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*Address all communications to*

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## Value of Transfer Inspection

In a recent discussion of methods for preventing transfer frauds in which several managers participated, it was found that not a single road represented had any systematic plan for preventing the abuse of this privilege. It should be mentioned that, with one exception, all the companies represented were comparatively small concerns, the only large property interested being one which had consistently and persistently opposed the issuance of transfers and had generally succeeded. All of the other companies had made spasmodic attempts to check up their returns especially when abuses became too flagrant, but after a short period the investigation was discontinued on the ground that it cost too much. Most of the managers admitted that the companies suffered as soon as the system of inspection was discontinued, but they did not seem to think that the losses sustained through these frauds warranted them in organizing and developing a permanent inspection bureau. This, of course, is a matter for each management to decide for itself, but in reaching a conclusion consideration should be had for the fact that neglect to take cognizance of these conditions and remedy them cannot fail to have a very bad influence on the organization generally and encourage laxity in other branches of the service. When the management winks at pilfering, simply because it is believed the amount involved is less than the cost of detecting it would be, heavier losses resulting from the betrayal of its interests in other departments will probably follow, and every failure on the part of the company to investigate fraud and punish its perpetrators is an encouragement to others who may have opportunity to do likewise. In general, it may be said that the moral effect of strict inspection cannot be too highly valued.

## Just a Little More Speed

We note with pleasure that our space-devouring friends at Zossen have not yet satiated their hunger for pace and touched the record the other day for no less than 140 m. p. h. They seem to be overcoming air pressure rather comfortably up to the present, and we have heard nothing about the motors failing or the pressure caving in the front end of the car. Perhaps the doubting gentlemen who figured on the motors burning out from overload at about 80 m. p. h. to 100 m. p. h. will now be convinced that higher speeds are both possible and practicable. One hundred and forty miles per hour is a decidedly hot pace, but it will more than likely be beaten before we go to press. It has taken a good many years to evolve the two-minute trotting horse, but this year we have him in triplicate, and just so it has been with electric railroading. Once the records began to break they fairly blew up and left only small fragments. One hundred and forty miles per hour, even if not outdone by a considerable margin, still means that the hundred-mile-an-hour train is much nearer to reality than it has ever been before. That speed is quite feasible whenever it is demanded, and it is, moreover, quite high enough to meet the requirements of humanity for some little time to come. Its real importance lies, as we have often remarked, in its application to long lines on which the saving of time would be material. Cutting down the running time to Flatbush or Hackensack may defer the dyspepsia of the commuter for another season or two, but it is not commercially important. It is cutting the time on long runs that counts—reducing the time to Washington to less than three hours, and converting the trip to Chicago into a mere night's run. It is now announced that the experiments have been conducted largely with the idea of the early application of the system to the railroad connecting Berlin with Hamburg, distant by rail 176 miles from each other, and that an early conversion of that line is by no means improbable. Somehow the hundred-mile-an-hour train looks nearer than it did a few months ago, and our spyglass is still trained in the direction of Germany.

## The Fire Danger

The report on the Paris disaster which we published in our last issue, together with an unimportant accident in this city, to which some of the papers attached altogether too much sensationalism, has served again to bring before the public eye the subject of fire risk in electric cars. Ordinary electric roads need hardly be seriously considered in this connection, since exit from them is so easy, but elevated roads and subways undeniably present some new sources of danger. Fire is, of course, a possible contingency on any cars constructed of inflammable material, and any electric arc once started is an incendiary capable of producing a fire in anything that will burn at all. Once well started, a fire in a train is likely to spread as it did in the Paris instance, and the results, as there, may be

very grave. But upon reflection there seems no good reason why an electric train may not be thoroughly safeguarded. In the first place, the surroundings of the motors and their cables ought to be practically fireproof, and can easily be made so. In fact, many American cars are pretty well safeguarded in this particular. In the next place, if a motor car is used to draw trailers, this car can be of out-and-out fireproof construction, so as effectively to remove danger of a conflagration. Finally, all the cars could be of fireproof construction throughout without working any particular hardship on anybody. But quite aside from removing danger of electrical fires one must consider another set of precautions directed to ensuring the safety of passengers in case of an actual fire or such alarm of fire as might cause a panic. In the Paris disaster the means of exit from the stations appear to have been altogether inadequate. This direful lesson should be taken to heart in planning subway entrances and exits hereafter, and means should be provided for clearing a station with great rapidity in case of necessity. Next, on lines using the third-rail the danger from shocks in case of a rush from the cars should never be forgotten. It is not a difficult matter to use a protected third rail, especially on underground lines, and there seems to be no good reason why it should not be done. With such precautions taken, and general operative care of the excellent quality usual on American lines of the first magnitude, we see no reason to worry over the fire risk.

## Proposed Electric Operation on the Boston & Albany

Some time ago we published an item in regard to the failure of a steam motor car to capture the traffic on the Newton Lower Falls branch of the Boston & Albany Railroad in the face of severe trolley competition. The Boston & Albany, as nearly everyone in the East knows, is a finely equipped steam railway system, leased by the New York Central & Hudson River Railroad, and the excellence of its suburban service is familiar to transportation experts the country over. It is now reported that the Lower Falls branch is shortly to be equipped for trolley operation, and if this work is soon carried out it will doubtless furnish an object lesson to Boston commuters which will result in a demand for more extended electric service.

The branch line in question is but 1.1 miles in length, and serves a comparatively small population. Nevertheless, it is a good place to show what electricity can do in the way of rescue work, as there are at present twenty trains per day over it in each direction, operating, it is said, at a loss financially. Wisely, the road will probably buy its power from a local electric company, as but a single car will be operated at first. The equipment will consist of a motor car divided into three compartments, one for baggage, one for smokers and one for non-smoking passengers.

The electrification of the entire Brookline and Newton circuit suburban loop of the Albany road has been a subject of discussion in railway circles for certainly a decade. With the advent of the third rail and the completion of the Southern Terminal Station, with its depressed loop tracks for suburban trains, prospects began to look brighter for the application of electricity on a large scale to one of the most interesting and favorable fields in the domain of transportation. While the Newton Lower Falls branch is but a feeder to the main circuit line, we cannot but believe that the adoption of even the overhead trolley marks a step toward the gradual realization of electric power in the entire suburban traffic of the Albany road about Boston. From time to time it has been authoritatively stated that the management has considered plans for this latter far-reaching change, with the great manufacturing companies, and this driving in of the outposts looks encouraging.

## The Heating of Railway Motors

A recent Institute paper, by Dr. Hutchinson, brings again to the front the very interesting question of the rating of motors with respect to temperature, and the predetermination of the heating due to any particular kind of run. The paper itself does not permit of abstracting to advantage, and is of a highly technical character, but it suggests quite incidentally some very important questions. One of the most practical, it seems to us, is the possible effect of specialized means of ventilation on the final temperature of railway motors and on their useful working capacity. Every one who has followed the improvements in electrical apparatus knows well the great change for the better in the ventilation of generators, and the resulting lowering of cost and improvement in efficiency. But few outside of practical constructors know the great change for the better that can be made by even few and small apertures for ventilation in a machine of the iron-clad type. The early railway motors were not enclosed, and were pretty badly designed as well, so that the iron-clad motor was a welcome change for the better. But to-day, and most particularly in interurban service, the need of an extreme iron-clad construction is much less pressing that it once was, and we would much like to see the results of a less extreme enclosed construction. The practical question is merely how much ventilation can be introduced without material trouble from dust and moisture. We have already reported some experiments on ventilating devices that seemed to give excellent results, but these, tried on standard motors, were, of course, under less favorable conditions than if the motors had been deliberately designed to facilitate ventilation. The whole subject needs to be conscienciously gone over, for the possible gains are very considerable. It is a task for the designer, in particular, and we are more than half-inclined to think that a motor can be found which will do the work of the present machines at a materially reduced cost and with lessened weight of equipment, which is itself an end greatly to be desired.

## Track Work

"If those who originally built street railways had to maintain them they might have been built differently."

This is how Mr. Wilson sums up the situation in his paper on "Track Construction and Maintenance" at the Syracuse Convention, and no doubt there is much truth and wisdom in the remark, but on the other hand may be cited instances to-day where experience, although dearly bought, does not seem to have left much of an impression, and very little, if any, improvement over earlier methods is shown. We are actually floundering about to-day without any fixed purpose and definite aim, and, consequently, the data available is not as conclusive as it should be at this late day. The trouble seems to be largely in failure on the part of the operator as well as the builder to appreciate the actual requirements of the service which the road is to perform. As in the cases cited by Mr. Wilson many promoters to-day do not know what class of service is to be given over the lines they project, and, besides, they do not possess sufficient experience to determine the character of equipment best adapted for their needs. A great many roads seem to be operated without regard for economical con-

siderations, and, consequently, it cannot be expected that their track construction and maintenance will be treated scientifically.

Mr. Wilson, of course, refers to a different class of properties, including roads whose present management has well defined ideas regarding the possibilities of properly operated electric lines. Many of these companies, especially those created by the consolidation of smaller systems, have been seriously handicapped by the condition of the property turned over by the promoter or builder, and they have not infrequently been put to the necessity of rebuilding the entire plant. How to avoid such faults in the future is the lesson of these experiences, and this applies to present roads as well as projected lines. It must be apparent to all that a careful investigation of this problem along scientific lines cannot fail to repay those who will engage in it. To-day there is no standard, no generally accepted method, but each engineer or manager follows his own inclination, and thereby contributes to the general confusion. Such an important subject is deserving of the best thought available.

## The Business Outlook

It is a somewhat curious fact that while some of the leading capitalists of the country, such as the Goulds and Harriman interests, are proposing important betterments to their railroad interests in the Central and Western parts of the United States, while the aggregate clearing house exchanges over the entire country for the year, outside of New York City, are larger than those of last year, and while the railroads are taxed to their utmost to carry the goods bought and sold, stock exchange prices should have so long been low.

Judging from this latter fact alone, the opinion has been expressed in Wall Street that the country, having passed the summit of the great industrial prosperity of the last five years, the movement of trade has set very definitely in the opposite direction. It is important in discussing this question to consider, first, what are the actual signs of a commercial decline, and, second, whether they are sufficiently serious to suggest that we are likely in the near future to run into a period of positive business depression. The unpleasant symptoms which have gathered during the last twelve months are: an excessive advance in commodity prices, the exorbitant demands on the part of organized labor, which have led to an abnormal rise in wages, and increases more or less considerable in the cost of materials entering into manufacturing and trade in general. These circumstances, working in unison, have certainly cut heavily into the profits of capital, the result of which is that in various lines of industry, notably in iron and steel, demand has fallen off, prices have dropped, and production is being curtailed.

This appears to be the full extent of the facts upon which the notion of a retrograde movement is based. The overproduction which usually ushers in a real commercial crisis, plainly does not exist. Thanks to the concentration of administrative control, which is a part of our new industrial regime, prices have not been allowed to rise far enough to arouse new competition and so stimulate new production to what can be termed a dangerous degree. The unfavorable attitude of union labor has itself been a powerful additional check upon these unwholesome tendencies. If over-production is not present now, there is but one other way in which a serious revulsion in business could occur, and that is through a general curtailment of consumers' demands. It is true that higher prices have raised the cost of living and that for this reason a part of the population is able to buy less than it could two or three years ago. It is also true that high prices have caused some decline in foreign purchases of our agricultural products. On the other hand, our manufacturers have not lost any of their hold on the foreign markets, for our manufacturing exports are as large now as they were last year, and far larger than the average of recent years. The loss in agricultural exports, there is every reason to believe, will be easily recovered after prices of our wheat and corn and cotton have fully felt the influence of this autumn's enormous harvests.

With this much assurance for the foreign trade, the only anxiety is as to whether the buying power in our home markets will be sustained. We know that the great farming regions of the West and South have before them one of the most promising seasons in their history—that the corn crop is the largest but one on record, that the wheat crop has never but twice been exceeded, that cotton will be much more than an average crop, and that all this new wealth coming up out of the ground is going to be enormously augmented by the unusually high prices offered for all the products of the farms. What this means clearly enough is that the buying power of a large section of the country is not only not likely to diminish but is most likely to rise greater than ever, and that the prosperity of the agricultural West and South will reflect itself in unlessened degree in the demand for the products of the mercantile and manufacturing East. In our view of the case too little weight has been given to the fundamental and too much weight to the superficial elements in the situation. The only really serious feature now confronting is the unfriendly position assumed by organized labor. Labor unions pushing their claims too far caused the suspension in the building trades; the loss of this important custom has been the main reason for the decreased earnings of the steel trade, and it is still an open question whether it, also, is not the chief explanation for the reduction of the dividend on the Steel Corporation's common stock, which has served more than any other recent event to arouse the misgivings of the commercial community. All candid observers must admit the possibility of a crisis soon to be reached, where labor will have to choose between the alternative of working for less wages or going without any work at all. The issue will not be tried by strikes and lockouts, but by a frank statement on the part of employers that they prefer to suspend operations altogether rather than continue them on an unprofitable basis. The recent exposure of the mercenary objects of some of the leading labor leaders will do much to clear the labor horizon.

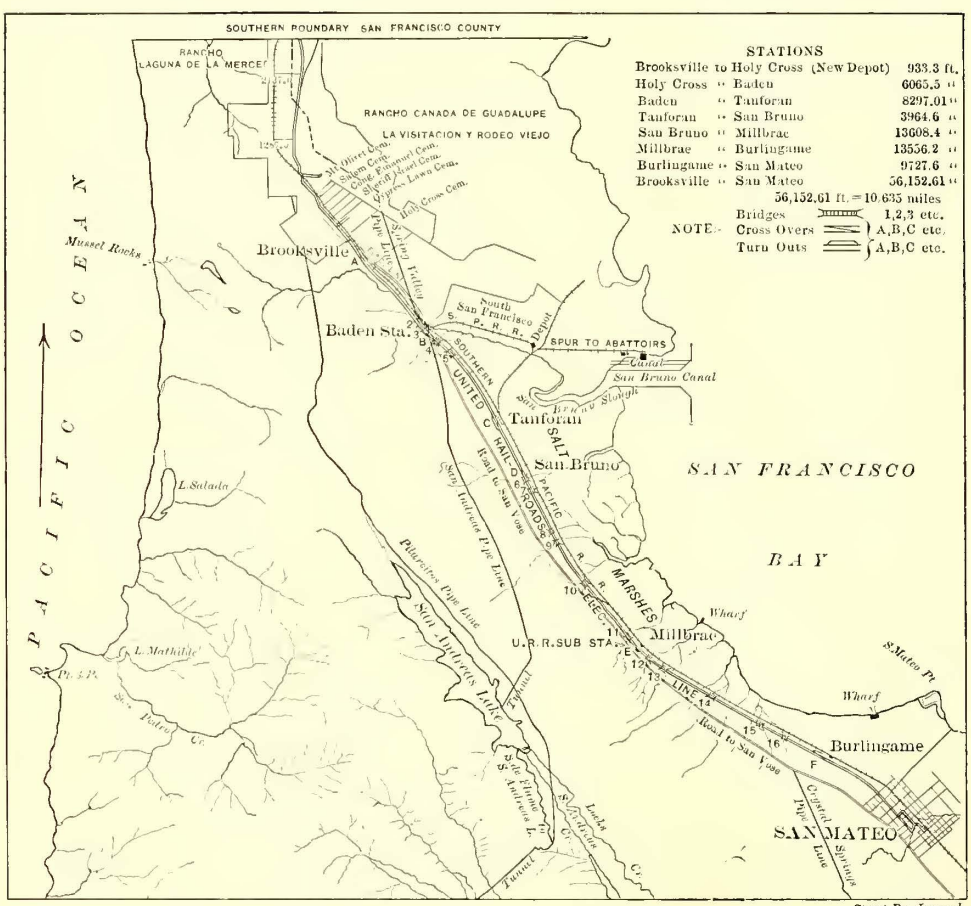
A sensible reaction in many lines of business has already appeared, and it is quite likely to go further. Where prices have risen too high they must come down, where production has gone ahead too fast it must be curtailed, and, finally, labor must be brought to recognize that its profits cannot keep up as they have been when profits of capital are declining. But the point we wish to emphasize is that what this calls for is a period of readjustment, not a period of real depression. The vital wealth-giving forces have not suffered from anything that has happened during the past twelve months. No collapse of the nation's buying power, such as happened in 1883 and 1893, is now at hand. The foreign outlets for our surplus products are not seriously impaired. Production has not so far exceeded its proper bounds that it cannot easily be brought back. In brief, the real underpinings of our great industrial prosperity remain as sound as ever.

## SAN MATEO EXTENSION OF THE UNITED RAILROADS OF SAN FRANCISCO

Isolated from the noises and apparent confusion which pervade a city like San Francisco, the pretty town of San Mateo, Cal., 'midst orange, olive and eucalyptus trees, palms, roses of every description, fuchsias and geraniums that attain the height of small trees and literally loaded with blossoms, caulilies, poppies and other beautiful and fragrant flowers, offers an ideal home for the business man or man of leisure. Here he may spend his evenings with his family and friends, far away from the crowds that throng the streets of San Francisco by day and night. There are other attractions that make this town popular. First of all, the climate is superb. Sheltered by mountains from the winds and fogs that sweep over San Francisco, and make overcoats and sealskins necessary in that city, one may gaily venture forth in a tennis suit in San Mateo. And yet, on account of its proximity to San Francisco Bay, it does not get uncomfortably warm.

