburbs about 90,000.

The traffic is handled in a very pecaliar way. The cars all start from one central point and run in trains, so to speak, of five or six cars, each drawn by its own mules, to the outskirts of the city, where the mules are taken off, the cars coupled together and the trains are run by dummies out into the country. It is an odd sight to see these cars all starting out together on the various radiating lines, leaving the great Central Plaza entirely free from cars for some time after.

Mr. McLean will doubtless be obliged to experiment somewhat carefully before introducing all the improvements known in American practice, and it will be interesting to note the results to the City of Mexico from his work there.

Personals.

Mr. G. C. Kuhlman, of Cleveland, O., was in New York last month on a business trip.

Mr. G. D. Rosenthal, general agent at St. Louis for the General Electric Company, was married last month.

Mr. L. D. Mathes has been appointed superintendent of the Norfolk & Ocean View Railroad, of Norfolk, Va.

Mr. D. C. Deming has been appointed superintendent of the Buffalo Railway Company. Mr. Deming has been for some months acting superintendent of the company.

Mr. James McLaughlin, recently with the Philadelphia Engineering Works, Ltd., has been elected secretary and treasurer of the Barr Pumping Engine Company, of Philadelphia.

Mr. J. C. Cameron, formerly of the Brooklyn Heights Railroad Company, has been appointed superintendent of the New Jersey Electric Railway Company, of Paterson and Hoboken, N. J.

Mr. Frank X. Cicott, manager railway department, Pettingell-Andrews Company, of Boston sailed for Europe last month on the American Line steamer "New York," to be absent about two months.

Mr. A. H. Paget, son-in-law of Wm. C. Whitney, has been elected treasurer of the Metropolitan Traction Company, of New York. Mr. Chas. E. Warren, who has held the office of secretary and treasurer of the company, will remain secretary.

Mr. T. Commerford Martin, has been appointed by President Duncan, of the American Institute of Electrical Engineers, representative of that body at the celebration of the Jubilee of the Professorship of Lord Kelvin, which will take place in Glasgow, on June 16. Mr. Martin will sail June 6 and while absent will lecture before the Royal Institute on the subject of the Niagara Power Plant.

Mr. Henry G. Issertel, well known in electric railway circles, has formed a connection with the Walker Company, of Cleveland, O., as sales agent with headquarters at New York City. Mr. Issertel has been identified with electric railway matters since the early days of electric railroading during which time he acted in the capacity of consulting engineer and sales agent for several well known manufecturing companies. Mr. Issertel has been made a member of the faculty of the National College of Electro-Therapeutics, of Indianapolis, Ind., and now fills the chair of practical dynamic electricity.

Mr. R. E. Dunston, who has recently completed the construction of the Cortland & Homer Traction Company and who has been acting as superintendant of that company, has resigned his position. Mr. Dunston is by birth an Englishman, and has acted as constructing railway engineer both in that country and in Ceylon. In 1884 he came to this country to take charge of the manufactures of the Schuyler Electric Manufacturing Company, of Hartford, Conn., and in 1888 he organized the Connecticut Motor Company of which he was president and engineer. In 1892 Mr. Dunston took the general managership of the Wightman Electric Manufacturing Company of Scranton, then controlled by the Thomson-Houston Company. Two years later he determined to return to railway practice and took charge of the Cortland & Homer Traction Company. Mr. Dunston is an Assoc. Mem. I. C. E. and a Mem. Am. I. E. E.

Mr. Franklin Brooks, junior member of the firm of Eugene Munsell & Company, New York, miners and importers of mica, has recently returned from a trip abroad. Mr. Brooks has been away some six months, including in his itinerary London, Paris, and Monaco; then through the Mediterranean Sea, and Suez Canal to India, where he spent two months in the mica fields, in which the company is largely interested. He has brought home a large number of photographs, which are very interesting, and which have been procured at a great deal of expense. After having disposed of his business in the mica field, he visited Calcutta, and also spent some time in China and Japan; then returned by way of Vancouver and San Francisco. Some idea is gained of the magnitude of the mica fields from the fact that Mr. Brooks traveled about 4000 miles in that section of India alone. The firm imports mica direct from the mines and Mr. Brooks has completed arrangements whereby his firm will be in a position to supply mica to the electrical trade in larger quantities than heretofore.

Mr. Armistead K. Baylor, who has been connected with the General Electric Company for several years, has gone abroad in its interest and sailed for England, May 23, by the steamship "Campania." Mr. Baylor is but twenty-eight years of age, and is the man best qualified, in the opinion of the company and his friends, to undertake the responsible work which has been given him. He will devote himself to the railway interests of the British Thomson-Houston Company, Limited, licensees of the General Electric Company for Great Britain. Mr. Baylor's training for his new position is of the best, as he was formerly connected with the railway engineering department of the General Electric Company under W. H. Knight, and was assistant for the past two years to W. J. Clark, general manager of the railway department, who is known as one of the most energetic and successful men in the electrical trade. The British Thomson-Houston Company has recently been reorganized, and will enter most actively into the electric railway field, which gives prospects of offering abroad, as well as in America, highly profitable opportunities for the investment of capital and the sale of apparatus. Both Mr. Baylor and his new employers are to be heartily congratulated on their prospects for the future in this new arrangement.

ARMISTEAD K. BAYLOR.

Obituary.

F. K. Hain, vice-president and general manager of the elevated railway system of New York, was killed by a freight train at Clifton Springs, N. Y., last month. Mr. Hain was born in 1836, in Pennsylvania, and had an extended railroad experience with the Delaware, Lackawanna & Western and Pennsylvania Railroads. He was also for a number of years in charge of the designing department of the Baltimore Locomotive Works, and during the late war he served in both the army and navy. In March, 1880, he was appointed general manager of the Manhattan Elevated system, with which he had previously been connected as master mechanic. In 1891 he was elected second vice-president of the company.

Colonel Hain was a man of broad mind as well as of great activity, and was conversant with the minute details of the extensive system of which he had control. He possessed excellent executive abilities and introduced and maintained a strict system of discipline among his employes. As a result, although the elevated system of New York conducts a traffic of about 600,000 passengers per day, not one passenger has been killed in a train during the sixteen years in which Colonel Hain has been in charge.

AMONG THE MANUFACTURERS.

The Sawyer-Man Electric Company, has been reorganized and the manufacture of the Sawyer-Man incandescent lamp will be resumed. The offices of the company are the same as those of the Westinghouse Electric & Manufacturing Company.

A. O. Schoonmaker, of New York, offers to the trade his solid sheet mica segments for all the standard railway motors built up and gauged to required thickness. He reports an increasing demand for his solid sheet mica washers which he can furnish in any desired thickness.

The Corliss Steam Engine Company, of Providence, R. I., has received an order for three cross compound engines for the Union loop line (elevated), of Chicago. The cylinder dimensions will be 30 ins. and 60 ins. × 60 ins. stroke, and the engines will run at seventy-five revolutions per minute.

The Consolidated Car Fender Company, of Providence, R., I.. writes us that it is equipping cars with its fenders, in the followng places: Richmond, Va.; Staten Island, N. Y.; St. Louis, Mo.; Hartford, Conn.; West Hartford, Conn.; New Britain, Conn.; Waterbury, Conn.; Fitchburg, Mass., and Fall River, Mass.

Gilbert Wilkes, consulting electrical and mechanical engineer, of Detroit, Mich., has recently moved his office in that city to the Union Trust Building. Mr. Wilkes has acted as consulting engineer for a number of railway plants which have recently been installed, and has had long experience in electric railway work.

The Goubert Manufacturing Company, of New York, has just opened a Western office at No. 1403 Monadnock Block, Chicago, Ill. This branch will be in charge of E. Webster, a gentleman well known in engineering circles and expert in the matter of steam appliances, having been for many years with Stilwell-Bierce & Smith-Vaile Company.

Warren Webster & Company, of Camden, N. J., have recently published a pamphlet descriptive of their system of steam heating without back pressure on the engine. The Webster system has proved very popular among steam users as the long list of their customers shows, and the system of steam heating from engine exhaust promises to meet with equally wide adoption.

The Commutator Company, of Minneapolis, which has lately begun the manufacture of commutator segments by an entirely new process, reports that the demand for its goods has been a great surprise and far beyond its expectations. The company finishes its segments on the inside and bevels to standard gauges and claims that its product is of extremely low and uniform resistance.

The United States Projectile Company, of Brooklyn, N. Y., is extending its factory by a large addition, 100 ft. × 475 ft. This would seem to indicate that the company's business is increasing. The managers of the United States Projectile Company advise us that for some time past its works have been running night and day on Government work, bicycle tubing and hot pressed steel motor pinions.