Until recently the only means of traveling between San Francisco and San Mateo was by steam train or driving. The distance, 23 miles, made driving an impossibility as a regular means of going back and forth. Trains were rather few and far between. Shoppers had to devote a whole day in order to make a trip to the metropolis of the Pacific Coast. Theatergoers had to contend with the old bugbear—the last train—and to miss it meant spending a night in San Francisco, with incidental hotel expenses. Business men, if they missed their regular train, had to wait an hour or more for the next one.

TYPICAL SAN MATEO COTTAGE




MAP OF SAN MATEO EXTENSION OF THE UNITED RAILROADS OF SAN FRANCISCO

Besides, after one arrived in the city, via steam train, ten minutes or fifteen minutes were consumed in reaching the business or shopping district of the city by trolley. So, taken as a whole, with its many attractions and allurements, San Mateo was not regarded as a desirable place to live.

The high-speed trolley service which has solved the interurban problem so many times before, again came to the front and solved this transportation problem. To begin with, 11 miles of trolley line already existed, extending from the ferries in San Francisco to what is known as Holy Cross. About 4 miles of this was through the city. Seven miles was suburban line. A private right of way was secured from Holy Cross to Burlingame, through the outskirts of Baden, San Bruno and Millbrae. From Burlingame to San Mateo franchises were secured to run on the streets. There were, therefore, about 12 miles of interurban road to be built.

### TRACK CONSTRUCTION

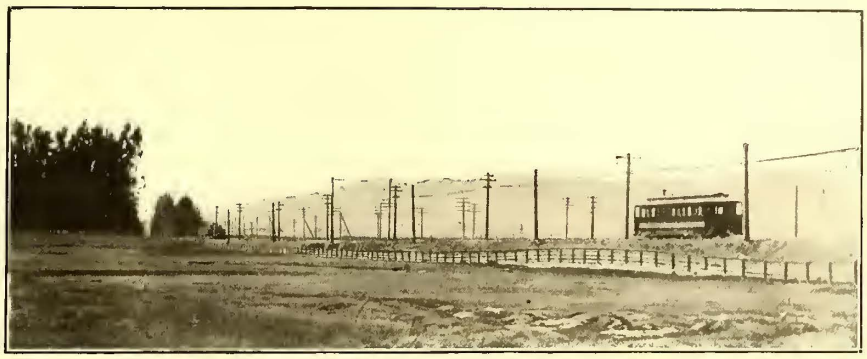
A map of the double track with cross-overs, switches, etc., from Holy Cross to San Mateo, and a sectional drawing showing roadbed construction, are presented. The ties are redwood, 6 ins. x 8 ins. x 8 ft. They are placed 2 ft. 6 ins. from center to center. The rail is a 72-lb. T-rail, on the private right of way. The joints are cast-welded, with an expansion joint every 1000 ft. Each cast-weld weighs 120 lbs. In the town of San Mateo a 9-in. girder rail is used. With the exception of a slight grade in San Mateo the interurban line is practically level. Several views, reproduced from photographs, illustrate typical cuts and fills. Except in San Mateo the entire interurban line is heavily ballasted with crushed rock. Track centers are 13 ft., and the gage is standard.

### LINE CONSTRUCTION

Wooden side-pole construction is used on the entire interurban section. The poles carrying high-tension wires are 7 ins. x 7 ins. at the top, 13 ins. x 13 ins. at the base, and 35 ft. long. The other poles are 8 ins. x 8 ins. at the top, 12 ins. x 12 ins. at base, and 25 ft. long. They are all of redwood, and that portion which extends into the ground was coated with crude oil. They are painted a dark green, with a mixture of linseed oil, yellow ochre and lamp black.

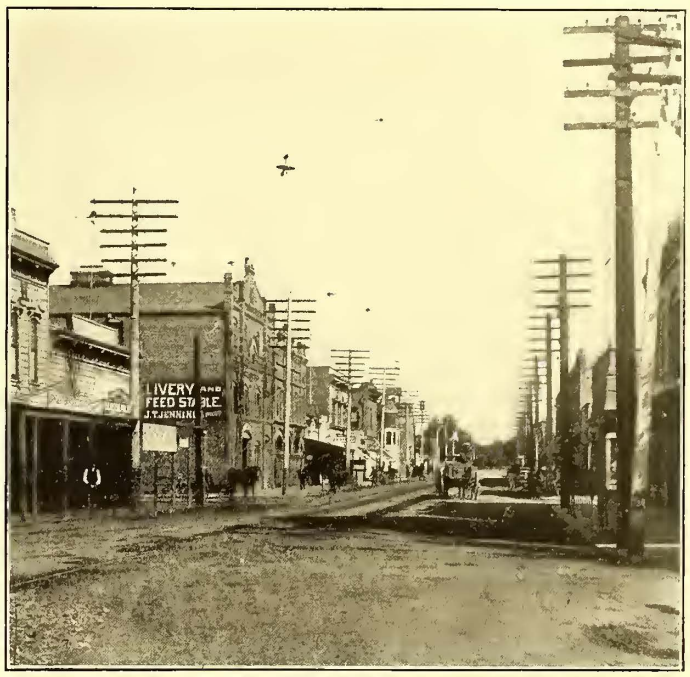
The cross arms are all made of Oregon pine, those carrying

the high-tension wires being 4 ins. x 6 ins. x 5 ft., and 4 ins. x 6 ins. x 7 ft. The three high-tension wires are arranged in a triangle on one side of the pole, making it possible to add another set if it is desired. One wire is carried on the upper cross-arm and two on the lower. The wire is No. 0, and is triple braided, waterproof. John Martin No. 100 brown porcelain, single-petticoat, iron-pin insulators are used. The cross-arms carrying the feeder wires are 4 ins. x 6 ins. Steel-pin porcelain insulators are used. There are at present five feeder wires from Millbrae substation, all being 500,000 circ. mils. The trolley wire is No. 00 hard-drawn copper. The span wires are



A FILL ON SAN MATEO LINE

A CUT ON SAN MATEO LINE



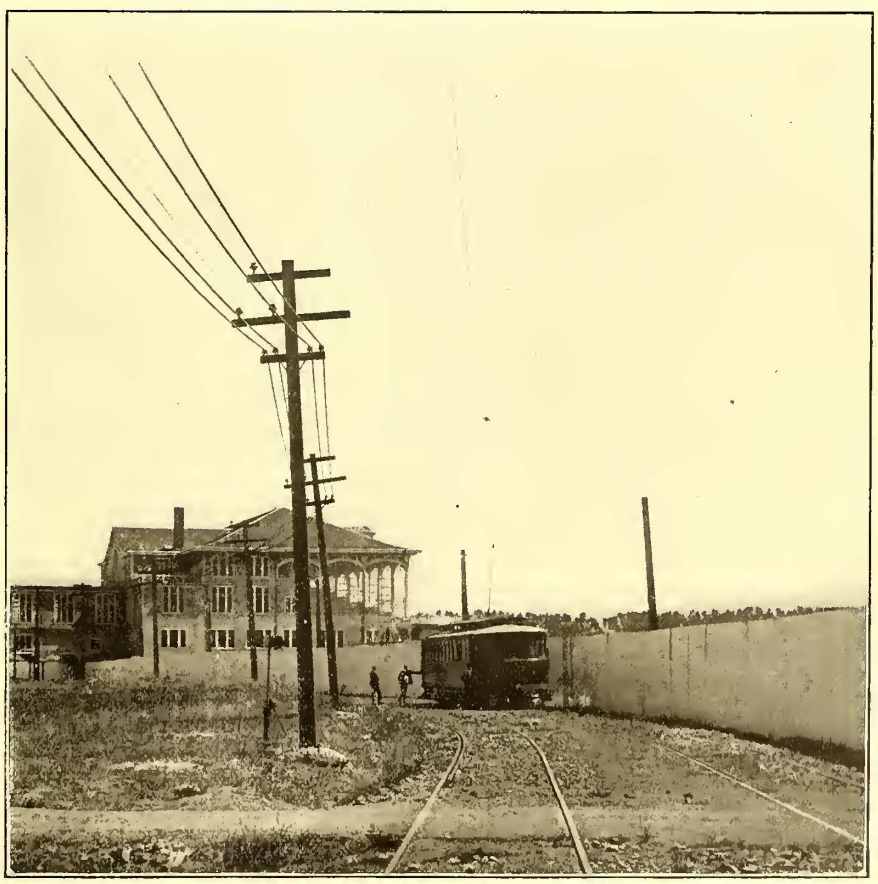

SAN MATEO'S MAIN BUSINESS THOROUGHFARE

5-16-in. galvanized iron strand wire. The ears are all soldered. The construction work on this line followed the same high standard as that adopted on other parts of the system.

POWER DISTRIBUTION

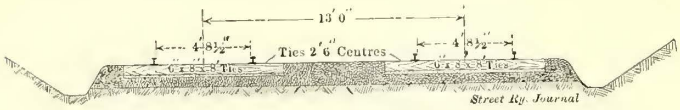
Power is furnished to this line as follows: From the ferries to Thirtieth Street, the Bryant Street power house furnishes direct current at 550 volts; from Thirtieth Street to Holy Cross, the Geneva Avenue sub-station supplies the power, and from Holy Cross to San Mateo the Millbrae sub-station is depended upon. The latter section, supplied by the Millbrae sub-station, includes almost all the interurban portion of the road, although the Geneva Avenue sub-station has sufficient capacity to supply both the suburban and interurban sections, and enable the Millbrae sub-station to be closed down when the rush hours are over, but this necessitates transmitting power for about 14 miles. It is being done, however, with fair success, through the aid of sufficient feed wire and a good return circuit employing cast-welded joints.

The Millbrae sub-station, illustrated herewith, is a substantial fireproof, red brick building, 40 ft. x 75 ft. The walls and foundations are built of brick and cement, the floor is of concrete, and the roof is covered with best quality California slate, nailed on cinder concrete. The station is well lighted by large



LINE TO TANFORAN RACE TRACK, SHOWING OVERHEAD CONSTRUCTION

windows. The walls and ceilings are painted with light, harmonious colors, thus presenting an inviting appearance. A waiting room is provided for passengers in the basement, the floor of which is on a level with the track. A toilet room, lockers, telephone booth, desk, neat work benches, supply



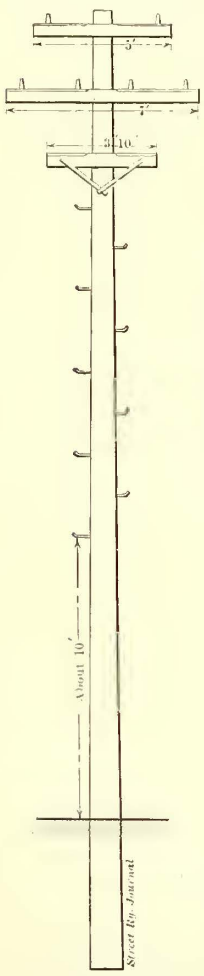

SECTION OF ROADBED ON SAN MATEO EXTENSION

closets, etc., are provided for the comfort and convenience of the men operating the plant.

The station is equipped at the present time with two six-pole, 500-kw, 600-volt compound-wound rotaries, operating at 500 r. p. m.; two sets of three each of 25-cycle, three-phase, 185-kw, 13,200-440-volt air-blast transformers; one blower set, consisting of one four-pole, 2-hp, 350-volt induction motor, directly connected to a Buffalo Forge Company 40-in. blower, operating at 750 r. p. m.; two motor-controlled oil switches, operated from a storage battery in the basement; two reactive coils, connected on the low-tension side of the transformers, and switchboard with the usual complement of instruments, circuit breakers and switches.

There are five feeders going out from the switchboard, all being 500,000 circ. mils. There is room enough in the station to double the present equipment if it is desired.

Alternating current is transmitted to Millbrae sub-station from the main power plant of the United Railroads at North Beach at 13,200 volts, over a distance of about 85,000 ft. At Millbrae the current is stepped down to 440 volts and then converted into direct current at 550 volts. The entire electrical machinery is of the General Electric type.




35-FT. POLE AND CROSS-ARMS

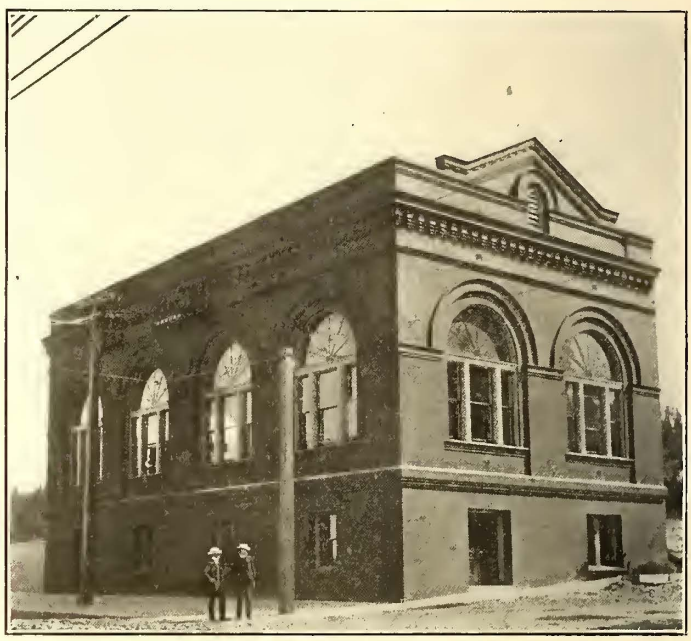
For the purpose of blowing out the rotaries a 10-hp, 550-volt, 1100-revolution Christensen automatic motor compressor has been installed.

A traveling crane, with an 8-ton Yale & Towne triplex tackle block for handling machinery is also a part of the sub-station equipment.

### CARS

The cars are of the monitor deck pattern, with drop sash, cross seats, smoking compartment and vestibuled ends. They were built by the Laclede Car Company, of the following dimensions: Length over all, 45 ft. 9 ins.; length over body, 34 ft. 4 ins.; width over sills, 9 ft.; width over belt rail, 9 ft. 2½ ins.; width over drip boards, 9 ft. 6 ins.; width over steps, 9 ft. 8 ins.; height of car from bottom of bolster to top of trolley board, 9 ft. 4 ins.; bolster centers, 23 ft.

The framing of the car is made especially strong. The side sills are long-leaf Southern pine, 4¾ ins. x 7½ ins., plated on the outside clear around the end sills with ⅝-in. x 6-in. steel plate. On the inside the sills are plated with 6-in. channel iron. The two center longitudinal sills are 8-in. I-beams filled with wood. The end sills are 4¾-in. x 7½-in. Southern pine. The longitudinal sills are joined to end sills and plates with angle-irons securely bolted. The whole framework is securely cross-braced and tied together with eleven ¾-in. tie rods. The posts are all of straight grained white ash. The corner posts are 3¾ ins. thick, and the side posts 3¼ ins. thick. There are four



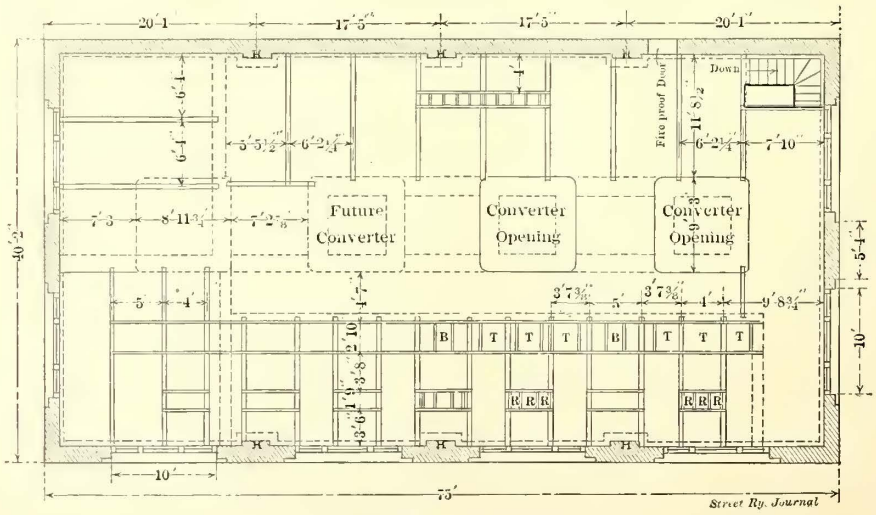
MILBRAE SUB-STATION

ash ribs between every two posts. The panels are of ½-in. dried poplar. All posts are fastened at the top to letter board by means of malleable iron-angle brackets. The car lines over each post are plated with steel. The roof is covered with No. 8 cotton duck, well laid in white lead and painted with three coats of "Trolley Top."

The platform sills are made of 6-in. channel iron, bent to the required shape and bolted to longitudinal sills. The bumpers are of 3½-in. x 6-in. x ⅜-in. angle-iron, with draw-bar cup set in. The dashers are made of No. 12 soft steel. The steps are covered with Universal safety treads. Vestibules are equipped with Wood folding gates, and the doors are of the mutually operating sliding type, having an opening of 36 ins. They are 1¼ ins. thick and made of cherry.

The sashes are made of cherry, and so arranged that they can be dropped and a small trap or shelf closed over them, thus not not only hiding them but also preventing passengers from throwing paper, etc., in the openings.