The Chicago Truck Company is putting fourteen of its trucks under open bodies that are being built for the Akron & Cuyahoga Falls Rapid Transit Company, by the Wells & French Company. The company has also sold two extra trucks that will be used by the above road under cars now in service. The truck is the Curtis truck and is manufactured by the Wells & French Company, for the Chicago Truck Company.

The Kensingto Engine Works, Ltd., of Philadelphia, Pa., have just closed a contract with the William Cramp & Sons Ship & Engine Building Company, for two of their large water tube heaters. They will be be thirty-eight inches in diameter by twenty feet long and tested for a working pressure of 150 lbs. These heaters will be installed in the power plant at Washington, D. C., for the trolley line between Baltimore and Washington.

Arthur S. Partridge, of St. Louis, is widely known as one of the most progressive and wide awake dealers in the street railway supply trade. Mr. Partridge handles a full line of the best goods, but makes it a point to embrace nothing in his list that does not possess absolute merit or have an established reputation. This policy coupled with the fact that he is an energetic, hard worker has enabled him to build up a large business that is constantly extending.

The National Switch & Signal Company, of Easton, Pa., has been awarded the contract for installing two complete signal plants for the Troy Union at the terminal station at Troy. There will be a signal tower erected on a steel bridge spanning the tracks at each entrance to the station, which is a through station, and all tracks within the station shed will be connected with multiple indicators in the towers, and all the latest improvements in the art will be adopted.

Kohler Brothers, of Chicago, Western agents for the Walker Company, Cleveland, have just closed a contract with the Metropolitan Street Railway Company, Kansas City, Mo., for one 1200 k. w. multipolar generator which will be direct connected to an Allis engine. The Walker Company has also closed a contract with the Chicago City Railway Company for five 800 k. w. multipolar belted generators for the Fifty-second Street power station of this company.

The Berlin Iron Bridge Company, of East Berlin, Conn., has received a contract from the United States Projectile Company, of Brooklyn, N. Y., for the erection of a new building to meet the large demand for the products of the latter company. The new building will be 100 ft. × 450 ft., of steel skeleton structure throughout. The trusses have a clear span of 100 ft., and the general construction is such that it will make one of the finest buildings of the kind in the country.

The J. A. Fay & Egan Company, of Cincinnati, manufacturer of wood working machinery, has received, in the face of the strongest European and American competition, a large order for locomotive and railway car shop tools for Russia. This order, amounting to over $10,000 is especially gratifying inasmuch as being the second received during the course of a few years, it shows the high esteem in which the machines are held and the splendid reputation they have gained for themselves.

The Paul Boyton Water Show Company expects to do an excellent business during the coming year. The company's aquatic exhibitions are particularly applicable to street railway parks and have attracted large numbers of people where given. Captain Boyton is from experience well posted on the subject of exhibitions and knows just what attractions are most appreciated by the public. His invention "Shooting the Chutes" was described in a recent issue of the STREET RAILWAY JOURNAL.

Edwards Brothers & Company, of New York, propose to act as manufacturers' agents in New York City for a limited number of manufacturers outside of New York City. The object will be to enable the latter to present to buyers who visit the metropolis specimens of their apparatus, and for ease in effecting sales. The firm has secured large and light display rooms covering 3700 sq. ft. in the heart of the wholesale district convenient to every buyer as well as to the local export buyers. The firm will act as agents on the commission basis.

The Electric Railway Equipment Company, of Cincinnati, has just issued its 1896 catalogue of electric railway supplies. It is a handsome publication of over one hundred pages and is profusely illustrated with splendid cuts of most of the articles now used in connection with electric railways. The company is one of the largest manufacturers in the country of wrought iron and steel tubular poles for either railway or lighting service, also of overhead line material, gears, bearings, motor parts, etc. Its business is rapidly extending and increasing.

Joel H. Woodman, of Hoboken, N. J., has recently purchased the old "Gardner" plant owned by Edward B. Jordan, and with these increased facilities will be in a better position than ever before to supply veneer and other specialties for which he is well known. He has also secured the services of W. P. Seguine, the pioneer in the veneer business. As Mr. Seguine has been for over twenty years intimately connected with this department of railway practice, it is needless to say that he is fully acquainted with the needs and uses of veneer as car seatings and ceilings.

The Taylor Electric Truck Company, of Troy, N. Y., is enjoying an excellent business and its works are very busy turning out trucks. The company has received many unsolicited orders during the last few months. Among the orders received for single trucks are from roads in Grand Rapids, Mich.; Fishkill, N. Y.; Plattsburgh, N. Y.; Ottawa, Ont.; Galt, Ont.; Cohoes, N. Y.; Albany, N. Y., and North Adams, Mass. Among its customers for double trucks are roads in Oakland, Cal.; Portland, Ore.; Omaha, Neb.; Camden, N. J.; Lowell Mass., and San Francisco.

Baldwin, Rodgers & Vickers, of New York, are one of the most enterprising firms engaged in the electric railway supply business. The members believe in treating their customers in the best possible and most liberal way and that a reputation for fair dealing and high business methods is the most valuable possession that a firm can have. The firm represents a number of prominent supply companies including the Fulton Truck & Foundry Company, Changeable Electric Headlight Company, Corning Brake Shoe Company, Noti Insulator Company, and Mark Railway Equipment Company.

The C. W. Hunt Company, of New York, has recently published an interesting pamphlet and catalogue on its manilla rope for transmission and hoisting. This company has gone carefully into the subject of the use of rope for power purposes and its list of customers of stevedore rope covers six closely printed pages. The catalogue gives some very interesting engravings of the proper forms of grooves of transmission pulleys and a paper on the subject of rope driving read by Mr. Hunt before the American Society of Mechanical Engineers. The paper is accompanied by diagrams and engravings.

The Phœnix Carbon Manufacturing Company, of St. Louis has equipped its works with the very latest improved machinery and appliances. The company's claim that it is turning out the best motor brushes for electric railway use seems to be well substantiated by the rapid increase and extension of this branch of its business. Col. S. G. Booker, the general manager of the company, thoroughly understands the carbon business and aims to turn out the very best carbon product that can be made. The Phœnix brush is claimed to be low resistance, self lubricating, long lived, will not cut the commutator and wears smoothly.

The Sterling Varnish Company, of Pittsburgh, Pa., writes that the Union Traction Company, of Philadelphia, has recently completed an exhaustive line of test of the Sterling extra insulating varnish. As a result of this test the company reports that these varnishes are entirely satisfactory, and it has sent in orders for the varnish for use on its cars. The Siemens & Halske Company, of Chicago, has also decided after preliminary tests of the varnish to give it a thorough trial with the idea of adopting it for use in its shop, and that the Royal Electric Company, of Peoria, Ill., has taken the subject up in like manner.

The Dodge Coal Storage Company, of Philadelphia, Pa., has secured from the Erie Railroad Company the contract for the construction of a 150,000 ton storage plant at East Buffalo, N. Y. The coal will be stocked in nine divisions or piles, each of about 17,000 tons capacity. The plant will be constructed under the patents of the well known Dodge system, with the latest improvements, including a complete haulage system for handling the cars. The efficiency of the Dodge system is demonstrated by the fact that every railroad using it has contracted for a second plant after more or less extended experience with the first.

The Berlin Iron Bridge Company, of East Berlin, Conn., is erecting for the Boston & Montana Consolidated Copper & Silver Mining Company, of Great Falls, Mont., a new electrical power house in connection with a large mining plant. This building is to be modern in all respects. The building will be absolutely fireproof and the covering will be lined with the Berlin Company's patent anti-condensation roof lining. This material has proved itself to be very efficient for lining on engine and dynamo room roofs and

the Bridge Company is constantly receiving orders for this work from all parts of the country.

The Pullman's Palace Car Company, of Chicago, has received, among other recent orders, one for thirty-four double truck cars for the Pasadena & Pacific Railway, Los Angeles; thirty-five open motor ten seated cars for the North Chicago Street Railroad Company; twenty-four large double truck cars for the Suburban Railroad Company, Chicago; eighty ten seated open motor cars for the Calumet Electric Railway, Chicago; six motor cars for the Tri-City Railway Company, Davenport, Ia.; thirty for the Chicago City Railway Company; eight for the Hammond & East Chicago line, and other orders of various sizes and descriptions.

The Ohio Brass Company, of Mansfield, O., has recently distributed to the trade two descriptive circulars and price lists, that commend themselves for their neatness of design and exceedingly plain way in which the prices and merits of the goods are set forth. One is a revised list of the genuine bell metal motor bearings, manufactured by this company, which gives in addition to the bearings contained in the previous circulars, those used on the latest types of motors. The other is devoted to steel and copper bonding caps, which is one of the company's principal specialties. The Ohio Brass Company reports an increasing business every month over the preceding one, since the first of the year, and that its factory is now running overtime to fill the orders on hand.

The Jos. Dixon Crucible Company, of Jersey City, N. J., tells us that graphite, which is one of the forms of carbon, and more generally known as plumbago or black lead, has come to be an important factor in electrical industries. Pure flake graphite is used for lubricating cylinders and bearings of engines and dynamos, and the same material also forms the pigment for protective paints for trolley poles, electric light poles, and roofs of dynamo plants and trolley car sheds. During the last year or two the demand has very greatly increased for graphite resistance rods, for which purpose the material has a number of advantages over German silver. The Joseph Dixon Crucible Company is supplying the electrical industries with large quantities of material.

The New York Switch & Crossing Company, is the title of a new corporation organized at Hoboken, N. J., to engage in the manufacture of special work for street railway lines. The company is organized with ample capital and has purchased the works and all of the patents and patterns formerly belonging to the New York Frog & Switch Company of Hoboken. The president of the company is W. C. Wood, formerly engineer of the Lewis & Fowler Girder Rail Company in charge of its construction work. The treasurer is H. R. Sherman, an experienced engineer formerly connected with the Brooklyn City Railway. Both of these gentlemen have had long experience in street railway service and are well versed in the conditions required for the special work of electric railways.

The Wheeler Reflector Company, of Boston, has recently added to its line of headlights for electric railways, city, suburban and cross country, one for permanent attachment to the dashboard, called Style No. 180. It fits the curved front of the dash without cutting into it, thereby adapting it to vestibule as well as other cars. It projects but 4½ ins., and is therefore amply protected by the bunter. Its body is of malleable and not cast iron. It has a perfect parabolic reflector 10½ ins., in diameter, of the high grade distinguishing all manufactures of this company, insuring the best possible illuminating result. Its entire weight is but ten pounds. The large facilities of the Wheeler Reflector Company also enable it to produce this high grade of goods at little, if any, increase in cost over others of much inferior quality.

George Cradock & Company, of Wakefield, England, whose ropes in Kansas City, Chicago and other American cities have been making an excellent record, have recently received a letter from D. McGill, general manager of the London Tramways Company, of London, describing the service given by a Cradock rope on that line. The rope was installed July 8, 1893, and removed Nov. 8, 1895. It was taken out because of no fault of the rope, but on account of an extension of the cable line and the desire to have the rope on the extension and main line the same size. Otherwise, the management states that the rope would probably be still running. During the time that it was in service, it ran 1,791,293 car miles, and carried 24,232,699 passengers without being the cause of a single stoppage. The actual number of days in use was 853.

The Standard Underground Cable Company, is determined to be in a position where contracts for any character of installation can be handled with the least possible delay. For years the company has been able to successfully undertake any contract for installing underground cables of high character, except conduits and rubber covered wires and cables. Appreciating the importance of meeting every possible demand on the part of the electrical public, a large addition to its already extensive factories has been erected, and a complete modern plant for insulating wires and cables of all descriptions with rubber, has been installed therein. This branch of the company's business has met with approval on the part of customers and the character of the product will undoubtedly steadily increase the output. The arrangements for testing the wires are particularly complete and the care exercised in this department ensures the production of perfect insulation, or the discovery of any faults before the wire leaves the factory.

The Carnegie Steel Company, nearly two years ago being favorably impressed with the design of the Cahall vertical water tube boiler, made an investigation as to its merits, the result of which induced the managers to put in a trial plant of these boilers of 2000 h. p. at their gas pumping plant at Bagdad, Pa. The performance of the boilers at Bagdad was such a marked improvement over the general boiler practice of to-day that they, about a year later, put four of these boilers at their Edgar-Thomson Steel Works. They very carefully watched and tested the boilers at Edgar-Thomson under varying conditions, with the result that they have been so well satisfied by the work done by these four that they have made arrangements to tear out all the old style boilers at furnaces A. H. & Company at the Edgar-Thomson Steel Works, and have purchased 5250 h. p. of the Cahall vertical water tube boilers to be installed at these furnaces, in place of the ones they will remove.

The Stanwood Manufacturing Company, of Chicago, manufacturer of the Stanwood patent steel step so extensively used on street cars throughout the United States, reports business as steadily improving and is in receipt of several good orders from various sections of the country. Some late orders are from the Canandaigua Electric Light & Railway Company, Laclede and American Car Companies, Canadian General Electric Company, J. G. Brill Company, Rathbun Company, Desoronto, Ont., Barney & Smith Car Company, Jackson & Sharp Company, Pullman's Palace Car Company, and others. The Stanwood Company is also in receipt of several orders from the shipbuilding firm of Wm. Cramp & Sons, the Stanwood step having been adopted by the United States Government in the construction of ship ladders. The step possesses the same advantages for this work as for street cars, namely, non-slipping, strong, light and not affected by dirt, snow or ice.

The Mica Insulator Company, manufacturer of micanite, and whose factories are at Schenectady, New York and London, has opened a branch house at 153 Lake Street, Chicago. Here the company will carry a full line of micanite plates, commutator rings, segments and slot insulations for all the standard railway motors and power generators, micanite and Empire cloth and paper. The company's goods were formerly sold in Chicago through W. H Sills & Company, as sales agents. The business will now be under the management of Chas. E. Coleman, who has been connected with the New York house for several years and is thoroughly familiar with the electrical trade. In the circular announcements that the company is sending to the trade, the assurance is given that all business will receive prompt and careful attention. The company has been compelled to establish this branch house on account of its increased business. This move will, no doubt, be highly appreciated by the Western customers on account of the excellent facilities which they will have for receiving micanite promptly.

The Standard Underground Cable Company, of Pittsburgh, Pa., announces that it has completed arrangements whereby it is enabled to undertake the installation of underground systems of all descriptions, complete in every detail. The company's reputation for the successful installation of underground cables in any quantity, is so well established as to need no comment. It will be learned with interest however by wire using companies, that the company is now ready to furnish and install the conduits as well. It is ready to furnish quotations for the equipment of underground systems with cement lined pipe, vitrified clay or wooden pump log conduit as may seem best under the circumstances, as well as for systems complete in every detail, conduits, manholes, handholes, cables, junction boxes, terminals, etc. The company has established a conduit department with F. S. Viele at its head as manager. Mr. Viele is an experienced practical engineer in conduit and cable construction and, with the high reputation of the company for construction work of all kinds, the conduit department is sure to prove an important and successful branch of this enterprising company's business.

The Broderick & Bascom Rope Company, of St. Louis, Mo., furnished some very tasteful souvenirs at a recent dinner given to L. J. Hirt, assistant chief engineer of the Metropolitan Street Railway Company, of New York, upon the occasion of his retirement from that company. The souvenirs were made of short sections of cable similar to that used on the company's Lexington Avenue line, and were nickeled and mounted with fancy top and base. They are designed for use as paper weights and were attached to each menu card. They proved to be very popular, and furnished a tasteful memento of the evening. The Broderick & Bascom Rope Company is one of the largest manufacturers of cables for street railway service in this country, and its ropes have achieved an enviable reputation for durability and excellent workmanship. They are used on the principal lines in St. Louis, and when in that city recently, a representative of the STREET RAILWAY JOURNAL was shown the excellent records made by them. The company has a record as a leader in its particular line of business and has always shown a readiness to adopt any new improvement which would improve the quality and service of its cables.

The Triumph Electric Company, of Cincinnati, O., reports a very encouraging increase in its business over the same period of last year. Among others, some of the more important deals closed in April were the following: Caledonia Electric Light & Power Company, Owosso, Mich., one 150 k. w., 550 volt generator, direct connected to Fischer engine; Owosso & Corunna Traction Company, Owosso, Mich., two 65 k. w., 550 volt generators, belted; Lane & Bodley Company, Cincinnati, O., one 100 k. w. belted generator; Studebaker Brothers Manufacturing Company, South Bend, Ind., one 65 k. w. belted generator; Hot Springs Hotel Company, Hot Springs, Va., one 55 k. w. generator, direct connected to Buckeye engine, and one 30 k. w. belted generator; Krippendorf, Dittman &

Company, Cincinnati, O., two 65 k. w. generators, direct connected to Willans engine; J. M. High & Company, Atlanta, Ga., one 45 k. w. belted generator; U. S. snag boat, "E. A. Woodruff," Cincinnati, O., one 10 k. w. generator, direct connected to vertical engine; A. H. Ely, New York City, one 80 k. w., type W generator, direct connected to Ames engine; Sol Sayles, New York City, one 25 k. w. generator, direct connected to Woodbury engine; Nordberg Manufacturing Company, Milwaukee, Wis., one 30 k. w. generator, belted; John B. Mallers, Chicago, Ill., one 15 k. w. generator, direct connected to Fischer engine.