The ventilator sashes are glazed with chipped glass, and are hinged on the ends, so that by operating a small



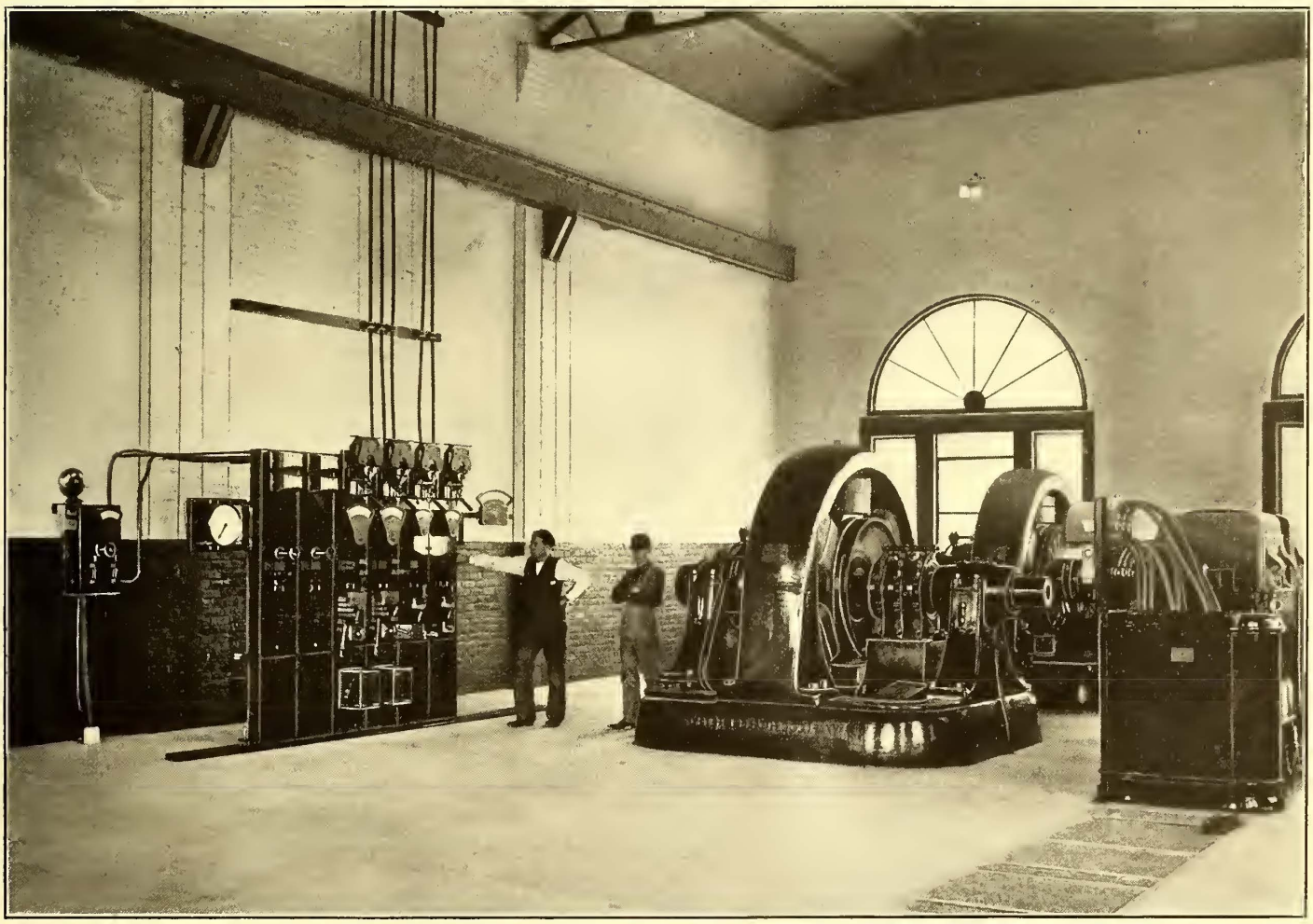

PLAN OF MILLBRAE SUB-STATION

brass handle two at a time can be thrown open. The seats are of the Hale & Kilburn walkover type, upholstered with rattan, and have a grab handle on the back. They are 37¾ ins. long and 18 ins. wide. A novel feature is introduced to keep people from sliding off the ends of the seats, and also providing more seating capacity on the seat by having a concave casting placed on the end, extending about 3 ins. above the seat. This casting can be seen on the seats in the interior view of the car presented herewith. This casting does not interfere with passengers, and adds greatly to their comfort. The aisle still has a width of 27 ins., so that these castings do not cut down this space to any extent. The legs of the seats are bent toward the sides of the car, leaving a space under the end for packages. There are eighteen seats in the main compartment and six in the smoking compartment.

gong, a Ham sand box, a Christensen air whistle and a Sterling hand-brake with Laclede 12-in. handle. Mosher detachable arc headlights and Railroad Signal & Lantern Company's oil signal lanterns are used. The cars are also equipped with Christensen straight air brakes. The brake rigging is an outside link-hung one.

The trucks for these cars are the Brill standard No. 27. The wheel base is 6 ft. The side frames are solid forged steel. The wheels are made by the St. Louis Car Wheel Company, are 33 ins. diameter; weigh 450 lbs., and have eight spokes. The treads measure 2¼ ins. and the flanges ¾ in. On account of passing over grooved rail in the city it was impossible to make the dimensions any larger. The axles are of Jones & Laughlin cold rolled steel, 4½ ins. diameter.

Each car is equipped with four General Electric 57-A



ELECTRICAL EQUIPMENT AT MILLBRAE SUB-STATION

The interior of the car is finished with selected cherry, and the ceilings covered with three-ply bird's-eye maple veneer, decorated with a single stripe of aluminum leaf.

There are twenty-five 32-cp lamps used for lighting, twelve being placed along the sides, six on each side, and three three-light clusters on the ceiling of the main compartment, and one two-light cluster in the smoking compartment. There are also two lamps on the back platform, so wired that the rear platform can always be lighted and the front platform kept dark. Two oil lamps are in the car to be used in case of emergency.

Pantasote curtains with spring rollers are placed over each window and also over the end doors, so as to prevent the light from being thrown on the vestibule windows and blinding the motorman. The door curtain rollers are placed under neat wooden boxes on the outside, and slide in grooves so as to prevent the curtains from flapping.

Each platform is equipped with a new departure rotary foot

motors, inside hung. The fields instead of being wound on brass spools are "mummified" so as to admit of the maximum insulation. K-14 controllers and grid resistances are used. The pinions have twenty-four teeth and the gears sixty-two.

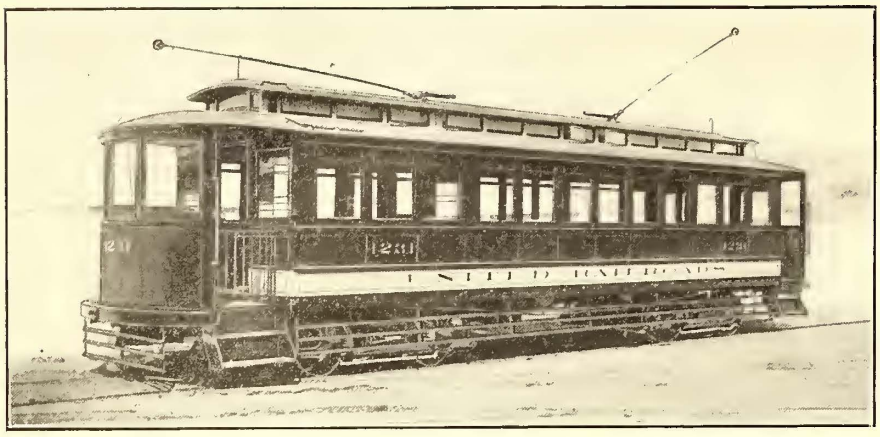
The trolley bases are placed 10 ft. from the ends of the upper deck. The trolley poles are 15 ft. long, and the wheels 6 ins. in diameter. Kalamazoo harps and wheels are used.

The wiring and making of the cables was done by the railroad company, and instead of nailing up the cables with leather straps they were screwed to the floor with large wooden cleats, to facilitate inspection. Particular attention was paid to making perfect splices and to the protection of all electrical apparatus from dirt and water.

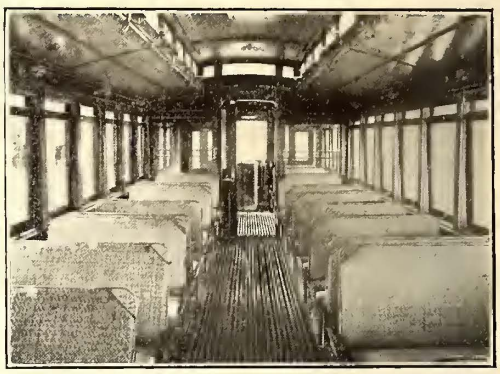
The motor bearings are lubricated with oil. This is accomplished by fitting a thin brass shell cup into the grease cups. In the middle of this brass oil cup a ½-in. brass pipe runs up nearly to the top edge. An ordinary lamp wick leads from the

oil surrounding this ½-in. pipe down through the pipe to the bearing. The life of the bearing is thus prolonged to a considerable extent, as it is not necessary for the bearing to heat up before the lubricant starts to run.

In designing these cars it was not intended to spend any money on superficial decorations, but every effort was directed to make them strong, neat, roomy, comfortable and easy to keep clean and repair.



STANDARD CAR

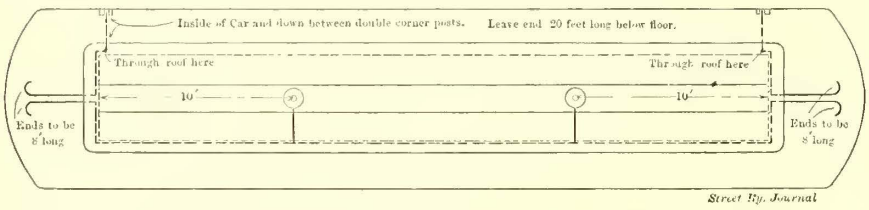


INTERIOR

### PRECAUTIONS FOR SAFETY

In order to insure safety and to warn people of the danger on the private right of way, several precautions are taken.

In the first place, the private right of way is fenced in. At every point where a road crosses the private right of way cattle guards are put up, and signs reading, "Danger, Look Out For Electric Cars," are placed on each side of such crossings.




POWER CIRCUITS IN WIRING PLAN FOR 45-FT. CAR

Light clusters are placed over these crossings so that a clear view of the signs and of the crossing may be had at night. People who attempt to walk on the private right of way will find signs as follows: "No thoroughfare—Private Right of Way," staring them in the face. On all gates leading on the private right of way there are signs warning people to close them, otherwise making themselves liable to prosecution.

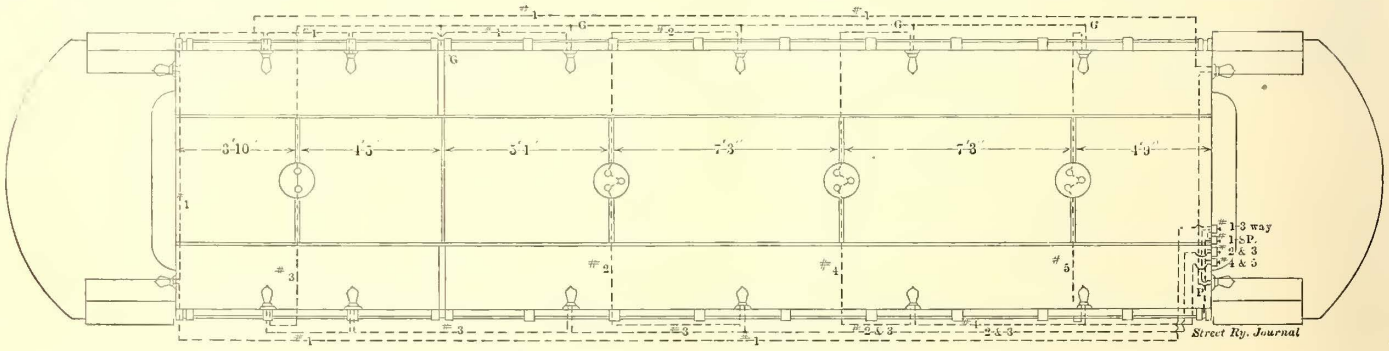
The arc headlight, air whistles and rotary gongs on the cars are used within their respective limits to give warning. The red signal lanterns on the rear and oil lamps in the cars were installed with a view of preventing collisions in case of cars becoming disabled at night.

### SERVICE, FARE AND PATRONAGE

The cars at the present time are operated every half-hour from 5:30 a. m. to 8:00 p. m., and every hour from 8:00 p. m. to midnight. On Sundays and holidays cars are run every fifteen minutes or less, as the traffic requires. The time required to make the trip one way is one hour fifteen minutes, the distance being 23 miles. The running time, of course, could be greatly reduced were it not for the fact that one-half of the entire distance is either through the city or its suburbs. Here, of course, a greater speed than 8 miles or 10 miles is not allowed. On the private right of way a speed of 40 m. p. h. is attained.

The fare is 25 cents one way, entitling passengers to transfer to any part of San Francisco.

That these cars will be well patronized is already established. Besides the regulation passengers, such as business and workingmen, theatergoers, shoppers, etc., there are many other patrons. At Holy Cross and nearby there are situated all the cemeteries of San Franciso, numbering about eight. This class of travel alone is naturally very large. There are also a great many places of amusement along and near the line. Amongst these might be mentioned the Ingleside and Tanforan race tracks, Union Coursing Park, Burlingame polo grounds, duck hunting grounds, celebrated taverns, etc. San Mateo, with its charming surroundings, is a mecca for pleasure riders, and that city in common with the other towns along the line is already feeling the effects of this means of communication with San Francisco. Real estate and rents have advanced, and on all sides are evidences of increased prosperity.




WIRING PLAN FOR LIGHTING 45-FT. CAR

H. A. Everett's private car "Josephine" recently made a remarkable run from Toledo to Cleveland over the Lake Shore Electric Railway. From the city limits of Toledo to Norwalk, 61 miles, was made in sixty-six minutes, and the entire run to Cleveland city limits, 112 miles, was made in two hours and thirty-seven minutes, including stops.

## SPECIAL TRACK WORK

The aeeompanying illustration is a reproduction of a photograph showing the special track work of the Colorado Springs & Interurban Railway in front of the car houses of the company at Colorado Springs. It will be noticed that an independent track is used for handling the cars when they are to be taken in and out of the ear houses, thus leaving the regular lines free for the eommercial service. There are nineteen tracks, extending into the car houses from this independent track, which runs along the entire front of the building, 14 ft. eenter to center, from the west track of the main line. There is a cross-over on the main line. This arrangement permits the company to handle the ears quickly without interfering with the regular traffic or bloeking the serviee lines, and it is entirely satisfactory to the management, as it has proved a very economical and convenient method. The ear houses are spacious buildings and are well arranged. They are all of steel and brick construction, with concrete flooring and division walls for fire protection. The combined storage capacity is seventy-two double-truck cars, and these can be handled quickly with the provisions here described. Each of the old car houses is 50 ft. wide, the new one being 80 ft., and all are 180 ft. deep. Each of the smaller buildings is provided with trackage for sixteen cars, and the new house ean accommodate twenty-four. There are six tracks in the new building, three of which are provided with open pits. There are three open pits in the old houses, and at the north is a single-track wash house with concrete floor and open pit.

SPECIAL WORK AT CAR HOUSE OF COLORADO SPRINGS & INTERURBAN RAILWAY

The report of a prominent Swiss engineer on the advisability of substituting electrieity for steam on Swiss railways favors eleetricity, and has already caused one eompany to apply for authority to use electrieity on a trial road 12 miles long.

## TWELVE HUNDRED-VOLT DIRECT-CURRENT RAILWAY IN FRANCE

The fact that there is a 1200-volt direct-current electric railway in regular operation is not generally known, but there is such a line in the Grenoble region in Southeastern France. The line is used largely for freight, and is of 1-m gage. Steam has been the motive power employed for hauling the empty cars up grades, which are 2¾ per cent for practically the entire distance from St. Georges de Commiers to la Mure, the two terminals, 20 miles apart. The present steam locomotives, which are of 37 tons and 41 tons weight, can haul up this grade only ten and fourteen empty cars, respectively. Another reason for the adoption of electricity was that water-power is abundant. A special feature of interest is that the portion of the road electrically equipped is on the three-wire system, so that the voltage between the outside wires is 2400.

The company has at present one electric locomotive, which is illustrated in the accompanying engraving. Fig. 1 illustrates the body raised, leaving the trucks exposed, while Fig. 2 very clearly indicates the appearance of the overhead line. As will be seen the overhead frogs are of wood, as in three-phase work.

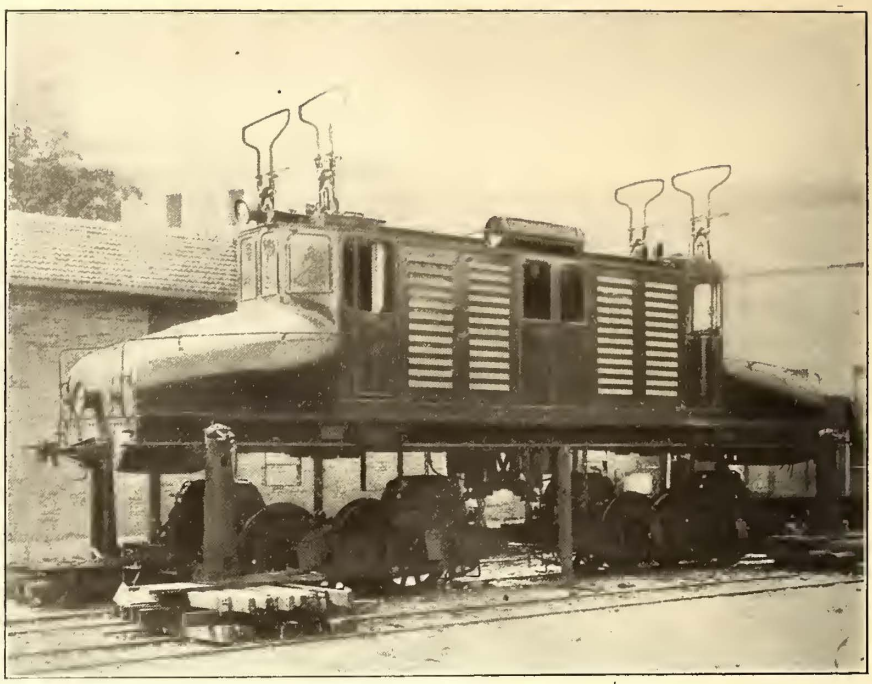


FIG. 1.—LOCOMOTIVE CAB RAISED FROM TRUCKS

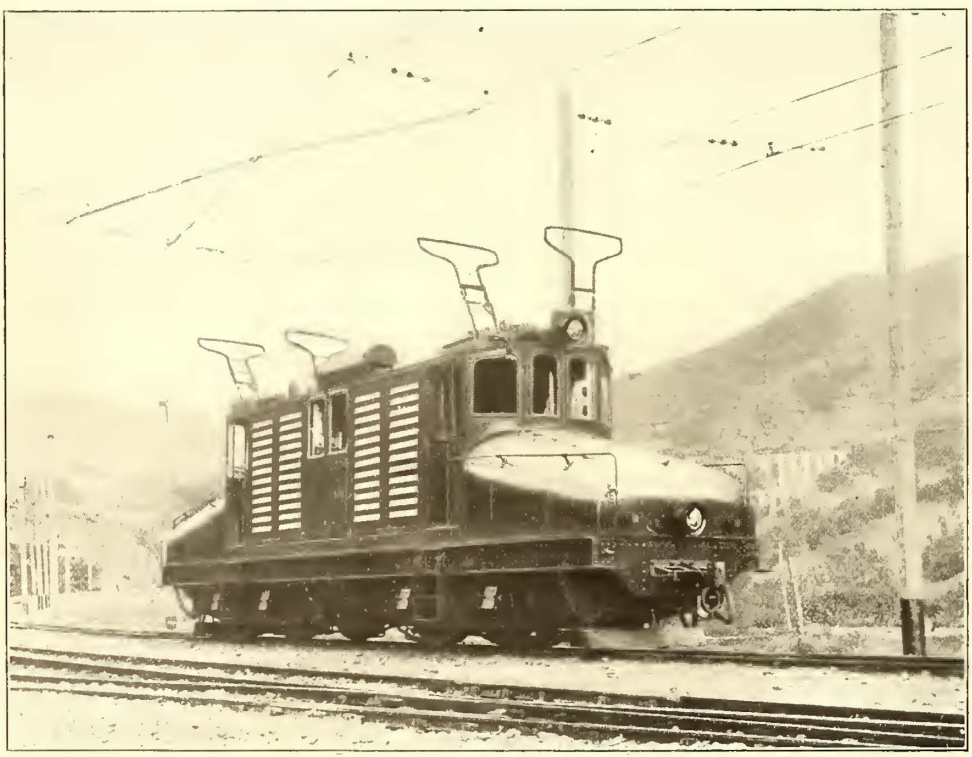


FIG. 2.—OVERHEAD CONSTRUCTION FOR ELECTRIC LOCOMOTIVE

The locomotive weighs about 50 tons, and is of 500-hp capacity. This permits it to operate on the 2¾ per cent grade at a speed of from 22 km to 23 km an hour, hauling twenty cars having a gross weight of 111 tonnes.

The electrical construction was carried out by the Compagnie Générale de Construction of Saint Denis and the Compagnie de l'Industrie Electrique, owners of the Thury patents. The overhead line consists of two copper wires of figure-8 section and 114-mm cross section. The voltage used is 2400 volts between the outside wires, that is 1200 volts between each contact wire and the rail which forms the neutral. Siemens bow contactors are used. The upward pressure used is very light, being only about 2 kg.

The four motors are of 125 hp each, two on each truck. They are connected in series and work on 625 volts and 185 amps. As the trip down grade is made with loaded cars the motors are arranged to run as generators and act as brakes, being connected to the resistance. Oil switches are used for breaking the circuits. The general connections are shown in Fig. 3. The main dimensions of the locomotives are as follows:

| | | |
|---|---|---|
| Length of body | 11.350 | meters |
| Length over all | 12.510 | " |
| Length of motorman's compartment | 7.300 | " |
| Height of motorman's compartment above rail. | 3.720 | " |
| Width of motorman's compartment | 2.400 | " |
| Diameter of wheels | 1.200 | " |
| Wheel base of each truck. | 1.850 | " |
| Height of bows when completely raised | 5.125 | " |
| Number of trolleys | 4 | |
| Weight, empty | 50,000 | kg |
| Weight, complete, ready for operation | 50,500 | " |

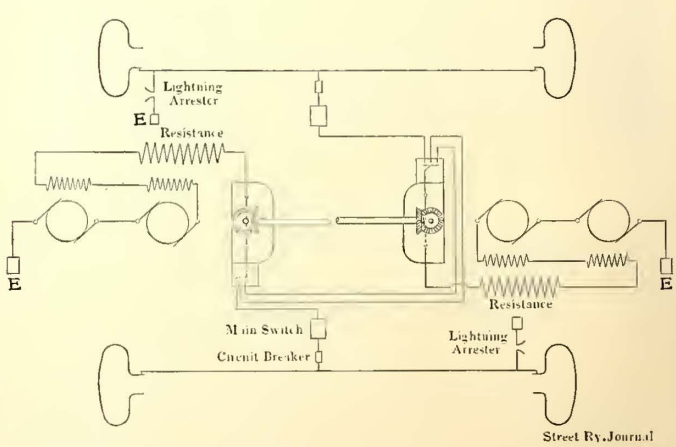



FIG. 3.—DIAGRAM OF CONNECTION ON THREE-WIRE LOCOMOTIVE

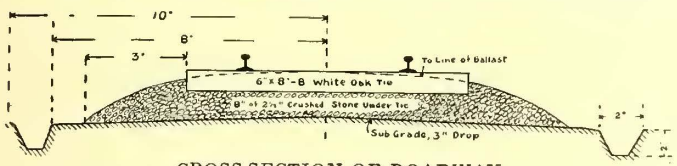
| | |
|---|---|
| Weight per axle, ready for operation | 12,625 kg |
| Revolutions of armature at normal speed | 400 |
| Reduction in gearing | 1 to 4 |

One generator, operated by a Piccard turbine, is used. It is over-compounded, giving at full load and 250 r. p. m., 180 amps. at 2 volts by 1350 volts, and without load 2 volts x 1200 volts. It has two armatures mounted on the same shaft, and two sets of field coils mounted on a common base. The armature length is 550 mm, and the distance between opposite pole pieces 1250 mm. The commutators are 750 mm in diameter and 150 mm long. The shaft has a diameter of 52 cm on account of its length, 3.275 m between journals, and the weight of the armatures is 9 tonnes. The total weight of each half-revolving part is 33,400 kg, made up as follows:

| | |
|---|---|
| Armatures | 2 x 4500 = 9,000 kg |
| Shaft and bearings | 2,700 " |
| Base and journals | 2,500 " |
| Field frame | 2 x 6600 = 13,200 " |
| Half of the fly-wheel clutch coupling | 4,000 " |
| Total | 33,400 " |

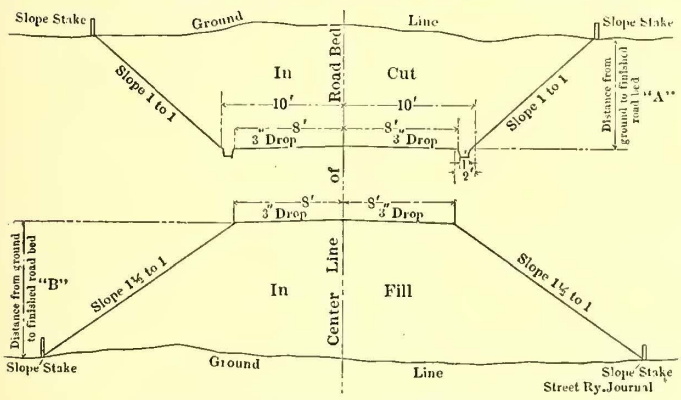
## STANDARD INTERURBAN TRACK CONSTRUCTION OF THE INTERNATIONAL RAILWAY COMPANY

As the track construction of the International Railway Company, which controls the lines around Buffalo, is noted for its excellence, the accompanying diagrams, showing the arrangement of ballast and slopes of cuts and fills, will be of interest.




CROSS-SECTION OF ROADWAY

In cuts a slope of 1 to 1 is allowed, in fills a slope of 1½ to 1. The depth of the ballast is 8 ins. The sub-grade has a drop of 3 ins. in the 10 ft. from the center of the track to the gutter, and on the sub-grade 8 ins. of crushed stone is laid




STANDARD ROADBED CONSTRUCTION

In track location in cuts and fills, slope stakes are placed at every 100 ft., and are marked in three ways, viz.:

(1) Number of station.

(2) Distance from center line of roadbed.

(3) Depth of cut or height of fill from ground at foot of stake to finished roadbed at bottom of cut or at top of fill, as shown by distances "A" and "B" in accompanying diagram.

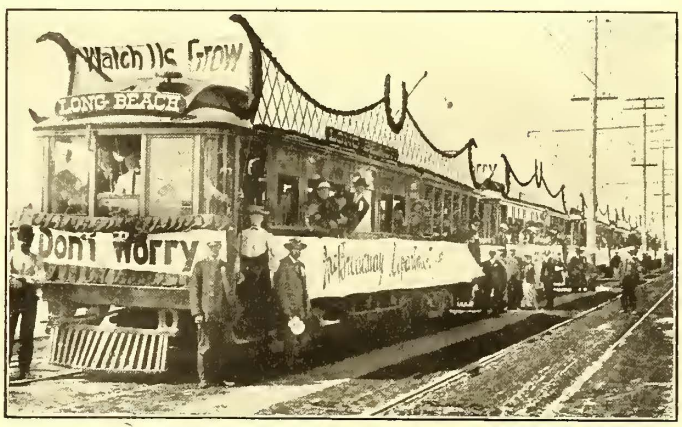
The Northern Ohio Traction & Light Company has ordered ten new interurban cars and will install a limited service between Cleveland and Akron. Other Cleveland roads are figuring on adopting this plan, which has been developed by the Cleveland, Painesville & Eastern Railway, and has been received with universal favor.

## TRAIN CABLES ON THE AURORA, ELGIN & CHICAGO RAILWAY

Cars on the Aurora, Elgin & Chicago Railway are being equipped with train cables of sufficient capacity to carry the current required by the car motors, so that when two-car trains are run the contact-shoes on the cars can be connected electrically that there may be no interruption of the current at crossings which are narrow enough to be bridged by two-car trains. The interruption of the current supply, due to the omission of the third rail at highway crossings, causes considerable annoyance to passengers at night, because of the momentary extinguishing of the lights. As most of the highway crossings on this road are between Wheaton and Chicago, and all trains between Wheaton and Chicago are now two-car trains, much of the annoyance formerly caused by extinguishing lights at crossings will be obviated.

## DEPARTMENT STORE'S BIG TROLLEY PICNIC

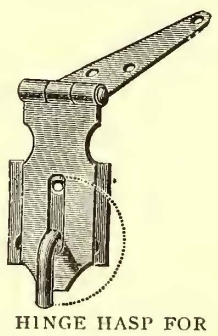
One day last summer the Broadway Department Store, of Los Angeles, Cal., gave all of its employees an outing at the seashore. The accompanying cut shows ten special cars of the Pacific Electric Railway Company as they looked just before they left the city with 600 happy excursionists for the gala day at Long Beach. The cars were decorated and festooned in a most striking manner, all bearing the two slogans of the store—"Don't Worry" and "Watch Us Grow." Flowers and bunting were used in great abundance. The wing-like decorations on the roofs of the cars were of white cloth latticed with red paint. The party was personally conducted by Hugh F. Stewart, assistant general passenger agent of the Pacific Electric Railway Company. Refreshments were served en route.




A CALIFORNIA PICNIC PARTY

## FASTENING MOTOR LIDS

In a discussion at the convention of the American Railway Mechanical & Electrical Association, H. J. Lake, master mechanic of the Muncie, Hartford & Fort Wayne Railway Company, spoke of a method of fastening motor commutator lids on the motors to prevent their being torn off by the brake rods when rounding curves. The accompanying illustration of the hasp used may make Mr. Lake's method a little plainer. The device is an ordinary heavy hinge hasp, which is a staple article of hardware. It is riveted to the commutator lid, and the single swivel which locks it down is fastened to the motor case. The lid has thus practically nothing projecting above it.



HINGE HASP FOR FASTENING MOTOR LID

# CORRESPONDENCE

## PLATFORM SUPPORT FOR FOUR-MOTOR EQUIPMENTS

THE CONSOLIDATED RAILWAY & POWER COMPANY

Salt Lake City, Utah, Oct. 2, 1903.

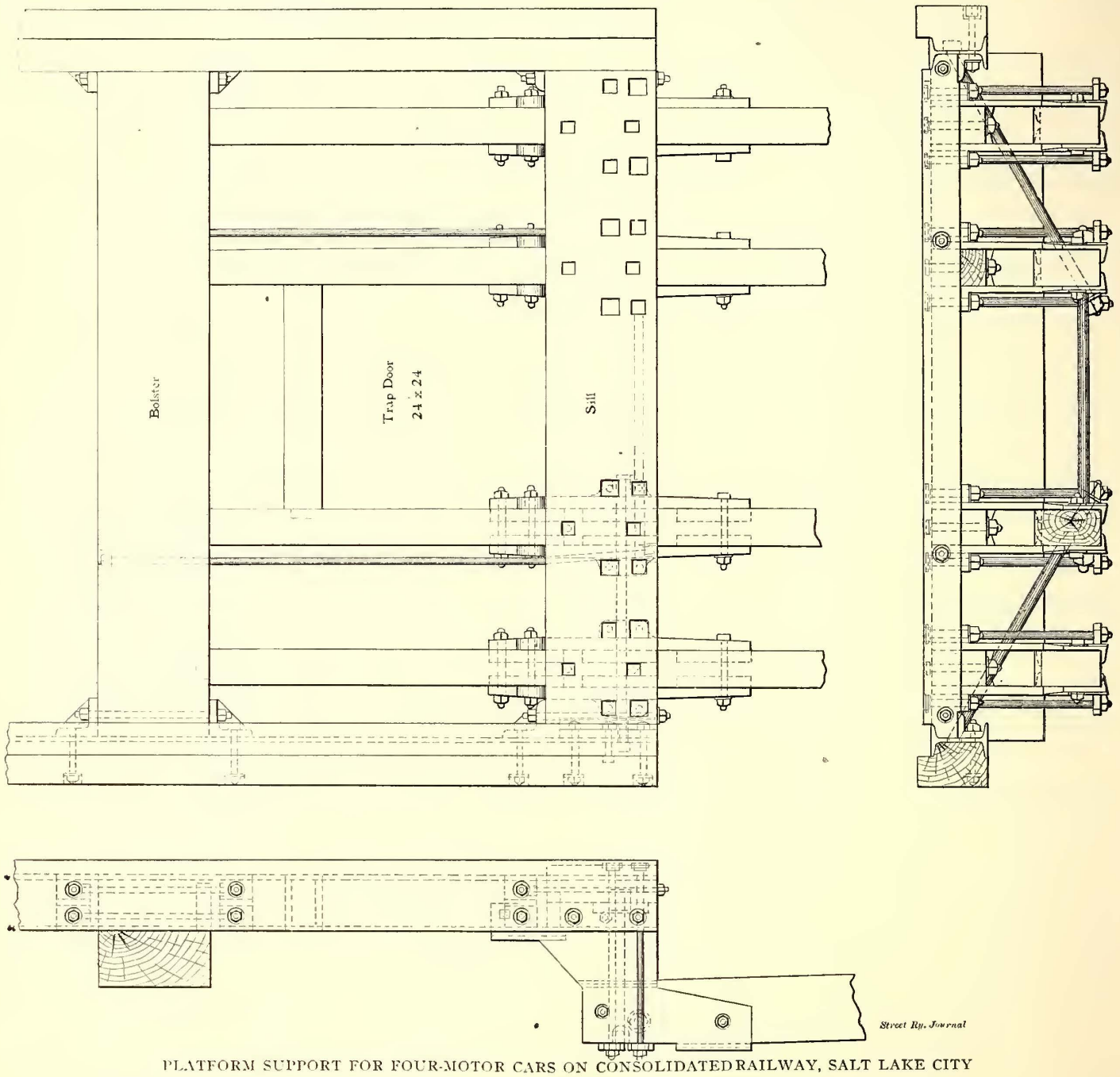
Editors Street Railway Journal:

The Consolidated Railway and Power Company, wishing to install double-truck, four-motor equipments on some of its new cars, found that in the ordinary construction of low-platform, single-step cars the draw timbers that support the platform and extend back under the car body prevent the placing of a motor on the front axle of each truck. In order to overcome this difficulty the writer designed the form of platform support illustrated in the accompanying drawings. As other car builders have undoubtedly met with the same difficulty, an explanation of the construction may be of interest.