The McGuire Manufacturing Company, of Chicago, reports the following orders since last issue: Interstate Consolidated Street Railway Company, Attleboro, Mass.; Electric Railway, Light & Power Company, Anaconda, Mont.; Consolidated Traction Company, Pittsburgh, Pa.; Mt. Adams & Eden Park Inclined Railway, Cincinnati, O.; Galesburg Electric & Power Company, Galesburg, Ill.; Tri-City Railway Company, Davenport, Ia.; Toledo Traction Company, Toledo, O.; Calumet Electric Street Railway Company, Chicago; Colorado Springs Rapid Transit Railway, Colorado Springs, Colo.; South Chicago City Railway Company, South Chicago, Ill.; Dighton, Somerset & Swansea Street Railway Company, Taunton, Mass.; New York & Brooklyn Bridge Railroad Company, Brooklyn, N. Y.; Glen Echo Railway Company, Washington, D. C.; White Line Street Railway Company, Dayton, O.; Norfolk & Ocean View Railway Company, Norfolk, Va. The order for the Consolidated Traction Company, of Pittsburgh, is a duplicate order for 190 of the A1 suspension truck, which has been adopted as standard on this road. The McGuire Company refers to the past month as the most successful in its long business career, and says that the outlook is very promising. The company also reports an encouraging amount of orders for its ratchet brake handle.

The Composite Brake Shoe Company, of Boston, of which W. W. Whitcomb is president, has recently established a number of agencies for the sale of its "Compo" brake shoes. An exclusive right to manufacture and sell this shoe has been granted to the Snead-Van Alstine-Meldrum Company, of Louisville, Ky., for the states of Kentucky and Tennessee, and that part of Ohio and Indiana south of a line parallel with Columbus and Indianapolis, including the cities and towns thereon; to the Dorner & Dutton Manufacturing Company, Cleveland, that part of Ohio and Indiana north of this line, and the states of Michigan and West Virginia and Pennsylvania west of the Susquehanna River; to the Sargent Company, Chicago, the states of Illinois and Wisconsin, and the states west and north to the Pacific Coast, they having agencies at St. Louis, St. Paul, Tacoma and Portland, Ore. The Composite Brake Shoe Company has also appointed Hoefgen, Moxham & Company, New York, as selling agents for the cities of New York, Brooklyn and vicinity, and the states of New Jersey, Pennsylvania, east of the Susquehanna River, Delaware and Maryland, and the District of Columbia. The Boston office of the Composite Brake Shoe Company will look after New England and New York State, having the shoes made at Buffalo and Boston. By this distribution of its agencies long distance in transportation is avoided, and more favorable conditions and prices given the consumer. This brake shoe, known as the wooden plug shoe, has come into general use on a large number of electric street railways, and has strong endorsements for braking and wearing qualities, overcoming in a large measure the sliding of the wheels and the jumping or bucking of the cars. Undoubtedly the elasticity of the wood, it being soft and fibrous, produces this effect, as well as deadens the sound or sereeching of the wheels.

The Jackson & Sharp Company, Wilmington, Del., writes us that among its other recent orders are six double truck cars for the Saginaw & Bay City Interurban Railroad Company. These cars are specially designed for interurban service equipped with vestibules and steam type of roof. Two of the cars are of the combination type with baggage and express compartment, while the other four are straight passenger coaches. All are equipped with a saloon and spring upholstered seats. The ten bench open type of car with six reversible and four stationary seats and bulkhead at each end, has been the prevailing type for summer use this year. Of this class of equipment the company has furnished from one to fifteen cars for each of the following roads: Fair Haven & Westville Railroad Company, New Haven, Conn.; Braintree & Weymouth Street Railway Company, Braintree, Mass.; Hoosac Valley Street Railway Company, North Adams, Mass.; Commonwealth Avenue Street Railway Company, Boston, Mass.; Hingham Street Railway Company, Hingham, Mass.; Washington & Great Falls Electric Railway Company, Washington, D. C.; Schuylkill Valley Traction Company, Norristown, Pa.; Hanover Street Railway Company, Hanover, Mass.; Greensburg, Jeannette & Pittsburgh Street Railway Company, Greensburg, Pa.; Asheville Street Railway Company, Asheville, N. C.; City Electric Railway Company, Port Huron, Mich.; Camden, Gloucester & Woodbury Railroad Company, Camden, N. J.; The Long Island Electric Railway Company, Jamaica, L. I.; Carbon County Electric Railway Company, Mauch Chunk, Pa.; Ocean City Electric Railroad Company, Ocean City, N. J.; Franklin Electric Street Railway Company, Franklin, Pa.; Bristol Belt Line Railway Company, Bristol, Tenn.; Newton, Langhorne & Bristol Trolley Street Railway Company, Langhorne, Pa.; Bergen County Traction Company, Ft. Lee, N. J.; Glen Echo Railway Company, Washington, D. C. In addition to the above the company has, in anticipation of the demands for cars wanted for quick delivery, completed for stock a lot of equipment of the standard ten bench open type, the same as above referred to. The company has on its books at the present time orders for closed cars as follows: twelve twenty-two foot car bodies for the Paterson Railway Company, Paterson, N. J.; one vestibule closed motor car body for the Buffalo, Gardenville & Ebenezer Railway Company, Gardenville, N. Y.; five twenty foot closed motor car bodies for the Hingham Street Railway Company, Hingham, Mass.; twelve closed motor car bodies for the Richmond Railway & Electric Company, Richmond, Va. It is interesting to note that street railway companies operating electric cars on lines of long distance between points, are accepting with general favor long double truck type of equipment. By using cars of this class, the service is much enhanced, not only in the added comfort and ease of conveyance that is given the passengers, but also in the speed which can be attained, and the latter is especially an important factor where electric lines are placed in direct or indirect competition with steam car roads.

New Publications.

FAREWELL TO ENGINEER HIRT. Receipt is acknowledged of a printed copy of the speech made by H. S. Beattie at the recent farewell dinner given by the members of the Metropolitan Street Railway Club, to L. J. Hirt, late assistant chief engineer of the Metropolitan Street Railway Company.

THE ELECTRIC RAILWAY IN STUTTGART. By F. Mertsching. Published by Julius Springer, Berlin. Eight pages. Illustrated.

This is a reprint from the "*Zeitschrift des Vereines deutscher Ingenieure*" of an article on the electric railway in Stuttgart, recently installed by the Allgemeine Elektricitäts-Gesellschaft of Berlin.

A PAPER ON SELF ACTING RAINPROOF SEATS AND OUTSIDE SIGNAL BELLS, ETC. By C. Challenger. Published by E. Everard, Bristol, England. Sixteen pages.

This is a reprint of two papers by C. Challenger, traffic manager of the Bristol Tramways & Carriage Company, on rainproof seats, outside signal bells and supplementary brakes for tramway cars.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY for 1896. Published by W. J. Johnston Company, New York. 832 pages. Price $5.

This directory, which has been published annually for a number of years, gives a list of officers of electric light and street railway companies, a list of isolated plants, electrical manufacturers, etc. A casual glance over the department relating to street railways reveals a number of typographical errors, especially in the names of the officers of the companies. Among these are: J. L. Flirt, for L. J. Hirt, J. R. Bootem, for J. R. Beetem, B. Fricks, for B. Frick, and N. Brin, for N. Perin.

DYNAMO ELECTRIC MACHINERY. By Sylvanus P. Thompson. Fifth Edition. Published by E. & F. N. Spon, London. Spon & Chamberlain, New York. 835 pages. Illustrated. Price $5.50, net.

This work has become a classic on dynamo design both in this country and in Europe. Since the appearance of the fourth edition in 1892 much has been done in the development of the subject, chiefly in the domain of alternating current machinery, and the work has been enlarged and revised to bring it up to date. Many new illustrations are added and those published include nineteen large plates.

A work of this character would have been of more value to railway engineers if the recent electric railway machines which have become standard in this country during the last few years had been discussed to a greater extent. Thus, among constant current dynamos, the largest generator illustrated and described is a 400 k. w. machine of the General Electric Company, and that a belted one. In the chapter on Modern Forms of Motors, practically nothing is said of any of the latest types of railway motors. Among the stationary motors two pages are given to dimensions and diagrams of the Sprague motor, which has been obsolete for five years, while only one other American motor is illustrated.

THIRTEENTH ANNUAL REPORT OF THE BUREAU OF LABOR AND INDUSTRIAL STATISTICS OF MICHIGAN, for the year ending Feb. 1, 1896. Published by authority. Lansing, Mich. Cloth. 402 pages.

In this report Commissioner Charles H. Morse attempts for the first time to deal with the question of street railway reports from the companies in that state and to handle exhaustively the question of street railway labor throughout the state. The financial information obtained from the various street railway companies is reasonably full considering the fact that the Bureau is not armed with authority to demand complete returns. In a section of the report devoted to street railways in general, the Commissioner describes the general conditions under which the Michigan companies are working and gives a large amount of statistical matter, which he very kindly credits to the STREET RAILWAY JOURNAL. The schedules of street railway employes are exceedingly voluminous, the information obtained from each man being reported in tabular forms by the schedule number, the idea being, we presume, that information should be furnished from which others might duduce conclusions. The deductions made by the Commissioner himself refer chiefly to the nationality of employes, their membership in the different labor organizations, their ages and the question of wages, all of which are interesting and important from many points of view.