It consists of eight cast-iron angle seats, or supports, which are bolted to the bottom of the end sill, and form seats for the ends of the four platform timbers, which only run back as far as the castings. The castings, which preferably should be made of malleable iron, have inside horizontal lugs to take the thrust of the platform beams, and two cross bolts are used to hold the beams in place. At the top and bottom of the castings, under the sill, are L flanges, through which are run 6-in. and 21-in. sill bolts. The back portion of the casting, where it rests under the longitudinal sill beams, also has flanges for distributing the thrust. The platform is made secure from side thrust by bolting the two center beams together and connecting them by oblique bolts with the I-beams of the car body.

This construction provides a 24-in. x 24-in. trap door for reaching the front motor and, at the same time, is strong and comparatively inexpensive. It was adopted by the St. Louis Car Company on eight new cars recently built for our company, and we are using it on six four-motor cars which we are building in our own shops from spliced cars.

W. S. Patterson, Master Mechanic.




PLATFORM SUPPORT FOR FOUR-MOTOR CARS ON CONSOLIDATED RAILWAY, SALT LAKE CITY

## THE ADVANTAGES OF ASSOCIATIONS

Pillsbury-Washburn Flour Mills Company, Ltd.

Minneapolis, Minn., Oct. 20, 1903.

Editors Street Railway Journal:

I was much surprised to learn from your report of the Street Railway Accountants' Association, published in a recent num-

ber of your journal, that several companies had withdrawn from the Association during the year. I cannot understand how any company can fail to derive great benefit from a membership in the Accountants' and also the Street Railway Association.

I have often ished it were possible to have such an organization among the flour mills, but, of course, this is not possible. The millers do sometimes get together to discuss transportation, labor problems, etc., but when they begin to talk of the quantity of wheat they are using to make a barrel of flour, or the percentage of patent flour they are making, or the cost of manufacturing and selling per barrel, none believes what the other fellow says, and in this they are right. Of course, there is some reason for the miller not caring to tell all the details of his business to others, as they all come into competition with each other to a more or less extent, but this is not the case with street railway companies.

It must certainly be very profitable for an employee of any company to be able to meet others in the same line of business, and have a regular heart to heart talk on any, and all, of the many questions which are constantly arising, and I should think every street railway company in the country would secure membership in both organizations.

Although not engaged in the street railway business, I have been reading your journal for the last few months as a matter of general information, and find it very entertaining and instructive and wish you great success.

Jas. T. Perkins.

## INTERURBAN TRAIN DESPATCHING

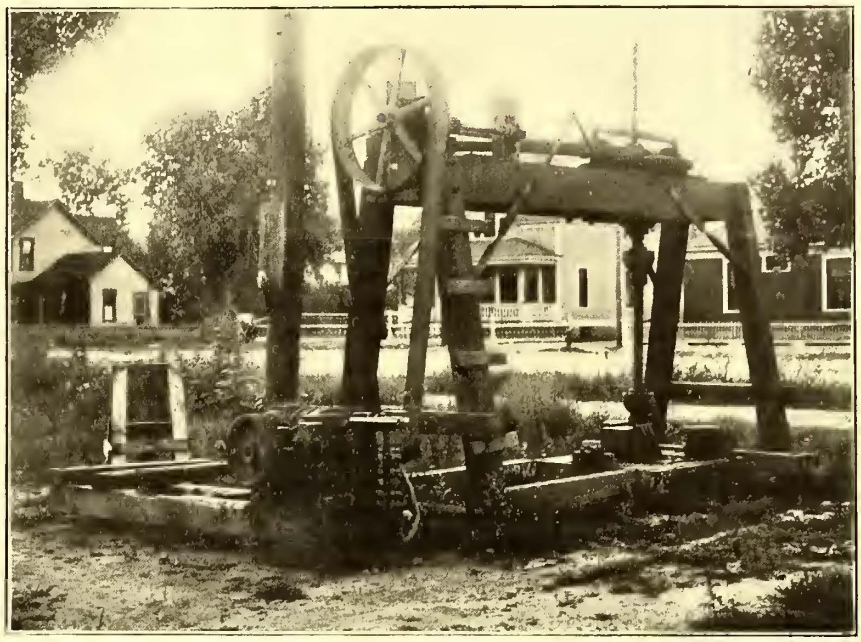
Boston, Oct. 20, 1903.

Editors Street Railway Journal:

I read with interest the paper and discussion on the subject of "Interurban Train Despatching," as given in your issue of Oct. 17. I notice that the remarks made on the paper related to a large extent to the question of cut-outs under the control of the train despatcher, so that in case of the detection of an error the cars affected could be deprived of current. The very insistence of such a question shows how keenly alive are street railway men to all questions touching the safety of their passengers. Several roads are experimenting with the cut-out scheme, but it seems to me that the whole merits of the question were put in evidence by a remark that on a Western road last summer the despatcher made a blunder, and being quick of wit telephoned to the sub-station to cut off the current. But the two cars were coming down into a valley from opposite sides, and having no power to stop, the cars came together in a head-end collision.

If the cars seeing each other did not have braking capacity enough to make a stop, they were clearly not running under proper control, considering the topography of the road, unless they were expected to rely on reversal of the motors as an emergency measure, in which case cutting off the current was risky. There seems to be very little information floating about as to the real value of reversal as an emergency braking measure. If it has a high value, then it should be more easily applied than is possible with most of the forms of controller. If brakes are the sole reliance they should be efficient enough, and the view along the track should be clear enough, to make them effective in preventing head-end or rear-end collisions, even if the desptacher blunders. When a road is going to run at high speeds on a blind track it is time to use a block system or its equivalent. First-class brakes, combined with well-trained motormen, who know when their cars are under proper control, will reduce accidents to an almost negligable quantity at any speeds proper to attempt on a single track without a block system.

A. P. Johnson.



CURVING RAILS FOR SPECIAL WORK.

## RAIL CURVING MACHINE

Colorado Springs and Interurban Railway Company

Colorado Springs, Col., Oct. 8, 1903.

Editors Street Railway Journal:

The accompanying illustration shows a rail-curving machine which was built by us to do our special work during our reconstruction, and which is similar to a number of curvers throughout the country, with the exception of a few minor changes, which can readily be seen by the picture.. It is built upon a wooden frame 7 ft. high, 2 ft. wide and 9 ft. long, with legs spread to 5 ft. at the bottom. The main casting, which holds the rolls, sets on the bottom timbers of the frame, and the shafting and gears running the driven roll are set on top of the frame. The rolls have bearings of 4 ins. x 4 ins. in Magnolia babbitt, two rolls being stationary and one fixed in a sliding head, which can be adjusted in curving a rail while the machine is running. The running roll is connected by a double ball-and-socket coupling and is connected through a horizontal bevel gear, running twenty-two revolutions to one revolution per roll. The bevel gear is 36 ins. in diameter, and the shaft connected to the motor has two loose pinions traveling on a shaft running across the bevel gear, with a slide sleeve on the shaft, which engages with either pinion to reverse the rolls. When the sleeve is midway of the pinion it stops the rolls without stopping the motor or engine which may be driving it.

With this machine we roll 75-lb. rail with 100 ft. radius at the rate of 30 ft. to 50 ft. per minute.

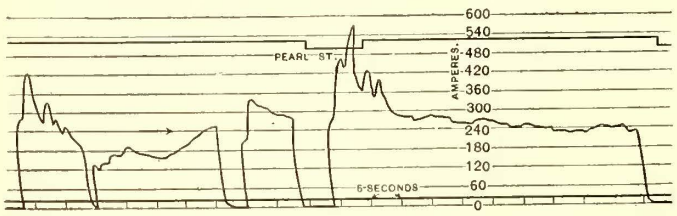
We have just completed one of these machines for the new Moffatt Short Line road, from Denver to Salt Lake, and it is giving very good satisfaction.

D. L. Macaffree, General Manager.

## A GRAPHIC RECORDING AMMETER

A new type of recording ammeter for use in making tests of current consumption on cars was described at the meeting, last week, of the American Institute of Electrical Engineers, by A. H. Armstrong, of the General Electric Company. The object aimed at was to secure an instrument capable of registering accurately the violently fluctuating current readings, and one which would not be affected by the vibration on high-speed cars, due to more or less imperfect track. This made it necessary to have an instrument which should be thoroughly balanced, and one in which there would be no friction between the marking instrument and the paper over which it traveled. To secure the required torque, a dynamo construction was employed in which the current to be measured is carried by the fixed element, and the moving element carries a constant current, supplied by a small storage battery. The moving coil is a small rectangle of several strands of wire surrounding an iron core and carries about 1 amp. The ampere turns in the moving coil are about 80, and that in the fixed coil about 2400, so that the torque at the end of the scale is about 200-gram centimeters. This is from 80 times to 200 times the torque usually employed in a measuring instrument in which the indications of the pointer on a scale are observed, and from 3 times to 15 times that employed in the usual integrating of curve drawing instruments. With this high torque the friction due to the pen moving over the paper is practically negligible.

The pen consists of a capillary tube supplied from an ink reservoir by a siphon. The paper is about 3½ ins. wide, and is usually run at rate of 6 ins. per minute. The instrument




CURVE OF FOUR-MOTOR EQUIPMENT ON HEAVY GRADE

replaces the labors of several men required by the old method of two-second readings, and gives results of greater accuracy. It is, therefore, a simple matter to run a full day test upon a railway motor, and determine its copper loss quickly and accurately. The instrument weighs about 100 lbs., and measures 32½ ins. x 13½ ins. x 11¼ ins. The same construction is equally applicable to voltmeters and wattmeters.

The accompanying diagram shows a curve made by the ammeter on one of the Schenectady & Albany cars equipped with four General Electric 73-motors. This car was climbing a heavy grade and the motors were in series.

## PLATFORM MEN IN KANSAS CITY

The Metropolitan Street Railway Company, of Kansas City, Mo., is trying the experiment of having a regular conductor and an extra on its cars in the retail district during the rush hours, in order to make better time. The regular conductor takes a position inside of the car and devotes all of his time to collecting the fares, while the extra takes up a position on the back platform and there facilitates the ingress and egress of passengers and attends strictly to the operation of the car. The extra conductor simply makes a run from the heart of the city to the district where it is not likely that many more passengers will be taken on. He then leaves the car, returns to the city and again resumes his work as an extra. The policy has been adopted by the company of collecting the fares as soon as the passengers are properly seated.

## NEW SHOPS AT LOS ANGELES

Increased demands upon the capacity of the Huntington railway shops in Los Angeles, Cal., have made the joint arrangement now existing between the Pacific Electric Railway Company and the Los Angeles Railway Company no longer practicable, and it is announced by General Manager Muir that the Los Angeles Railway Company is soon to have its own shops, at a cost of about $300,000. These shops will be located on South Park Avenue, between Fifty-Third Street and Fifty-Fourth Street. They will adjoin the big car houses now in course of construction in the same locality. The site for the new shops will have a frontage of 700 ft. In addition to headquarters for Superintendent Aikin and reading rooms for the trainmen, the scheme involves storerooms, machine shops, blacksmith, repair and paint shops and a car building shop. Cars in their entirety will not be constructed at the beginning, but after a time all such equipment needed by local Huntington-Hellman lines will be manufactured in Los Angeles. Plans are being prepared for the buildings, and in a general way they will be a duplicate of the Pacific Electric Railway shops on Central Avenue, and will contain a turn-table for car-moving purposes. When the old shops were opened about two years ago it was supposed their capacity would be sufficient for many years to come, but the new shops now planned are badly needed. The new enterprise will give employment to about 300 men.

## TOLEDO AS AN INTERURBAN CENTER

The development of the interurban lines around Toledo has resulted in making that city one of the most important interurban centers in Ohio. At the present time 136 electric passenger trains, operating on regular schedules, enter and leave the city daily. The number of freight trains entering and leaving on regular daily schedules is twelve. As a rule one car constitutes a train.

The above count is divided among the various lines as follows:

| | Passenger | | Freight | |
|---|---|---|---|---|
| | In | Out | In | Out |
| Maumee Valley Ry. & Light Co. | 47 | 47 | 2 | 2 |
| Lake Shore Electric Railway | 22 | 22 | 2 | 2 |
| Detroit, Monroe & Toledo Short Line | 17 | 17 | 2 | 2 |
| Toledo & Indiana Ry. | 11 | 11 | 2 | 2 |
| Toledo, Bowling Green & Southern Trac. Co. | 21 | 21 | 0 | 0 |
| Toledo & Western Ry. | 18 | 18 | 4 | 4 |
| | 136 | 136 | 12 | 12 |
| Total trips | 272 | | 24 | |

Total passenger and freight trains, 296.

In addition to the above there are under construction the following lines: Toledo & Port Clinton Railway, Toledo & Ann Arbor Railway, and Cincinnati, Dayton & Toledo Railway, all of which are to be in operation before the expiration of the year. The completion of these lines will bring the total number of cars entering and leaving Toledo to 325.

## THE PROPOSED SALT LAKE & SUBURBAN RAILWAY

The Salt Lake & Suburban Railway Company, of Salt Lake City, Utah, has franchises for about 40 miles of interurban railway, radiating in three branches from that city and covering the small towns and farming territory south of the city. Work is about to be begun on 13 miles of railway, entering the city on Second East Street and terminating on that street at First South Street.

This line will run to Murray, 7 miles south, and to the large ore smelters in the vicinity. Connecting with the smelters will be a line to Mill Creek Canon, where the company controls a large and excellent limestone quarry. This quarry has been but little developed, and it is stated that the company already has assurances of orders for 1000 tons of limestone daily from the smelters. This will comprise the main business of the company, but there is also said to be a splendid field for the development of a fruit and dairy, and of a small freight business in the territory tributary to the city, as it is a rich farming section and has insufficient shipping facilities. It is also expected that a good passenger business will be developed. The road will be built with 70-lb. rails, after the best suburban railway practice. The power supply has not been definitely determined upon, but it is thought the company will erect its own plant in Mill Creek Canon, using both water and steam power. Electric power will be used for operating the machinery at the quarry. The officers of the company are: Fred. M. Steele, of Chicago, president; A. V. Taylor, of Salt Lake City, vice-president and general manager; Charles Fury, of Chicago, second vice-president; L. W. Pitcher, of Chicago, secretary. Guy Sterling, of Salt Lake City, did the preliminary engineering work for the company.

## THE WARREN ROTARY ENGINE

The accompanying illustrations refer to an interesting type of rotary engine designed by E. C. Warren and made by the Rotary Engine Company, of Philadelphia.

Fig. 1 is a perspective view of this engine direct connected to electric generator. The cross-section view, Fig. 2, shows that the engine consists of a concentric piston wheel and shaft mounted between two abutting rollers, which are in close contact with the periphery of the piston wheel, and revolve in a direction opposite to that of the piston. As shown in Fig. 3 the piston wheel carries a broad flange at each end, and a web in the center. The driving vanes are located between these flanges and the web, and their outer edges, as indicated in Fig. 2, run in close contact with the surrounding casing.

The main bore of the casing is slightly tapered from end to end, and the diameter of the piston wheel, as measured over the web, flanges and vanes, is tapered to correspond. The steam admitted to the interior of the piston wheel passes through ports alongside the vanes into the spaces between the drum and casing, thus driving the drum. The slight difference between the diameter at the ends of the piston causes a moderate end-thrust, which tends to force the tapered wheel further into the tapered bore of the casing, thereby preserving a close joint between the flanges, vane and casing. A small thrust bearing is provided outside the casing, to prevent the tapered wheel from being pushed in far enough to cause excessive friction. This bearing is adjustable along the axis of the shaft, and enables the accurate determination of the position of the piston wheel within the casing.

Grooves are provided along the peripheries of the abutment rollers, and the shafts of these rollers are geared to the shaft of the piston wheel so that the roller grooves come opposite to the piston vanes when these reach the abutting rollers. These rollers are mounted on shafts having bearings in the counterbored end-plates of the abutment chamber, and provision is made in these bearings for the application of elastic pressure toward the main shaft to offset the outward pressure of the steam which tends to force the abutment rollers away from the piston wheel and open up the joints. This pressure is applied on small pistons or diaphragms, to which steam is delivered from the interior of the engine, and is just enough to overbalance the outward pressure, whatever the latter may be.

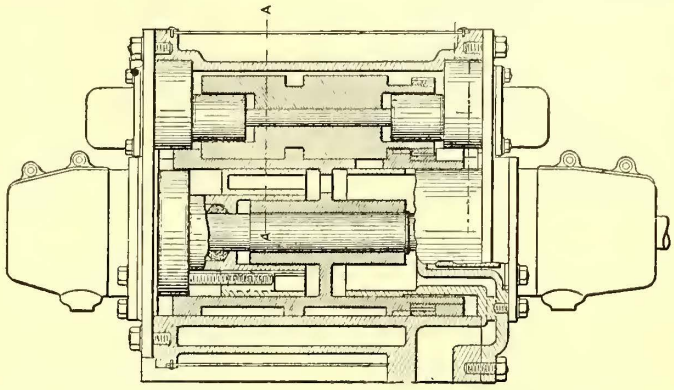


FIG. 4.—LONGITUDINAL SECTION OF WARREN ROTARY ENGINE

The exhaust openings are indicated in Fig. 2 at E-E, from which it will be evident that steam is admitted behind the vanes (between the piston drum and casing) when the piston drum is about in the position shown, the direction of revolution being clockwise. The admission of steam through the ports in the periphery of the piston drum is controlled by drum-shaped valves within the piston drum and mounted on hubs projecting from the heads of the casing. It is maintained that it is not necessary to maintain a perfectly tight joint between the valve and the interior surface of the piston drum, as leakage past the valve simply raises the expansion line in the working space and adds a slight superheat during the latter stages of expansion. The valve is, therefore, machined merely for a running fit. In the simple type of engine shown the point of cut-off is fixed and speed regulation is accomplished by throttling.