A TREATISE ON THE LAW OF EMPLOYERS' LIABILITY ACTS. By Conrad Reno, L.L. B., Boston. Houghton, Mifflin & Company, 1896.

The English Employers' Liability Act passed in 1880 is the parent of acts passed in Alabama, Massachusetts, Colorado and Indiana.

between the years 1885 and 1893. All of them are designed to extend the common law of liability of employers for personal injury suffered by their employes. No one who has an interest in the relation of master and servant, in occupations where the servant is in danger of personal injury, can afford to be unfamiliar with Mr. Reno's work. The appendix contains the text of all five acts, and the work reviews the decisions of the highest courts which have been rendered in actions brought under these statutes. The work does a great deal more, for it is almost a complete treatise upon the common and statutory law bearing upon the responsibility of the master to his servant for personal injury. Mr. Reno's well known work on the law of Non-residence and Foreign Corporations has already placed him among the best of our text writers.

Mr. Reno thus sums up the most important provisions of the acts defining them to be "those which give the employe a right of action against his employer for injuries caused by reason of the negligence of the employer's superintendant, and, in the case of railroad employes, for injury caused by reason of the negligence of any person having the charge or control of certain railroad instrumentalities". Some nine hundred cases are cited, and the work typographically is worthy of its well known publishers.

Street Railway Law: a Digest of Important Decisions, Covering the More Important Class of Cases which Daily Arise in the Management of Street Railways for Managers and Claim Departments. Chicago; Windsor & Kenfield Publishing Company, 1896.

This is an anonymous and uncopyrighted collection of decisions of all sorts and from courts of high and low degree. We are told in the preface that the cases have been collected by a prominent member of the Chicago bar, and that "the index is arranged by a gentleman conversant with the troubles of a railroad manager." We do not believe that these troubles will be lessened if the manager takes the advice of the preface and uses this work to "help him in the more intelligent decision of the many cases he is often obliged to decide on his own responsibility and without the assistance of counsel." The preface naively states that the index "does not appeal to legal talent." We believe the same remark would apply to the whole book. The author has merely thrown together promiscuously, without arrangement, a large number of cases. Among them are a few leading decisions, but the bulk of them are cases of minor importance, so that there appears to be not only lack of arrangement but no method of selection.

Thus a case which deals with the rights of a street gamin who steals a ride is followed by one which treats of the afflictions of a trolley road whose wires are interfered with by a moving house; next comes a collision case, and that is succeeded by an opinion on the construction of a railroad charter (pp. 109 to 111.)

Out of the mass of elevated railroad cases which have in New York made a complete system of law relating to the right to an injunction by abutting property owners, only two are given and only one of them is from the court of last resort, and neither of them is a leading case.

Finally, instead of giving all the citations of cases from the official reports or from the admirable series of the West Publishing Company, a very large number of the citations are from the daily law papers, or from periodical and law reviews.

The work is neatly bound and printed, and is not a bulky volume.

Trade Catalogues.

An Era in Boiler Performance. Published by the Stirling Company, Chicago, Ill. Eight pages.

Manilla Rope for Transmission and Hoisting. Published by C. W. Hunt Company, New York. Forty-four pages. Illustrated.

The Webster Vacuum System of Steam Heating. Published by Warren Webster & Company, Camden, N. J. 24 pages. Illustrated.

Electric Railway Overhead Parts. Catalogue XII. Published by the Creaghead Engineering Company. Cincinnati, O. Forty-two pages. Illustrated.

Introducing the Stratton Combined Separator and Steam Receiver. Published by the Goubert Manufacturing Company, New York. 8 pages. Illustrated.

List of Street Railway Patents.

U. S. Patents Issued April 21, 1896, to May 12, 1896, Inclusive.

Apr. 21.

Electric Street Car Motor—Samuel Harris, Cleveland, O. No. 558,491.

This motor has each of its field coils separately detachable with its core from the motor body.

Car Fender—Wm. Waegel, Philadelphia, Pa. No. 558,538.

Consists of a frame having journaled thereon a number of rolls, a bracket carried by the frame, mechanism to operate same, and a circuit breaker adapted to shut off the current when the fender is dropped.

Car Fender—Walter Batten, Brooklyn, N. Y. No. 558,711.

Trolley—Jas. H. Rabbitt, Wethersfield, Conn. No. 558,741.

Consists of a spring actuated pole, a bar, which is centrally pivoted to the free end of said pole, and two contact wheels, which are respectively pivoted to the opposite ends of said bar.

Fender for Cars—Wm. Everdell, Brooklyn, N. Y. No. 558,793.

Car Fender—S. W. Neall, Philadelphia, Pa. No. 558,833.

Means for Reversing Trolley Pole Supports—H. P. Wellman, Ashland, Ky. No. 558,868.

Trolley for Electric Railway Cars—Same inventor. No. 558,869.

Has a pneumatic device for engaging the trolley pole and effecting same when the wheel leaves the wire.

Trolley—Same inventor. No. 558,870.

Car Brake—Jas. A. Cinswell, Philadelphia, Pa. No. 558,898.

Power is transmitted to the brake shoes by gears instead of levers.

Apr. 28.

Car Fender.—S. A. Politsky, Boston, Mass. No. 558,982.

Car Fender.—R. Wilkinson, Philadelphia, Pa. No. 559,091.

Electric Railway Conduit.—J. H. Munsen, Chicago, Ill. No. 559,105.

The lateral extension or containing box of a slotted conduit having a recess or chamber, an insulating lining therefor, a metallic lining within the same, a plunger slidable within said metallic lining or barrel, and contact and switch devices provided in connection with said plunger.

Safety Car Brake.—W. F. Condon, Saginaw, Mich. No. 559,121.

Consists of a check block having a face to bear against the rim of the wheel and a rear face made eccentric therewith and adapted when the block is projected between the wheel and bottom of the car to contact with a bearing surface beneath the car so as to contact with the same and hold the block out of contact with the wheel.

Car Fender.—Peter Dunwald, Rio, N. Y. No. 559,269.

A fender frame carried by the car and brushes mounted to turn in front of the fender frame and being at an angle to the track.

Car Brake Mechanism.—J. W. Rice, Springfield, Mass. No. 559,344.

May 5.

Electric Railway.—H. Brandenburg, Chicago, Ill. No. 559,357.

Consists of oppositely arranged trolley conductors and the trolley for co-operation therewith having the independently pivoted contact shoes.

Electric Railway.—Henry Brandenburg, Chicago, Ill. No. 559,356.

A rail for electric railways formed integral in cross section having the tread surface of the wheel and the longitudinal chamber or cavity formed in the body thereof with a relatively narrow longitudinal slot or opening leading to said chamber.

Trolley Wheel.—John McKenna, Johnstown, Pa. No. 559,461.

A trolley wheel having a separable inner wearing flange on each side of a central hub and an outer supporting flange fitting against the inner flange and adapted to support the outer edge of the same.

May 12.

System of Electrical Transportation.—P. K. Stearn, St. Louis, Mo. No. 559,872.

An electric transportation system, consisting of a route or line of travel, a vehicle which is adapted to travel along said route, a primary inducing element, which is arranged along said route, and a laminated wheel mounted on said vehicle, which wheel is influenced by the primary element.

Safety Fender for Cars.—G. P. Kate, Jr., Jersey City, N. J. No. 559,979.

Car Fender.—W. Grunow, Jr., Bridgeport, Conn. No. 560,029.

Comprises arms pivoted beneath the car platform, and rearwardly movable, springs between said arms and the platform, whereby they yield, a cross bar connecting the arms at the front, and a fender frame detachably pivoted in said arms.

Car Fender.—W. P. Young, Pottstown, Pa. No. 560,075.

A fender consisting of connected curved arms, each having two rearwardly projecting arms, one of which is provided at its rear end with a hook, and the other at its rear end with a vertical limb, and braces secured to said arms, all of said parts being combined.

Trolley Wire and Trolley Therefor.—H. R. Keithley, New York, N. Y. No. 560,098.

A trolley wire having three ribs, the sides of one or more of said ribs diverging outwardly, and a trolley wheel double grooved to receive the same.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of twenty-five cents. Give date and number of patent desired. The Street Railway Publishing Company, Havemeyer Building, New York.

TABLE OF OPERATING STATISTICS.

Notice.—These statistics are carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement, "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years.

Abbreviations.—The following abbreviations are used: * Including taxes. d. deficiency. m. months.

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
ALBANY, N. Y.						
The Albany Ry.	3 m., Dec. '94	122,382	85,240	37,142	22,579*	14,564
	3 " " '95	132,407	83,928	48,479	21,457*	27,022
	12 " " '94	461,918	298,972	162,947	92,592*	70,354
	12 " " '95	522,276	314,319	207,957	88,657*	119,300
ALTOONA, PA.						
The Altoona & Logan Valley Elec. Ry. Co.	12 m. Dec. '94	73,128	33,217	39,911	32,248*	7,663
	12 " " '95	83,292	41,158	42,135	33,564*	8,570
City Pass. Ry. Co. of Altoona	12 m. Dec. '94	50,303	40,302	10,000	4,300*	5,700
	12 " " '95	56,527	46,146	10,381	4,051*	6,330
BALTIMORE, MD.						
Baltimore Traction Co	12 m., Dec. '94	1,012,319	623,040	389,279	359,243*	30,037
	12 " " '95	1,179,191	639,707	539,485	413,097*	126,387
City & Suburban Ry. Co.	12 " June '94	605,123	409,363	195,760		
	12 " " '95	751,720	546,970	204,750		
BATH, ME.						
Bath St. Ry. Co	12 m. June '94	16,300	12,862	3,438	2,500	938
	12 " " '95	21,703	14,698	7,005	3,400	3,605
BAY CITY, MICH.						
Bay Cities Cons. Ry. Co.	12 m. Dec '94	83,450	52,011	31,439	30,000	1,439
	12 " " '95	88,658	58,517	30,141	30,000	141
	1 " Mar. '95	6,121	3,920	2,201		
	1 " " '96	6,258	4,384	1,874		
	3 " " '95	17,464	12,188	5,276		
	3 " " '96	18,866	14,188	4,678		
BIDDEFORD, ME.						
Biddeford & Saco R R Co	12 m. June '94	24,219	14,813	9,406	6,391*	3,016
	12 " " '95	24,287	12,186	12,101	5,915*	6,186
BINGHAMTON, N. Y.						
Binghamton R. R. Co.	12 m. Jan. '95	121,969	69,581	52 388	30.152*	22,237
	12 " " '96	128,972	73,345	55,628	35,459*	20,169
	1 " Mar. '95	8,372	5,615	2,757		
	1 " " '96	9,932	6,165	3,767		
	2 " " '95	15,415				
	2 " " '96	19,173				
BOSTON, MASS.						
West End St. Ry. Co.	12 m. Sept. '94	6,823,879	4807,083	2 016,796	725,064*	1291,732
	12 " " '95	7,746,171	5633,163	2,113,008	746,963*	1366,044
Lynn & Boston R. R. Co.	12 m. Sept. '94	1,238,410	746,304	492,106	379,029*	113,077
North Shore Traction Co	12 " " '95	1,381,389	784,392	59,997	391,681*	205,316
	1 " Feb. '95	76,851	59,450	17,401		
	1 " " '96	87,591	56,931	30,660		
	3 " " '95	448,646	313.125	135,521		
	5 " " '96	481,014	330,154	150,860		
BRIDGEPORT, CONN.						
Bridgeport Traction Co	12 m. Dec. '94	144,447				
	12 " " '95	298,883	151,697*	147,186	75,000	72,186
	1 " Mar. '95	20,227	14,321	5,906		
	1 " " '96	22,406	13,645	8,761		
	3 " " '95	55.660	41,259	14,401		
	3 " " '96	65,573	41,515	24,058		
BROCKTON, MASS.						
Brockton St. Ry. Co.	12 m. Sept. '94	214,370	143,511	70,859	70,974*	d 11
	12 " " '95	266,892	154,950	111,942	84,691*	27,251
	1 " Feb. '95	15,683	10,457			
	1 " " '96	19,970	12,632			
	5 " " '95	92,815	54,089			
	5 " " '96	106,798	70,939			
BROOKLYN, N. Y.						
Brooklyn Elev. R.R. Co	12 m. Dec. '94	1,780,848	1041,095		831,093*	d 141339
	12 " " '95	2,082,937	1158 219		859,447*	65,271
Brooklyn Traction Co.	1 m. Jan. '95	44,599	56,3:7	d 11,728		
	1 " " '96	82,796	52,236	30,560		
Atlantic Ave. R. R. Co.	12 m., Dec. '94	1,011.258	615,863	395,395	265,118	130.277
	12 " " '95	891,940	706,900	185,040	302,918	d 117877
Brooklyn, Bath & West End R. R. Co	12 m June '94	111,605	86,717	24,888	39.718*	d14,830
	12 " " '95	130,928	79,394	51,535	61,150*	d9,616
Brooklyn City & Newtown R. R. Co.	12 m., Dec. '94	595,449	346,285	249,164	120,632*	128,532
	12 " " '95	598,691	372,554	226,137	127,647*	98,489
Brooklyn, Queens Co. & Sub. R. R. Co.	12 m. June '94	543,413	427,101	116,312	169,225*	d52,913
	12 " " '95	625,537	415,255	210,282	339,068	d 128786
	6 " Dec. '94	348,969	213,351	135,618	167,644*	d32,026
Brooklyn Heights R.R. Co.	6 " " '95	362,162	230,425	131,737	169,134	d37,396
	12 m., Dec. '94	3,509,016	2143,567	1,365,448	1468,553	d 103105
	12 " " '95	4,076,117	2682,614	1,393,504	2102,061	d 706758
Coney Island & Brooklyn R. R. Co	12 m., Dec, '94	316 183	207,478	108,706	52,157*	56,549
	12 " " '95	383,367	236,547	146,820	52,861*	93,959
	1 " Feb. '95	24.418				
	1 " " '96	19,313				
	2 " " '95	51,242				
	2 " " '96	40,801				
Nassau Elec. R. R. Co.	8 m Dec. '95	82,140	59,904	22,236	20,286*	1,950
	6 " " '95	173,757	106,127	67,630	33,627*	34,003
BUFFALO, N. Y.						
Buffalo Ry. Co	12 m., Dec. '94	1,536,284	856,631	679,653	468,917*	210,736
	12 " " '95	1,351,919	649,097	702,822	417,038*	285,783
CHICAGO, ILL.						
Chicago City Ry. Co.	12 m., Dec '94.	4,264,618	2838,684*	1,425,934	207,878	1218.057
	12 " " '95	4,476,824	2807,726	1,669.098	300,389	1368,709
Chicago General Ry. Co	12 m., Dec. '95	82,082	64,334	17.748		
Lake St. Elev. Ry. Co.	12 m. Dec '94	428.095	290,090	138,005		
	12 " " '95	517,301	319,606	197,695		
	1 " Jan. '95	44,670	28,180	16,490		
	1 " " '95	52,855	30,713	22,142		
No. Chicago R. R. Co.	12 m., Dec. '94	2,565,618	1247,326	1,218,292	465,648	752,644
	12 " " '95	2,780,487	1311,607	1,468,880	471,251	997,629
West Chicago R. R. Co	12 " " '94	4,181,237	2518,627	1,662.610	859,471	803,139
	12 " " '95	4,201,477	2267,195	1,934,282	902,016	1,032,266
Chicago & So. Side R. T. Co.	1 m., Mar. '95	70,013	47,113	22,900		
	1 " " '96	67,026	40,250	26,776		
	3 " " '95	193,073	140,694	52,379		
	3 " " '96	193,012	125,449	67,563		
CINCINNATI, O.						
Cinn. Newport & Cov. Ry. Co	12 m., Dec. '94	497,950	370,606	127,344		
	12 " " '95	624,034	418,710	205,324		
	1 " Feb. '95	37.254	34,293	2,961		
	1 " " '96	42 702	33,917	8 885		
	2 " " '95	76 689	65,557	11,132		
	2 " " '96	89,402	68,399	21,003		
CLEVELAND, O.						
Cleveland Elec. Ry. Co	1 m. Feb. '95	95.631	73 096	22,535		
	1 " " '96	118.977	82,781	36.196		
	2 " " '95	199.527	146.494	53,033		
	2 " " '96	244,384	167,551	76,833		
COLUMBUS, O.						
Columbus St. Ry. Co.	12 m., Dec. '94	566,811	269 362	297,449	176.648	120,801
	12 " " '95	629,995	311,594	318,401	183,506	134,895
	1 " Mar. '95	47,828	23,481	24 347		
	1 " " '96	50,896	25,743	25,154		
	3 " " '95	133,726	69,571	64.155		
	3 " " '96	148,507	78,549	69.958		
DENVER, COL.						
Denver Cons. Tramway Co	12 m., Dec. '94	753,483	445,684	307.798	244,172*	63,625
	12 " " '95	716.039	441,283	274,756		
	1 " Feb. '95	48.001	30.485	17.516		
	1 " " '96	51.901	31.534	20.367		
	2 " " '95	103,697	66.380	37,317		
	2 " " '96	106,441	65,755	40.686		
DETROIT, MICH.						
Ft. Wayne & Belle Isle St. Ry. Co.	6 m., June '95	116,945				
Citizens' St. Ry. Co.	6 m., June '95	386,575				
Rapid Ry. Co.	5½ m. Dec. '95	30,356	15.586	14.770	6,875	7,895
Detroit Ry.	3 m., Jan. '96	113,738	70,818	42.920		
DULUTH, MINN.						
Duluth St. Ry. Co.	12 m., Dec. '94	208,105	111,105	97,000		
	12 " " '95	213,229	95,329	117,900		
	1 " Feb. '95	15.712	8,833	6 879		
	1 " " '96	15,247	8,679	6.568		
	2 " " '95	31,415	19,161	12,254		
	2 " " '96	31,087	17,754	13,333		
FALL RIVER, MASS.						
Globe St. Ry. Co.	12 m., Sept. '94	248,106	147,352	100,754	75,284	25,470
	12 " " '95	269,786	159,090	110,696	76,479	34,217
FINDLAY, O.						
Findlay St. Ry. Co.	12 m. Dec. '95	29,798	20,308	9,490	7,415	2,075
FITCHBURG, MASS.						
Fitchburg & Leominster St. Ry. Co.	12 m., Sept. '94	89,260	61,416	27,845	7 209	20.636
	12 " " '95	110,275	74,103	36,172	7,017	29,155
GALVESTON, TEX.						
Galveston City R. R. Co.	12 m., Dec., '94	199,133	131,407*	67,726	50,000	17,76
	12 " " '95	216.271	141,080	75,191		
	1 " Feb. '95	12,449	8,741	3,708		
	1 " " '96	13,058	9,303	3,755		
	2 " " '95	27,010	18,602	8,408		
	2 " " '96	26,317	19,610	6,707		
GIRARDVILLE, PA.						
Schuylkill Traction Co.	12 m Sept. '94	88,288	56.564	31,724	25,000	6,724
	12 " " '95	90,981	52,851	38,130	29,770*	8,360
	6 " Mar. '95	40,597	27,855	12,742		
	6 " " '96	46,157	26,758	19,399		
GREAT FALLS, MONT.						
Great Falls St. Ry. Co	12 m., Dec. '94	26,431	24.905*	1.526		
	12 " " '95	26,650	28,126	d 1,476		
HAZLETON, PA.						
Lehigh Traction Co.	12 m., Dec. '94	97,202	50,605	46,597		
	12 " " '95	119,588	67,979	51,609	39,297	12,312
	1 " Mar. '95	8,941	5,837	3,104		
	1 " " '96	9,166	5,613	3,553		
	3 " " '95	24,273	16,527	7.746		
	3 " " '96	27,882	18,241	9,641		
HOBOKEN, N. J.						
No. Hudson Co. Ry. Co.	12 m., Dec. '94	818,280	611,482*	206,798		
	12 " " '95	871,273	619,830	251,443	246,649*	4,794
HOLYOKE, MASS.						
Holyoke St. Ry. Co.	12 m., Sept. '94	75,427	48,546	26,881	3.524*	23,356
	12 " " '95	112,547	69,627	42,920	20,058*	22,862
KANSAS CITY, MO.						
Metropolitan St. Ry. Co	1 m. Feb. '95	107,058	77,238	29 820		
	1 " " '96	124,935	82,620	42,315		
	9 " " '95	1,285,498	806,109	479,389		
	9 " " '96	1,343,367	782,447	560,920		
LAWRENCE, MASS.						
Lowell, Lawrence & Haverhill St. Ry. Co	12 m., Sept. '95	269,740	205,816	63.924	73,423*	d 8,498
	12 " " '96	403,530	262.935	140,595	84,081*	56,514
	1 " Feb. '95	20,475	18,548	1,927		
	1 " " '96	26.132	18,160	7,972		
	5 " " '95	114,947	93,012	21,935		
	5 " " '96	141,835	98,265	43,570		