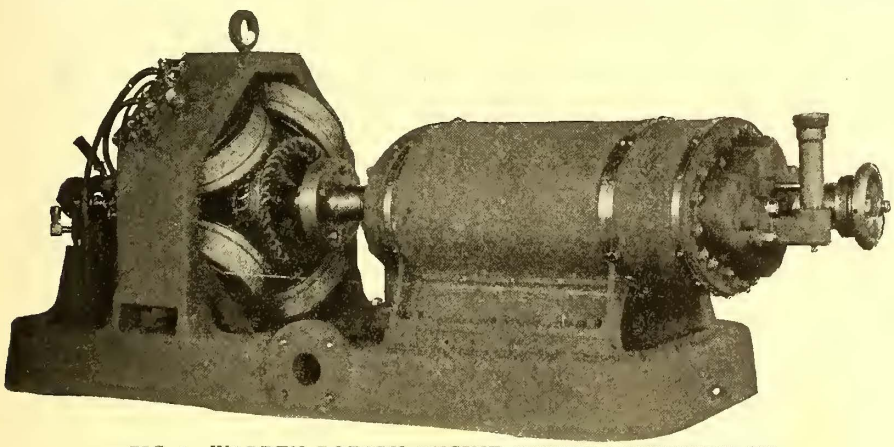


FIG. 1.—WARREN ROTARY ENGINE DIRECT CONNECTED TO ELECTRIC GENERATOR

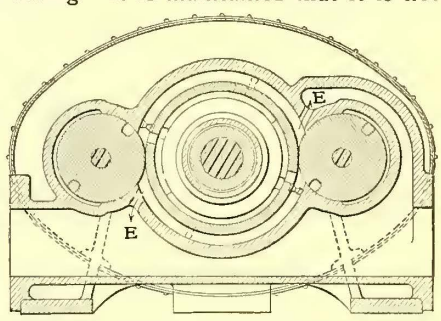



FIG. 2.—CROSS-SECTION OF WARREN ROTARY ENGINE

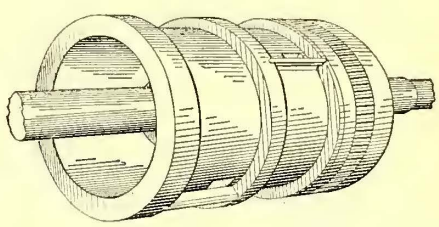
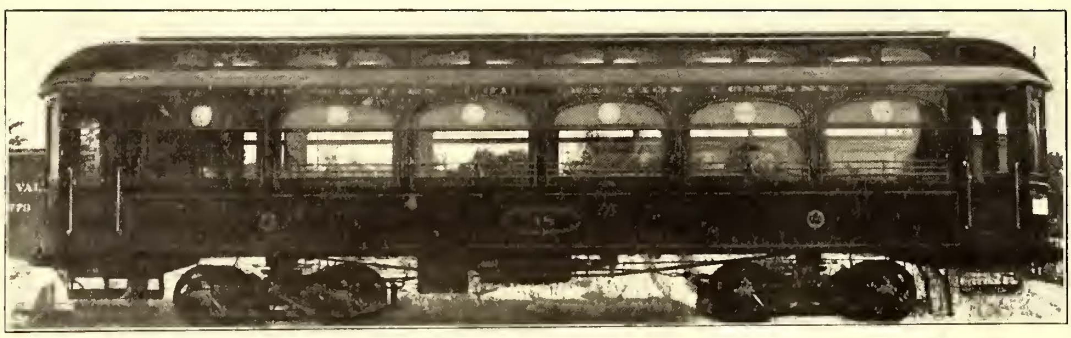


FIG. 3.—PISTON WHEEL

It should be noted that the respective diameters of the piston drum and the abutment rollers do not coincide exactly with the pitch diameters of the gears through which the three shafts are connected together; consequently, there is a difference between the surface speed of the piston drum and that of the abutment rollers, which amounts to about 600 ft. per minute under normal conditions. This produces a sliding contact between the periphery of the drum and the abutment rollers, which is said to cause the three surfaces to wear away in harmony with the advancement of the abutment rollers toward the piston drum, due to the normal wear upon the journals of the rollers. The seats in the casing against which the peripheries of the abutment rollers rub are also worn away, but at a very slow rate. It will be evident from the illustrations that the piston drum is inherently balanced; the abutment rollers are balanced by means of holes drilled in the sides opposite the longitudinal slots.

## CARS FOR EASTERN OHIO TRACTION COMPANY

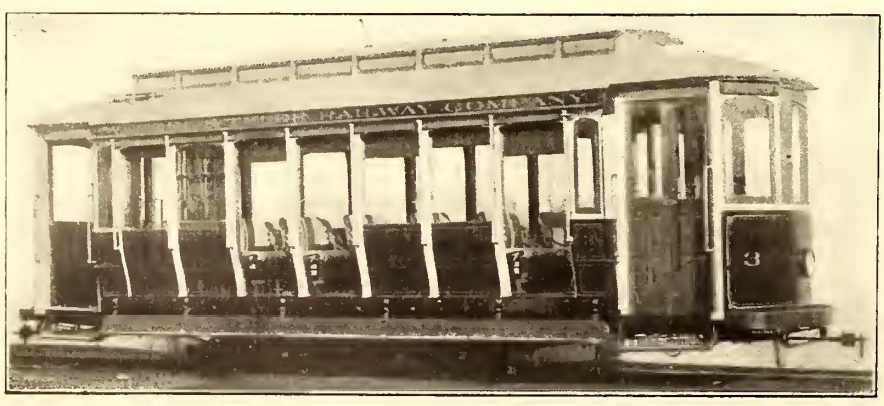
The accompanying illustration shows one of a lot of eight handsome interurban cars built for the Eastern Ohio Traction Company by the G. C. Kuhlman Car Company, of Collinwood, Ohio. These cars have extra large windows extending the length of two seats, and are equipped with sash balances. The trimmings are all of oxidized bronze with oxidized bronze electroliers. The construction is the regular Kuhlman standard with a few additions. Railroad men who have seen this car have pronounced it to be of the finest cars running into the city of Cleveland.



INTERURBAN CAR FOR CLEVELAND, OHIO

## CONVERTIBLE CARS FOR WEST VIRGINIA

The Wetzel & Tyler Railway Company, of Paden City, W. Va., has received three convertible cars from the J. G. Brill Company like the one shown in the illustration. The length of cars over end panels is 20 ft. 7 ins., and over vestibules 30 ft., from panel over vestibule 4 ft. 8 ins., width over sills and panels 6 ft. 1¼ ins., over posts at belt 7 ft. 9 ins., sweep of posts 5 ins. The end sills are 4¼ ins. x 6 ins., and the side sills 5¼ ins. x 6⅞ ins., with ⅝-in. x 6-in. plates. Thickness of corner posts 3¾ ins., of side posts 3⅜ ins. The seats are of spring cane, with reversible backs; they are substantially connected with the posts, and together with the round-corner seat-end panels stiffen the posts. The posts are unusually well tenoned to the sills. A broad and thick panel of ash connects the heads of the posts on the inside and is secured to each post and car line with two large bolts and three 4-in. screws; each post is gained into the panel. At the corners of the car are double posts, or rather heavy side posts are connected with the side posts by solid panels. This arrangement forms a firm upper structure so that the panels and sashes always slide up and down from the roof pockets with great ease. The interiors are finished in natural cherry, with ceilings of three-ply birch veneer; ratchet brake handles, radial draw-bars, angle-iron bumpers, "Dumpit" sand boxes and "Dedenda" gongs are among the patented specialties of the builder's make with which the cars are equipped. The cars are mounted on Brill 21-E trucks having wheel base of 7 ft., wheel 33 ins. diameter and 4-in. axles. The trucks are equipped with 55-hp motors.



CONVERTIBLE CAR FOR WEST VIRGINIA, PARTLY CLOSED

## A NEAT INTERIOR CAR FINISH

In these days, when increasing attention is being paid to simplicity and excellence in interior car finish, instead of elaborate moldings and complicated designs, the car interior herewith illustrated is of special interest. This is one of the trail cars recently built for the Fonda, Johnstown & Gloversville Railway by the St. Louis Car Company.

It is coming to be realized more and more by street railway men and car builders that simple interior finish is the best. This does not mean a cheap finish, but one that has few corners to catch and hold dust, and which will not look cheap and shoddy after a few years of use. What few cracks and corners are necessary in the construction are reduced to the smallest possible dimensions in the car here illustrated. Cars of this class of finish are much more easily cleaned, and the same amount of care bestowed on them keeps them much more attractive than a more elaborate type.

INTERIOR OF FONDA, JOHNSTOWN & GLOVERSVILLE CAR

# QUESTION BOX OF THE PENNSYLVANIA STREET RAILWAY ASSOCIATION—II

## OPERATION AND MAINTENANCE OF EQUIPMENT.

101. With roads not larger than twenty-five cars, how extensive a machine shop is advisable and what machine tools should be included? If possible state approximate cost.

We suggest a planer, a drill press, a lathe large enough to swing the largest motor armature, an emery wheel and a blacksmith's outfit. The approximate cost would be $1,800.—A. F. Rexroth.

102. To what extent is compressed air used in cleaning and repair work? What equipment is necessary for and what is the approximate cost of a compressed air outfit suitable for small and moderate sized roads?

Compressed air has by no means been used to the extent justified by its special adaptability for certain classes of work,—cleaning apparatus, etc., in power houses and car barns, operating machine tools, and in foundry work. For both of these latter uses the General Electric Company uses compressed air extensively and with great economy and success.—R. E. Moore.

Mr. Ellicott—For this service, we usually install either a small steam or motor driven compressor. Automatic devices are provided, which start or stop the compressor as the pressure falls or comes up in the reservoir. By a relatively small amount of piping, nozzles can be placed at various points in the plant for hose connection, making the air available for general service. For the special service around car houses and on the road we have supplied a portable compressor. This consists of a small air compressor and two reservoirs approximately 14 ins. x 48 ins. with a capacity of about 80 cubic feet. This outfit is especially desirable where electric current is available and it is not desired to completely pipe the plant. Among the special applications, there is a device used by the Pennsylvania Railroad Company for cleaning the plush seats in the cars, consisting of a flat nozzle with a comb in front of a number of holes. The teeth of the comb are pushed over the plush, loosening the dirt and raising the nap, and the air blows the dirt out thoroughly.

President Davis—Can you give some idea as to the average cost of a compressor outfit for car barns?

Mr. Ellicott—The cost of a stationary compressor and pipe within a radius of 30 or 40 feet, would cost about $375.00 for the electrical outfit. If high pressure steam was available, the steam compressor would reduce the cost to about $200.00.

Mr. Hammett—Where independent compressors are used on the cars in connection with the air brakes, a special hose connection is made, so that by operating the compressor the necessary air for cleaning and other work about the car can be obtained.

Mr. Power—A number of companies using our equipments on their cars, have an arrangement by which they attach a hose and clean their motors by means of the compressor in service on the car.

Mr. O'Toole—Our equipment consists of a second hand 8-in. standard Westinghouse compressor, such as is used on locomotives. We purchased our compressor for $10.00 from the Pennsylvania Railroad Company, which is discarding the 8-in. size and installing the 9-in. The total cost, including the station piping, hose, regulating valve and reservoir, was just about $25.00. We use it for cleaning generators, switchboard, etc., and for work on our boilers with pneumatic tools.

104. With maximum traction trucks, what proportion of the weight should be put on the pony wheels to insure reliability in operation?

To insure good traction to the drivers, the pony wheels should have sufficient weight to keep them from mounting the rail; say about 25 per cent.—Chas. H. Smith.

Various large users of these trucks advise percentages varying from 60 per cent to 75 per cent of total weight placed on drivers. The mode of adjustment we follow is as follows: With the compression post at height to just touch compression plate, we compress the spring 1½-ins. With 1¼-in. compression, running is claimed to be reliable; but with 1½-in. adjustment, it is sure.—C. T. Herrick.

Our experience has been, to obtain the best results with a Brill maximum traction truck, it was necessary to put 20 per cent of the total weight of the car on the pony wheels.—A. F. Rexroth.

105. With maximum traction trucks, what is the best method of placing brake-shoes—both inside, outside, or alternated?

On the outside; more convenient for repairs.—Chas. H. Smith.

Our experience has been to place the brake-shoes alternately, on the outside of the driving wheel and on the inside of the pony wheel. This reduces the wearing parts to a minimum.—A. F. Rexroth.

107. What is the cause for wheels, apparently in first-class condition, breaking down or collapsing in service?

This has occurred with us several times and an examination of the wheels developed no apparent reason for breaking.—Chas. T. Herrick.

108. What has been the experience relative to wheels becoming loose on axles?

Think this is due to the fact that they were originally put on too loosely.—Chas. T. Herrick.

In ten years we have had perhaps one-half dozen wheels get loose on the axles, and in each case we found it to be due to the fact that the wheels were not put on the axle with sufficient amount of press.—A. F. Rexroth.

109. What pressure is used in pressing wheels on axles?

We use from 35 tons to 45 tons.—Chas. T. Herrick.

110. Is there any form of wheel gage for use in accurately locating wheels on axles, and suitable for use in pressing on or subsequent inspection?

I do not know of any.—Chas. T. Herrick.

111. What are the specifications for car wheels for city and interurban systems?

We use a wheel with a 2½-in. tread and ⅝-in. flange for city service.—Chas. T. Herrick.

We use 33-in. wheels, 2¼-in. tread and ¾-in. flange.—A. F. Rexroth.

112. What grade and treatment of steel is the best for axles?

We use cold rolled steel.—Chas. T. Herrick.

113. Is it advisable to use a smaller axle than 3¾ ins. diameter?

No—makes them too weak for the load and work they have to perform.—Chas. H. Smith.

Think not, for the reason that anything smaller has a tendency to bend or break under heavy service.—Chas. T. Herrick.

114. Are any of the types of brake-shoes, using special inserted material or pieces, more reliable or economical than solid brake-shoes, taking into consideration both wheel and brake-shoe wear?

We get the best results from a solid casting. We find the cast-iron shoe made from good material to give the best results.—Chas. H. Smith.

We have used a brake-shoe with steel insertions, but we found it wore too much on the wheel to be an economical shoe.—C. T. Herrick.

The most reliable shoe for all parts of the system is the ordinary cast-iron shoe; but on hilly roads, the expense of maintenance has been enormous, and we have adopted the "Compo" for all suburban hilly roads, and the diamond "S" shoe for city work.—A. F. Rexroth.

115. What has been the experience with track brakes, either mechanical or magnetic?

Our experience has been they are not suited for making service stops. As an emergency device or for use on very long steep grades, there may be some small field.—R. E. Moore.

116. What results have been obtained in the use of emergency brakes?

The Bonta brake, as incorporated in our emergency reversing switch for controllers, fills the requirements for an emergency brake. It is simple and positive in its action, carrying the braking effect fully up to the slipping point on the wheels.—R. E. Moore.

117. Above what speed and weight of car is it the best practice to use air brakes?

In my judgment, it is advisable to use the air brake on any cars over 18 ft. in length, and making a speed of more than 10 miles an hour. We think the time saved in stopping and starting, and avoiding accidents, will more than compensate for the cost of the air brake equipment.—A. F. Rexroth.

We consider that air or some other form of power brakes should be used on cars weighing 15 tons or more, and operating at speeds of 25 miles per hour or over; and on cars weighing 25 tons, operating at any speed.—R. E. Moore.

118. Are independently operated compressors necessary for reliability with air brakes?

We do not consider that independently operated air compressors are necessary for reliability of air brakes on single cars. The use of individual compressors depends upon the character of the service which the cars are required to perform.—R. E. Moore.

## DISCUSSION ON QUESTIONS 116 TO 118, INCLUSIVE, ON AIR BRAKES

Mr. Musser—We have about twenty-four equipments, which have been in operation various terms up to three years. Mr. Rexroth, our master mechanic, has definite information as to the operation and maintenance costs.

Mr. Rexroth—Our early troubles were principally in connection with the brackets on the governor. The improved form now made has reduced this difficulty materially. We also had some trouble with water getting in the pipes and freezing. This we obviated by putting in drip cocks.

Mr. Herrick—Have your brakes ever failed? If so, why?

Mr. Rexroth—We have never had a case where the air brake failed. The only reason I have ever known for failure, was where something went wrong with the governor and it failed to work.

Captain Lanius—We have experienced no trouble on the three suburban lines which are equipped with air brakes.

Mr. Faller—We have only two equipments. These have been in operation three years and have given us practically no trouble.

Mr. Power—We have furnished air brakes for both single and double truck cars. The Lancaster system has been operating a number of single truck cars, equipped with our brakes, and they are entirely satisfactory. The majority of equipments are naturally installed on double truck cars; but it is my experience that regardless of the size of car, the air brake deserves careful consideration on the score of safety and reduction of accidents.

As to the merits of axle and independent driving, my advice is to stick to the independently driven compressor.

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119. What is a reasonable power consumption per car mile for 25-ft. closed cars mounted on maximum traction trucks and equipped with two motors about 40-hp each?

A 25-ft. car body usually weighs about 8400 lbs.; weight of maximum traction trucks about 1350 lbs. each; weight of double 40-hp equipment about 5710 lbs.; seating load of 36 passengers 4900 lbs. This makes the total estimated weight of cars equipped and loaded 12.85 tons.

For a car of the dimensions given and in averave service, the watt hours per car mile would probably average about 1400.

In comparing wattmeter readings taken on cars operating on different roads, all of the factors, such as number of stops per mile, coasting, schedule speeds, duration of stops, etc., should be taken into consideration.