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
LORAIN, O.						
Lorain St. Ry	12 m., Dec. '95	80,176	46,092	34,084		
	1 " Mar. '95	6,337	3,254	3,083		
	1 " " '96	5,431	4,207	1,224		
	3 " " '95	15,861	10,940	4,921		
	3 " " '96	14,496	11,915	2,581		
LOUISVILLE, Ky.						
Louisville Ry. Co	12 m, Dec. '94	1,176,790	633,206	543,584	355 799*	187 784
	12 " " '95	1,288,172	672,080	616,092	359,366*	256,726
LOWELL, MASS.						
Lowell & Suburban St. Ry. Co	12 m. Sept. '94	277,029	179,409	97,620	66,624*	30.99
	12 " " '95	329,817	199,346	130,471	66.575*	63.896
MACON, GA.						
Macon Cons. St. Ry. Co.	12 m., Dec, '95	69,190	44,529	24,661	16,711*	7,951
MANCHESTER, N. H.						
Manchester St. Ry. Co.	12 m, June '94	81,627	76,906*	4 721	3,302	1,419
	12 " " '95	82,923	87,594	d 4,670		
MARSHALLTOWN, IA.						
Marshalltown Light, Power & Ry. Co	12 m., Dec. '94	38,758	24,190*	14,568	7,650	6,918
	12 " " '95	40,757	24,307*	16,450	7,500	8,950
MINNEAPOLIS, MINN.						
Twin City R. T. Co	12 m, Dec '94	2,003,679	1,044,548	959,131	738,961*	220,170
	12 " " '95	1,988.803	979,485	1,009,319	750,839*	25 ,479
	1 " Feb. '95	134,896	67,947	66,949		
	1 " " '96	145,061	69,383	75,678		
	2 " " '95	286,927	143,024	143,903		
	2 " " '96	303,974	144,585	159,389		
MONTGOMERY, ALA.						
Montgomery St. Ry. Co	12 m., Dec '94	35,216	21,724	13,492		
	12 " " '95	50,645	27,915	22,730		
	1 " Feb. '95	2,825	1,794	1,031		
	1 " " '96	3,462	1,753	1,709		
	2 " " '95	6,330	3,958	2,372		
	2 " " '96	7,150	3,822	3,328		
MONTREAL, CAN.						
Montreal St. Ry. Co	12 m., Sept. '94	897,838	628,454	269,384	55,363*	214,021
	12 " " '95	1,102,778	652,812	449,966	98,617	351,349
	1 " Mar. '95	78,638				
	1 " " '96	92,146				
	6 " " '95	462,431				
	6 " " '96	664,997				
NEWBURGH, N. Y.						
Newburgh Elec. Ry. Co.	12 m., Feb. '96	91,156	55,190*	35.966	26,458	9,507
NEWBURYPORT, MASS.						
Haverhill & Amesbury St. Ry. Co	12 m, Sept. '94	98,346	58.061	40,284	27,664*	12,621
	12 " " '95	104,853	65,936	38,917	28,223*	10,694
NEW HAVEN, CONN.						
New Haven St. Ry. Co	12 m., Dec '94	126,183	69,517	56 666		
	12 " " '95	198,719	124,454	74,265		
	1 " Mar. '95	11.742				
	1 " " '96	12,679				
	3 " " '95	34,712				
	3 " " '96	39,988				
NEW LONDON, CONN.						
New London St. Ry. Co.	12 m, Sept '94	49,899	29,150	20,749	6,423*	14,326
	12 " " '95	51,759	30,230	21,528	7,650*	13,878
NEW ORLEANS, LA.						
New Orleans Traction Co	12 m., Nov. '94	951,528	620,508	331,020		
	12 " " '95	1,327,756	752,158	575,598		
	1 " Feb. '95	87,511	53,135	34,376		
	1 " " '96	115,326	59,256	56.070		
	3 " " '95	280 236	162,286	117,950		
	3 " " '96	343,183	180,282	162,901		
NEWTON, MASS.						
Newton & Boston St. Ry. Co.	12 m, Sept. '94	33.478	25,262	8,216	7 677*	539
	12 " " '95	32,297	24 685	7,613	7 108*	504
Newtonville & Watertown St. Ry. Co	12 m., Sept. '95	7,580	6,599	981	8 9*	172
NEW YORK, N. Y.,						
Third Ave. R. R. Co.	12 m., Dec. '94	2,178,336	1,177,344	1,000,991	341,083*	659,909
	12 " " '95	2,355,154	1,456 782	1,198,372	328,917*	869,454
Metropolitan St. Ry. Co.	12 m., June '94	5,398,466	3,223,956	2 174,510	1,859,971*	314 539
	12 " " '95	5,772,260	3,183.210	2,589,050	2,016,889*	572,161
	6 " Dec. '94	2,885,101	1,632,245	1,252,856	963,046	289,810
	6 " " '95	3,613,850	1,832,246	1,781,604	1,155,620	625,984
Manhattan Ry. Co	12 m., Dec. '94	9,953,840	5,446,029	4,507,811	2,674,049*	1,833,762
	12 " " '95	9,731,213	5,533,959	4,197,254	2,988,167*	1,209,087
Central Crosstown R. R. Co	12 m., Dec. '94	546,026	385,309	160,717	90,427*	70,291
	12 " " '95	547,491	379,523	167,968	101,526*	66,442
D. D., E. B. & Bat'y R. R. Co	12 m., Dec. '94	691,861	465.236	226,626	171,423*	55,202
	12 " " '95	748,443	557,074	191,369	138,112*	53,256
Eighth Ave. R. R. Co.	12 m., Dec '94	768,064	565,927	202,138	95,545*	106,592
	12 " " '95	530,009	424,706	105,303	68,978*	36,324
42d St., Man & St. N. Ave. R. R. Co	12 m., Dec. '94	645,130	517,445	127,685	122,804*	4,881
	12 " " '95	626,337	527,155	99,182	122,800*	d23,618
New York & Harlem R. R. Co	12 m., Dec '94	1,106,017	670,970	435,047	37,524*	397,523
	12 " " '95	1,015,076	693,487	321,589	40,150*	281,439
Second Avenue R. R. Co	12 m., Dec. '94	987,923	755 395	232,529	140,078*	92,450
	12 " " '95	941,290	721,417	216,873	124,566*	92,308
Union Ry. Co	12 m., Dec. '94	470,446	254,973	215,473	141,934*	73,539
	12 " " '95	457,457	280,435	177,022	127,287*	49,735
NORRISTOWN, PA.						
Schuylkill Val. Trac. Co	12 m., Dec. '95	50,752	36.580	14,172		
NO. ABINGTON, MASS.						
Rockland & Abington St. Ry. Co	12 m., Sept. '94	52,762	38,836	13,926	5.282*	8,644
	12 " " '95	67,815	49,759	18,056	6.008*	12,048
NORTHAMPTON, MASS.						
Northampton St. Ry. Co	12 m, Sept. '94	50,090	28,904	21,186	2,375*	18,811
	12 " " '95	83,504	46,240	37,264	3,131*	34,133