Regarding the relative power consumption of double truck cars equipped with two and four motors respectively, would state that with motors of equal efficiency geared to the same speeds and giving the same torque with the same total input to the car, the four-motor equipment should not take any more power when used in exactly the same service as the two-motor equipment, except for the slight increase in weight of the four-motor over the two-motor equipment. This increase in weight is a very small proportion of the total weight of the car equipped and loaded. On account of the grinding of wheels on the track during acceleration and when ascending grades, it is quite likely that the power lost in this way with two-motor equipments more than offsets the increased power required due to the slight increase in weight of the four-motor equipment.—R. E. Moore.

120. What is relative power consumption of double truck cars equipped with two and four motors respectively?

The power consumption with double truck cars equipped with four motors is about one-third higher than where the same trucks are equipped with two motors.—Charles T. Herrick.

With motors of equal efficiency geared to the same speeds and giving the same torque with the same total input to the car, the four-motor equipment should not take any more power when used in exactly the same service as the two-motor equipment, except for the slight increase in weight of the four-motor over the two-motor equipment. This increase in weight is a very small proportion of the total weight of the car equipped and loaded. On account of the grinding of wheels on the track during acceleration and when ascending grades, it is quite likely that the power lost in this way with two-motor equipments more than offsets the increased power required due to the slight increase in weight of the four-motor equipment.—R. E. Moore.

121. With double truck cars, equipped with only two motors, on which axle should motors be mounted?

I would not suggest using two motors on double truck cars. Our experience has been that the best results have been obtained from using four motors of less horse power per motor; but if a double truck car is to be equipped with two motors, the best way would be to mount the motors on the outside axles.—A. F. Rexroth.

122. What special grade or quality of metal gives the lowest cost per car mile for gears?

Steel gears, when steel pinions are used.—Chas. H. Smith.

Our experience has been that the best results can be obtained by using steel gears and steel pinions, run in oil and in regular gear casing.—A. F. Rexroth.

123. What are the relative merits of four-bolt and eight-bolt gears?

We find that the eight-bolt gear is more satisfactory under very severe conditions; but for ordinary conditions four bolts answer very well.—Charles T. Herrick.

Our experience has been that for all service it is best to use an eight-bolt gear, as it is impossible to draw four-bolt gear tight enough to stand a heavy strain. We have some four-bolt gears in stock that we are having drilled for eight bolts, rather than take the chances of the four-bolt gears giving way.—A. F. Rexroth.

124. What are the relative costs per car mile for rawhide and steel pinions?

We find that the rawhide is the more expensive as regards price, but it gives results that we cannot get with steel, in as much as requiring no lubrication, grease is not distributed along streets.—Charles T. Herrick.

125. What is a reasonable car mileage for motor bearings? What grade of babbitt is used?

We use the best babbitt. Using two parts babbitt to one of tin—mileage approximately 15,000 for both armatures and axles.—Chas. H. Smith.

We use genuine babbitt metal, or the same formula as used by the General Electric Company. We have been able to get 15,000 miles to 18,000 miles on armature and axle bearings on suburban lines, and from 18,000 miles to 20,000 miles on the city cars.—A. F. Rexroth.

Fifteen thousand 1 iles.—Charles T. Herrick.

126. What is the average mileage of armature bearings?

Fifteen thousand miles.—Charles T. Herrick .

128. What is the best material for journal bearings?

Brass; gives loi ger life and requires very little attention.—Chas. H. Smith.

Brass or bronze.—Chas. T. Herrick.

We have used the Lumen bearing metal, brass and bronze, but our experience has been that bronze gives the longest service.—A. F. Rexroth.

129. What methods of lubrication are employed in railway motors?

On the city cars we use grease entirely. On the long road cars we use grease on the axle-box; but on the armature bearings we fill the grease-box with wool waste, and depend on the oil for lubrication. To use oil on the armature boxes requires no change. Our reason for using oil on this particular line is that the line is considerably overloaded, and the voltage very low at end of line, resulting in the motor heating up more or less, and thereby causing the grease to melt and run away.—A. F. Rexroth.

During several years the General Electric Company has manufactured a large number of motors larger than 50 hp which use oil instead of grease for lubrication of both axle and armature journals. Motors of this class are in general use on elevated and suburban lines. More recently the General Electric Company has manufactured the General Electric 74-motor, rating 65 hp and the General Electric 70-motor, rating 40 hp, which have oil lubrications. The bearings in these motors are lubricated by means of oil and waste packed around the journal in a manner similar to that used in standard car journal boxes. This system of lubrication has given universally good results. I would also state that there are several devices on the market whereby a motor designed for ordinary grease lubrications can be fitted for oil lubrications instead. These devices usually consist of a cast-iron cap which is placed inside of the regular grease chamber and having some device for allowing the proper amount of oil to be fed to the journal. Reports from several roads indicate that the use of oil on these motors has given good results, both as regards cost of lubrication and wear of the bearings.—R. E. Moore.

132. Is there any cheap and reliable outfit by which car motors can be tested in place during inspections, and which can be operated by regular repair men?

In a statement made by the repair department of one of the large Western roads, which has tried the Conant motor tester, it is claimed that the great difficulty is in obtaining reliable results with the telephone method where such observations must be made in noisy places. They found it very difficult to determine the silence point accurately when tests were made in the car house because of the noises due to repair and other work.—C. H.

It is our experience that the testing of motors can be done rapidly and with ample accuracy by a system using an auxiliary trolley wire in connection with a regulating rheostat, ammeter and voltmeter. Our practice is to place the trolley of the car to be tested on the auxiliary wire. Cut out one motor entirely at the controller and short circuit either the armature or field of the remaining motor, depending on whether you desire to measure the field or armature resistance. With motors so arranged, the controller handle is moved to throw a notch on the motor to be tested, and by means of a water rheostat the current which passes through this

circuit is limited to twenty amperes approximately. The pit man then touches the ends of the field terminals or the armature terminals, as the case may be, with a cable which is connected to the voltmeter in the testing room. From the indication of the voltmeter in connection with the current passing, the resistance of either armature or fields is determined, and if the value so obtained is lower than the standard for that particular type of motor, the separate field coils are tested and the low resistance ones picked out. We have used this method, which is strictly a drop of potential method, for some years, and find that very little experience is necessary to manipulate the apparatus and to determine accurately the condition of the field coils. This method, as practiced by us, does not take into consideration the varying temperatures of the motors tested, but with comparatively little experience any of our men will detect evidences of faulty field coils. The cost of the outfit complete, exclusive of the labor of installing and connecting up the wires, is not over $60.—Charles T. Herrick.

The Conant motor tester operates on the principle of separately comparing the individual motor field coils in the two motors ordinarily installed on the car. It picks out those which are the weakest in magnetic strength. The coils do not have to be disconnected nor the motor opened for the test, as the leads can be readily reached through the hand holes of the motor case. Two of the prominent companies using them have in all twenty of these instruments in operation. Where proper instruction has been given the car house men there is no difficulty in their using the instruments.—R. W. Conant.

It is our practice to test all motors in place, by disconnecting each motor, and forcing ten (10) amperes of current through the resistance, and measuring the fields and armature separately, with a low reading voltmeter. This mode of testing can be done by any shopman and in a few minutes' time.—A. F. Rexroth.

In the Harrisburg repair shops, the following method for testing armatures for short circuits has been devised by Mr. Rexroth and has proven practically sure: In making test, pass a current of about ten amperes at 500 volts through it, with the aid of a yoke with adjusting contacts, so as to make connection with the bars on which the brushes should be set. Use a voltmeter with low reading dial so that two volts will read 600. With the terminals from the voltmeter, test the adjoining bars from one contact to the other, and when one space is tested, move the yoke to the other part of the commutator, so as to test all bars. If bars are free from short circuit, they will read about eight points on the voltmeter, but if a drop of two or more points occurs on any bar, you may look for a light short circuit. If meter does not read any figure you will find a dead short circuit. A coil of iron wire is used for resistance, or where this kind is not at hand, a water resistance can be used, as it only takes a few minutes to test an armature and the water will not have time to become hot.—Editor.

133. What is the average life of field coils and armatures in modern enclosed motors such as General Electric 57, Westinghouse 68, etc.?

We have never used the Westinghouse No. 68 motor, but have used some General Electric No. 57 motors for three or four years, and up to this time have not had occasion to replace either armature of field coils.—A. F. Rexroth.

It is a difficult matter to make a just comparison of the life of different field coils and armatures. In general the life of the windings of a railway motor depends upon the temperatures in service. The temperature of the winding depends upon many variable factors, such as schedule speed, weight of car, and other factors which vary power consumption as noted above. With a certain definite weight car and type of motor, making a certain definite schedule and stops per mile, the temperatures might vary greatly and hence the life of the windings by simply changing the gear ratio of the motors. Our experience has shown that in a great many instances the temperature of windings can and has been greatly decreased by a change in gear ratio, the same or practically the same schedule being maintained as before the change of gearing. It will therefore be seen that the conditions under which motors operate are so varied that it is almost impossible to make a statement as to the life of the windings which could be compared with the life of the windings on other motors operating under entirely different conditions.—R. E. Moore.

134. What is the average life of field coils and armatures in motors of the Westinghouse No. 3 class and size?

Two and one-half to three years.—Chas. T. Herrick.

From two (2) to three (3) years, averaging 160 car miles per day.—A. F. Rexroth.

135. Have any improvements been adopted in rewinding Westinghous No. 3 armatures tending to diminish the trouble by grounding at the ends of the slots?

We have devised an improvement in rewinding Westinghouse No. 3 armatures which has reduced our trouble account with this type armature about 40 per cent over the old style form wound coils. The difficulty with form wound coils is the liability of injuring the insulation in putting them in place, as it is impossible to put them on without using a hammer, and when the armature is put under heavy load it is liable to ground at the defective point and burn out. The present plan obviates this difficulty entirely. In the new system of winding, one sheet of fiber and one sheet of mica paper, each 1/32 of an inch thick, are used in lining the slots of the core, making the insulation 5/8 of an inch longer than the core of the armature. The fiber paper is dampened so that it can be bent in shape and fitted in the slots. The winding is the same as with the form coils from slot one to twenty-five. When the section is started put the left-hand lead in slot twenty-six until the section is finished in one and twenty-five. Then put a piece of lead cover on both leads the length of the core so as to make a good insulation between the sections. This is done so as to bring both leads out at the top of the section. On the ends of the armature one thickness of muslin or linen is enough on each section. The time of winding armature in this way is somewhat longer than with form coils, but the greater durability warrants the expense. The armature connections are the same as with other winding. The ends of the armature are much smaller with this system.—A. F. Rexroth.

136. Is there any brush holder for Westinghouse No. 3 motors, which overcomes the troubles with standard type brush holders, getting loose, damaging springs and causing sparking and beating of armatures?

We have had no experience with anything different from the original brush holder furnished by the Westinghouse Company. Frank Wambler, master mechanic of the Union Traction Company, Philadelphia, at the Sixth Street repair shops, has improved a brush holder, that, when used, will overcome the trouble referred to. This device is similar in construction to that brush holder and works similar to the brush holder on the General Electric 800-motor.—A. F. Rexroth.

137. Can a small road, not over twenty-five cars, save any money by rewinding all burned out armatures and field coils in its own shop?

Yes, if done by one of the car house employees who should be familiar with this kind of work.—Chas H. Smith.

We think not at the present time, but are willing to be convinced that we are wrong.—C. T. Herrick.

Yes, I think it would repay any road of ten cars and over, to do its own rewinding of both armatures and field coils.—A. F. Rexroth.

138. What is the best method of connecting motor terminals to car cables on double track cars?

Fasten your cable as near the kingbolt as possible and run from there to the motor.—Chas. T. Herrick.

We place lead wire from the main cable over to the motor, in the form of a cable, encased in cotton hose same as main cable, which is cleated to the floor of the car, leaving an end of about eight inches hang below the cleat. To this the leads from the motors are connected by means of a two-way connector. The wires from the motors are encased in a circular loom to prevent the insulation from wearing through on the truck.—A. F. Rexroth.

We use a split connector, one-half of which is soldered to the motor lead and the other half to the lead from the car wiring cable, the connection between the two halves being made either by clamping screws or by clamping effect produced by turning the connector through an angle.—R. E. Moore.

140. What has been your experience with flexible, stranded and solid wire for car cable? Also advantages of single, double and triple braiding?

We have used both stranded and solid wire for main cable in closed and open cars, and have found from experience that the cheapest and best is the stranded for the main cable, and the flexible for leads, using triple braided insulation in all cases.—A. F. Rexroth.

141. Is there any advantage in placing a hood switch at each end, and connecting so that throwing off hood cuts off trolley connection from controller at the end?

Yes, very useful in case of emergency; making repairs or examinations to motors, controllers or other parts of the circuit.—Chas. H. Smith.

We think there is.—Chas. T. Herrick.

We think it advisable to put a hood switch at each end of the car, connecting it independently, so that by throwing either of the switches the trolley wire is disconnected from the controller at the end of the car.—A. F. Rexroth.

We do not consider that there is any advantage in connecting hood switches at the two ends of a car in multiple so that throwing one switch cuts off the connection only from the controller at

the same end of the car. Such an arrangement would either necessitate a considerable amount of extra wiring, or the use of separate fuses and lightning arresters for each controller; and there would be, in our opinion, no compensating gain. Where the hood switches are connected in series, throwing either switch cuts off both controllers.—R. E. Moore.

142. What are the weights and designs for trolley wheels for city and interurban service?

We use the standard 4½ lb. wheel.—Chas T. Herrick.

We use the standard 3-lb. trolley wheel for city work, and for long line and suburban work we use the 6-in. trolley wheels, made by the Star Brass Company, Kalamazoo, Mich.—A. F. Rexroth.

143. What is most economical pressure of trolley wheel against the wire?

Depends upon the condition of the track and height of the trolley wire from the rail—usually 18 pounds.—Chas. H. Smith.

From 16 pounds to 20 pounds, depending upon the style of the trolley.—Chas. T. Herrick.

From 18 pounds to 20 pounds, depending upon the style of the trolley wheel.—A. F. Rexroth.

145. What average mileage is obtained from trolley wheels?

We think from 5000 to 8000 is a good average mileage.—Chas. T. Herrick.

From 5000 to 8000 is the average for the 3-pound wheel; but on 6-in. wheels we have been getting from 12,000 miles to 15,000 miles.—A. F. Rexroth.

146. Do you consider any form of trolley catcher or retriever commercially successful?

We have used the Wilson trolley catcher, with splendid results, for about two years.—A. F. Rexroth.

We consider that some form of trolley retriever is of great value on high-speed equipments. The retriever is much preferable to trolley catcher, as it immediately pulls the trolley pole down as soon as the wheel leaves the wire, thus insuring a minimum damage to the overhead construction.—M. O.

147. What size and kind of trolley rope is best for general service?

Three-eighths of an inch. When trolley catchers are in use, ¼-in. rope is the heaviest we can use.—Chas. H. Smith.

Three-eighths and ¼-in. Samson spot cord gives us the best results.—A. F. Rexroth.

148. How often should cars be completely repainted, assuming cars are varnished and retouched annually?

We have cars in service four years without repainting. We avoid this by giving them a coat of good varnish every year.—Chas. H. Smith.

We have found it advisable to varnish our cars at least once every year, and to completely repaint a car once every four years; but in repainting, where the coats are not cracked or grazed, we simply sandpaper the top coat off, leaving a smooth surface underneath, which saves the cost of a ground coat. We put on three priming coats of whitelead, mixed with a little Tuscan red. Then we add a dead coat of color, stripe and letter, and put on one coat of rubbing varnish and two coats of finishing varnish. The filling coats are not rubbed down. The cost under this system is about $40 per car.—A. F. Rexroth.

### DISCUSSION ON QUESTION 148, CAR PAINTING

Mr. Ohmer—In car painting, one of the troubles is surface cracking. This is attributable to two reasons:—putting on the coats too rapidly, the foundation coat not having sufficient time to thoroughly dry; and the use of inferior varnish. If ample time is allowed for each coat to dry, and the best grades of finishing varnish used, there should be no necessity for burning off every four years, if cars are regularly varnished each year. The foundation painting should be good for seven years or eight years.

Mr. Wendle—On our road this work has been done by contract; not only painting, but getting the car ready, dismantling, and other operations not strictly defined as painting. For this work our expense is about $80 to $85 per car. When I compare this cost with what other roads are doing, it seems exorbitant; but I have been unable to pick out just which of our operations was the luxury. In looking up the subject, I have received statements of labor costs alone, varying from $24 to $52 per car for burning off and completely repainting inside and out. This is a wide discrepancy for what is presumably a carefully conducted department of the business. The question comes to what each of the roads is getting for its money, and whether the requirements of street car service are as well met by the $24 job as the $52 one, and in order to place this matter on a more definite basis, I would suggest that our members keep a detailed record of what is actually done, how much time is required for each particular operation, and how much and the cost of each kind of material used in each coat. Such data, covering the roads controlled by our members, and others, would permit intelligent comparisons to be made and revision of methods adapted, if deemed advisable.

150. What is the most economical and serviceable color for car bodies?

Chrome yellow.—C. T. Herrick.

Tuscan red.—S. W. Rhen.

Chrome yellow, with dark brown or green striping and lettering.—A. F. Rexroth.

152. Assuming an 18-ft. or 20-ft. closed body, what is a fair cost for the following:—Burning off and repainting from the wood; retouching and varnishing exterior?