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income
NORWALK, CONN.						
Norwalk Tramway Co.	12 m., Sept. '95	43,315	29,858	13,457		
NORWICH, CONN.						
Norwich St. Ry. Co	12 m, Sept. '94	80,069	50,693	29,376	16,035*	13,341
	12 " " '95	85,210	53,454	31,756	17,400*	14,356
OAKLAND, CAL.,						
Central Av. Ry. Co	12 m., Oct. '94	32.668	26,781	5,887	1,852	4,035
	12 " " '95	30,808	26,148	4,660	3,785	875
Oakland Consol. St. Ry. Co	12 m., Dec. '94	129,351	95,821	33,530	31,139*	2,390
	12 " " '95	125,485	94,115	31,370	25,140	6 230
ORANGE, N. J.						
Suburban Traction Co.	12 m., Dec. '94	42 502	42,938*	d 431		
	12 " " '95	52,000	56,000	d 4,000		
PATERSON, N. J.,						
Paterson Ry. Co	12 m., Dec. '94	243,921	157,520	86,401	88,597	2,196*
	12 " " '95	298,689	174,619	124,070	97,264	26,806
	1 " Mar. '95	19,452	13,474	5,978		
	1 " " '96	23,643	14,659	8,984		
	3 " " '95	54,848	37,880	16,968		
	3 " " '96	69,121	41,006	28,115		
PHILADELPHIA, PA.,						
People's Traction Co	12 m., June '94	1,044.159	673,479	370.680		
	12 " " '95	1,660,676	829,815	830,861		
Hestonville M. & F. P. Ry. Co	12 m., Dec. '94	286,021	315,762	207,450	97,966	109,485
	12 " " '95	523,212				
Electric Traction Co	12 m. June '94	1,900 606	1,120,026	780,580		
	12 " " '95	2,151,853	1,241,584	910,269		
PORT HURON, MICH.						
City Elec. Ry. Co	12 m., Dec. '94	46,702	32,585	14,117		
	12 " " '95	52,848	34,771	18,076		
POUGHKEEPSIE, N. Y.,						
Poughkeepsie City & Wappinger's Falls E. R. Co	12 m., Dec. '95	93.557	60,257	33,300		
	1 " Mar. '96	5,448	4,198	1,250		
	3 " " '96	16,043	11,593	4,450		
ROCHESTER, N. Y.,						
Rochester Ry. Co	12 m., Dec. '94	782,520	448,304	334,216	269,045*	65,171
	12 " " '95	873,445	517,519	355,926	307,118*	48,808
ST. LOUIS, MO.,						
National Ry. Co	12 m., Dec. '94	1,353,136	776,582	576,554	337,684	238,870
	12 " " '95	1,403,957	821,315	582,642	366,587	216,055
SCRANTON, PA.,						
Scranton Trac. Co	12m, June, '94	247,768	140,080	107,688	105,796*	1,892
	12 " " '95	270,700	142,278	128,422	119,858*	8,564
	1 " Mar. '95	20,919	11,889	9,030		
	1 " " '96	25,523	14,219	11,303		
	9 " " '95	194,781	119,599	75,182		
	9 " " '96	243,967	121,977	121,991		
SEATTLE, WASH.,						
West St. & No. End Elec. Ry. Co	12 m., Dec. '95	29,737	15,031	14,706		
SPRINGFIELD, MASS.						
Springfield St. Ry. Co.	12 m Sept. '94	373,903	252,269	121,634	18,210*	103,424
	12 " " '95	442,006	277 156	164,850	30,637*	134,213
SYRACUSE, N. Y.,						
Syracuse Cons. St. Ry. Co	12 m., Dec. '94	194,547	181,105	13,442	197*	13,244
	12 " " '95	164,636	178.072	d13,446	304*	d13,750
Syracuse St. R. R. Co	12 m., Dec. '94	245,805	145,934	99,870	93,965*	5,905
TERRE HAUTE, IND.						
Terre Haute Elec. Ry. Co	1 m., Dec. '94	8,354				
	1 " " '95	11,602	7,9.9	3,663		
	6 " " '94	60,336				
	6 " " '95	83,507	48.855	34,652		
TRENTON, N. J.						
Trenton Pass. Ry. Co.	12 m., Dec. '94	198,681				1,129
	12 " " '95	222.761				1,771
TORONTO, ONT.,						
Toronto St. Ry. Co	12 m., Dec. '94	958,371	517,708	440,663		
	12 " " '95	992,801	489,915	502,886		
	1 " Feb. '95	62,460	39,032	23,428		
	1 " " '96	72,468	42.740	30,728		
	2 " " '95	132,997	82,114	50.883		
	2 " " '96	147,845	85,878	61,967		
TROY, N. Y.,						
Troy City Ry. Co	12 m, Dec. '94	432,596	212,407	220,189	130,474	89,705
	12 " " '95	490,489	242,775	247,714	126,116*	121.598
UTICA, N. Y.						
Utica Belt Line St. RR.	12 m., Dec. '94	149,105	90,754	58,351	29.844*	28,508
	12 " " '95	160.284	105,297	54,988	44 791*	10.197
WASHINGTON, D. C.						
Capital Traction Co	12 m, Dec. '95	1.063.776	634,013	429.754		
WATERBURY, CONN.,						
Waterbury Trac. Co	12 m., Dec. '95	247.730	142,073	105.657		
	1 " Feb. '95	16.588				
	1 " " '96	19.282	11,265	8,017		
	2 " " '95	33,830				
	2 " " '96	40,738	23,401	17,337		
WHEELING, W. VA.						
Wheeling Ry. Co	12 m., Dec '94	133,517	119,378	14,139		
	12 " " '95	150,094	88,552	61,542	32,248*	29,294
WILKESBARRE, PA.,						
Wilkes Barre & Wyoming Val. Trac. Co	12 m., Dec. '94	400,143	196.824	203,319	122,607*	80,711
	12 " " '95	451,941	209,600	242.341	134.215*	108.127
	1 " Mar. '95	30,557	15,223	15,334		
	1 " " '96	36,791	18,437	18,354		
	3 " " '95	81,992	47,987	34,005		
	3 " " '96	112,057	53,612	58,445		
WILLIAMSPORT, PA.						
Williamsport Pass. Ry. Co	12 m., June '94	61,863	49,646	15,217	10,255	4,962
	12 " " '95	66,845	52,459	14,386	9,691	4,695
WORCESTER, MASS.,						
Worcester Cons. St. Ry. Co	12 m., Sept. '94	355,000	284,215	70,785	45,479	25,306
	12 " " '95	420,498	309,787	110,711	51,778	58,933
	1 " Feb. '95	25,947	23,466	2 481		
	1 " " '96	34,168	26,505	7,663		
	5 " " '95	150,823	118,226	32,597		
	5 " " '96	186,686	139,100	47,586		