Twenty to 25 feet closed car bodies—(A) to burn off old paint and glazed with white lead, paint and varnish (including inside varnishing), and painting roof and floor, $32.50 per car; (B) burn off old paint and use wood filler, primer, etc., approximately $46 per car. As we find the first method very satisfactory, we have adopted it.—A. F. Rexroth.

153. Is it advisable, from a business standpoint, to decorate and letter sides of cars liberally, or simply stripe in color and number, omitting lettering and useless decorations?

It is useless expense and no profit gained. We use a plain stripe and number, omitting lettering and useless decorations.—Chas H. Smith.

Have cut out all fancy gold scroll work and lettering, as we do not think it is necessary.—C. T. Herrick.

In our judgment, the plainer the car can be made, the richer and better it will look, and the more serviceable it will be. Our system is to paint the car in plain colors, using a simple stripe, with number put on plainly, and small initials of the company painted in plain lettering at one end of the car.—A. F. Rexroth.

154. In a road where the amount of painting is not sufficient to keep one man regularly engaged, what is the best method of handling this work cheaply and properly?

We hire a painter in our town as we need him, paying 20 cents per hour.—C. H. Smith.

156. Which is the best system of operating registers, rod or cord pull?

We consider the rod pull the best.—Chas. T. Herrick.

157. What is the best size and material for register strap?

Five-sixteenth inch tannite.—Chas. T. Herrick.

Five-sixteenth inch oak tanned leather cord, cut with edges champed off.—A. F. Rexroth.

158. What kind and size of signal rope is most satisfactory?

One-quarter inch with wire center.—Chas. T. Herrick.

We use the same rope for the signal bell as we do for the register cord.—A. F. Rexroth.

159. What is the most durable covering for upholstered seats?

I think rattan.—Chas. T. Herrick.

Rattan is cleaner, and I think more serviceable.—A. F. Rexroth.

160. How do you clean your closed cars? Do you use hot or cold water? Do you use soap or any other special preparation in cleaning?

Warm water and soap.—Chas. H. Smith.

Cold water in summer and luke warm water in winter and a mild soap.—C. T. Herrick.

We use cold water in summer and luke warm water in winter, without any kind of soap.—A. F. Rexroth.

### DISCUSSION ON QUESTION 160, CAR CLEANING

Mr. Herrick—At Saratoga, the washing of cars was thoroughly discussed, and the use of linseed-oil soap was recommended by several members. Mr. Lake, of one of the Western roads, stated that a little linseed-oil soap dissolved in the cleaning water was absolutely necessary to clean the oil and dirt from his cars. His road operates through an oil territory and the grease and grime collect on the cars so rapidly that daily cleaning is necessary. In spite of daily cleaning, he reported no evidence of damage to varnish by the linseed-oil soap. Other large companies reported a similar experience. On account of the importance of proper car cleaning, I would ask whether any of our members have had experience with this soap or can advise me where to get it.

Mr. Ohmer—From a long experience in wood finishing, let me advise you—"Don't ever use soap of any kind in car cleaning." The soap contains lye and disintegrates the varnish. If you cannot clean with plain water, put a little wood alcohol in the water. This will clean off the grease and dirt and at the same time will stiffen up, or rather support the varnish, instead of cutting it away.

Mr. Wendle—While we are on the subject of car washing, will the members state the system they are using in car washing? How often are the cars gone over, and how many men are actually employed in washing cars exclusively?

Mr. Rexroth—We have some men who clean cars at night; they do some washing, but not very much. The main car washing,

namely, from the windows down, is done in the day time by seven special men. With this force, we generally get our sixty cars washed once a week.

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161. Is there any tread for car steps which will prevent slipping in winter?

We cover our steps with a strip of corrugated rubber.—Chas. H. Smith.

Corrugated rubber, we think, is good, and there is a safety tread manufactured with lead inserted that is very good.—Chas. T. Herrick.

162. Are car circuit breakers preferable to enclosed fuses?

I think they are.—Chas. T. Herrick.

Car circuit breakers are more reliable and convenient than enclosed fuses.—A. F. Rexroth.

For all equipments with a total capacity of 90 hp or over, operated only as single cars, we consider that the use of circuit breakers is preferable to the use of fuses, as they are much quicker in their action and consequently minimize the damage in case of short circuits on the apparatus. Circuit breakers also accomplish the double purpose of an overload interrupting device and a hood switch; and the circuit is more easily and quickly re-established than where fuses are used. It must be considered, however, that the circuit breaker is necessarily a piece of apparatus that must be carefully inspected. A fuse used in series with circuit breakers provides an additional factor of safety, but it is not necessary if the circuit breakers are carefully inspected and kept in proper operating condition.—R. E. Moore.

163. What type of headlight is best for city service?

Electric—cleaner and economical.—Chas H. Smith.

We think oil headlights, for the reason if anything gets loose or breaks in connection with the trucks, you can use the headlight about the car.—C. T. Herrick.

Electric headlights, with 16-cp incandescent lamps, are more reliable and economical.—M. A. H.

164. What has been your experience with fenders?

We think it economical to use fenders.—Chas. T. Herrick.

165. Do you have any system of reporting electrical and mechanical defects in cars by conductors, motormen or other employees, especially when defects are not serious enough to take a car out of service? What method is used to check up such reports?

Our employees are instructed to report to the car house defects of any kind that come before their notice.—Chas. H. Smith.

We have a blank which we furnish each crew at the car house, when the cars are turned in for the day. Upon this blank the conductors and motormen are instructed to report any repairs necessary to the car, or any shortage of tools or equipment kept upon the car.—A. F. Rexroth.

Our system is as follows:—Special report forms, bound cheaply in a manner similar to the Western Union books of telegraph blanks, are placed in each car by the car repair department. These forms are ruled and printed to make two columns. In the first column, the various items which affect the comfort or safety of passengers are listed, and the conductor indicates and briefly explains nature of defect. In the second column, items affecting the equipment or operation of the car are listed, and the motorman similarly marks and explains. This report is signed by both the conductor and motorman in their respective columns. At the time original report is made out, carbon paper is placed to give copy. The original copy of report is deposited with the repair department and the carbon copy with the despatcher. It is the motorman's special duty to see that these reports are properly made out and deposited before leaving the car house after turning in the car.

On receipt of report, the repair department is expected to remedy defect, if possible, before the car is again placed in service; and in order to check up whether repairs are promptly and properly made, the despatcher looks up all reported cars which are again placed in service, and if defects still exist, he reports such fact daily when his copies of reports are turned into the main office. This enables the management to keep close supervision on the condition of cars; and the efficiency of the repair department is determined by comparison of these reports with the daily labor and material reports from the car repair department.—Editor.

166. What is the maximum length of closed body, mounted on single truck, 7-ft. wheel base, which will give satisfactory service to the public and reasonable maintenance cost on track and body?

I think any car body over 18 ft. in length too long to be mounted on a single truck.—A. F. Rexroth.

169. What popularity has the semi-convertible car as compared with regular cross bench open cars, especially with reference to pleasure riding?

The semi-convertible type has given general satisfaction.—A. F. Rexroth.

170. Are accidents less with cross seat cars of the semi-convertible type than with twelve-bench or fifteen-bench open cars?

Very much less with the cross seat, semi-convertible type.—A. F. Rexroth.

171. What is the minimum satisfactory width over all for semi-convertible cars?

Our semi-convertible cars run from 8 ft. 2 ins. to 8 ft. 4 ins. wide over all, and give a satisfactory width of aisle.—A. F. Rexroth.

172. To what extent have track scrapers of the Van Dorn-Dutton, Root, and similar type, been a commercial success?

Would not be without them. They are excellent for removing snow and dirt from the rail.—Chas. H. Smith.

173. Is there any satisfactory device, attachable to each car, which will scrape packed snow from girder rails, especially along paved streets?

Where the scraper can be set on top of the rail we find the Dorner or Brill type very useful; but where the track is laid in asphalt with granite blocks which stick above the top of the rail inside and outside, this type of scraper is of practically no use for cleaning out snow and sleet from the tracks.—Mr. Wendle.

We have Dorner and Brill scrapers, and we also have a device on our combined snow scraper and plow, made by the Thomson-Houston Company a good many years ago, consisting of a spring track scraper which is kept sharpened and held against the rail by compression. This works very satisfactorily on a straight track as long as the joints are tight, but it would not be at all satisfactory for the entire service.—Mr. Musser.

### TRACK AND ROADWAY

201. What are the practical advantages of "Trilby" girder rails in paved streets?

I think none. While we use "Trilby" and side-bearing girder rails, the T-rail of proper height is best for paved streets.—A. F. Rexroth.

Very little of the "Trilby" rail has been in service sufficiently long to develop its defects. One of the New England roads, in connection with the municipal officers, looked into this matter, and their report on New York City results was that the pavement was not especially preserved by this special form of rail. The modified form, used in Philadelphia, has not been reported on. From best information we can get, the advantages of the "Trilby" type are largely theoretical. Practically it has the faults common to all grooved rails and is by no means the salvation of municipal pavements.—Editor.

202. What is the advantage in using girder rails higher than 7 ins. in streets paved with brick or asphalt?

If concrete foundation or beam construction is used, with welded joints, there is no advantage in using over 7-in. rails. On standard ballasted track, with mechanical joints, the 9-in. girder rail is most satisfactory.—T. J. King.

204. Has any satisfactory method been devised for attaching metal pieces to existing girder rails to change the head to a shape similar to "Trilby" or grooved rails? Has such change of form been voluntary or because of conditions imposed by the municipality? What results have been obtained?

We have had some experience in the use of Buckland blocks which are intended to transform the ordinary tram head rail into a grooved head rail. These blocks are made of short cast-iron, and when they are first placed in service seem to fill the bill quite nicely. They, however, wear out rapidly in the groove, due to the abrasion caused by ordinary street traffic as well as that caused by full-flanged wheels. In my opinion they are, at best, a makeshift which may be used in order to tide over the necessity of replacing rails for a short period. The cost of these blocks is about 20 cents a foot of rail or 40 cents a foot of single track. To this expense must be added the expense of splicing the same.—Norman McD. Crawford.

205. What is the experience with special rail joints, such as the Weber, Continuous, Atlas, etc., in regard to reducing maintenance and depreciation charges on track?

We have had some old rails, with pounded joints, reclaimed to some extent by using Weber and continuous rail joints.—A. F. Rexroth.

We have used the Weber joints and some few Continuous. The track on which we used Weber joints had been worn considerably and the rails were pounded down at some of the joints; after the new joints had been in service for some time, we found that the ends of the rails had smoothed out to some extent. It was not expected that the pounding would be entirely removed, but the rails were very much improved. It is our experience that these joints are economical in fixing up old track, where you do not

want to disturb the pavement for several years. We are now using these joints on a stretch of new work, but this has not been in service a sufficient time to determine results. On one street we used the continuous joint and at the end of a year's service we find it very satisfactory.—Mr. Musser.

208. Is there any way by which the hammered ends of girder or T-rails can be smoothed and trued up without taking up the rails?

By taking up sufficient pavement to permit sawing off the battered ends, and then cast-welding in a short piece of good rail of the same shape. By extending casting mould, it would be possible to complete the joint casting at one operation. In case work is to be done in connection with repaving, it is best to take up rails, saw off the defective ends and use a mechanical joint of Continuous or Weber type. This was done on about 1 mile of badly battered rails, Continuous rail joints were used, and from present indications, at least seven years or eight years additional life will be obtained from rails. In three years the maintenance cost in this stretch has been very low and riding is reasonably smooth.—T. J. King.

209. In resurfacing old track on which double truck cars are run exclusively, how much above the general level of the rail can the joints be raised without making the riding rough or seriously hammering the rail ends?

In resurfacing old track, laid with even joints, the joint can be raised ¾-in. above the general rail level. This elevation does not cause any annoyance to passengers or unusual wear on track or cars. If this work is done in connection with a general track repair, and joints thoroughly tamped, no attention should be required for three years, unless the joint becomes loose. With broken joints, it is not advisable to raise the joint very much above level.—T. J. King.

210. What is the proper safe distance between the inside rails on double track or in turnouts, to provide for passing of modern type of cars?

Sufficient to allow a space of 1 ft. or more between the running boards of open cars.—Chas. H. Smith.

Not less than 5 ft., and if possible, 6 ft. between inside gage lines.—Meade Coulton.

Our gage is 5 ft. 2½ ins. We make all our double track 10 ft. from center to center.—A. F. Rexroth.

211. Where girder rails are laid in dirt streets which are kept in repair by the company, what is the best method for preventing the continual cutting away of dirt immediately outside the rails, especially at curves, by wagon traffic?

We find it profitable to pave all track, and at places where the street is not paved, we pave between the tracks and 9 ins. outside of the rails with cobble stones. This preserves the ties and prevents water getting under, and at the same time avoids the continual expense of filling up with broken stone.—A. F. Rexroth.

Where girder rail is 6 ins. or higher, or on chairs, we find paving with cobbles or roughly dressed stones along the outside of rail to be most satisfactory and durable construction. By carrying paving out about 10 ins. to 12 ins. and ramming well, the stones remain in place even where the wagon traffic is heavy. Where paving cannot be done, we have had good success with tamping in the cinders from our power houses. In a comparatively short time these form a hard, compact bed and raise very little objection from city authoritics.—M. Coulton.

212. What satisfactory substitute has been found for planking inside and outside of the "T" rails laid in dirt streets?

We use stone macadam and find it more economical and better than planking. Not affected by frost.—Chas. H. Smith.

We use cinders wherever possible, and where teaming is light, have been able to meet requiremnts of city and county suprvisors. —M. Coulton.

213. What is the average life of modern hardened center special work?

Our experience is that this work will by no means last as long as the abutting rails. Examination of special work on our system in use about three years, shows material signs of wear with an average of about 400 cars passing over it per day.—Meade Coulton.

214. What is the average life of steam railroad crossings, made according to the Pennsylvania or Reading Railroad standard? What improvements can you suggest that will tend to lengthen life?

215. What are the relative costs of the following track constructions: Broken stone foundation, wood cross ties 2 ft. centers, and 70-lb. girder rails; concrete foundation, wood cross ties and 2 ft. centers, and 70-lb. girder rails; concrete beams, with track mounted thereon and bedded in concrete, and held to gage by iron tie-rods; rail 70-lb. girder?

Basing costs on first class of construction, and calling this 1.00, the relative costs are approximately as follows: Second type, 1.4; third type, if built in paved street, using no forms, 1.1; and third type, new work, requiring forms, 1.25.—T. J. King.

216. What is the minimum depth of concrete or broken stone required for permanent track construction in paved streets?

Not less than 4 ins. of concrete or broken stone.—A. F. Rexroth.

Where city has compelled back filling of trenches, etc., with sand or gravel, and subsoil is gravelly or sandy, with natural drainage, 6 ins. to 9 ins. of concrete. If clay or poor subsoil, concrete should extend below the frost line.—T. J. King.

217. What is the experience in using the cheaper grades of cement for concrete foundation work?

We substituted Rosendale for Portland cement on about ½ mile of new track work, paved with brick. A year's service has developed no difficulty whatever.—M. Coulton.

Rosendale does not seem to set up in air as well as Portland cement. For foundations of piers or abutments, below the water line, Rosendale seems as good as Portland. In paving, in order to obtain equal strengths of concrete, Rosendale at 85 cents per 300 pounds barrel is almost equal to Portland at $1.50 per 400 pounds barrel.—T. J. King.

218. What precautions must be observed in laying track on concrete beams without the usual cross-ties, in order to secure satisfactory track construction?

Provisions should be made as follows: First, to clamp or tie rails to concrete beam and at the same time hold the rail to line and surface. Second, to prevent rails expanding or contracting widely during the setting up of the concrete, otherwise rails are apt to become loose in the concrete. Third, to be so placed that rails are butted for welding joints. Fourth, to use welded joints so that wheels run perfectly smooth over joints, as any type of mechanical joint leaves a ridge, which in rigid construction of this type, will result in pounded rail ends. Fifth, to anchor each rail to concrete beam so that on grades there will be no creeping of rails, and rails will expand evenly in both directions and return to original position.—T. J. King.

The most important point is that concrete be brought up tightly against the bottom of rail. After concrete is properly tamped, it is advisable to pour a grouting of strong cement and fine stone. It is essential to use a good grade of Portland cement in the construction of the beam.—A. F. Rexroth.

219. In streets which are to be paved with asphalt, what is the most serviceable pavement to lay between the rails?

Brick, as it can be opened and replaced without impairing pavement, is not rotted by grease dropping from motors, and is relatively smooth for driving.—M. Coulton.

220. What form of cover plate and system of openings is best for track drains where wagon traffic is heavy?

We use cast-iron plates of the plane convex pattern.—Chas. H. Smith.

We have tried several types of track drain covers, including narrow rectangular slots; raised ridge tops with slots between; and flat smooth top with a series of round holes, ½-in. diameter, distributed over same. With all forms except the last, we have had considerable trouble with the caulks on horses' shoes getting caught in openings, and injuring the horse or pulling shoes loose. —M. Coulton.

## BONDING DEPARTMENT

250. In testing bonds against the connected rails with Conant or similar type of testing outfit, what length of rail is accepted as the equivalent of a first-class bond? What equivalent length of rail as read on the instrument, is regarded sufficient to condemn the bond?

A bond resistance equal to 3 ft. of rail is usually considered very good. If equal to 4½ ft. of rail, it is fair. If it equals 6 ft. or more of rail, it ought to be condemned. If the rail is bonded to the full capacity, and bonds of such a character as will maintain their initial efficiency are used, the resistance of the bond should be the same as clear rail of a length occupied by the bonds, and should remain so.—A. H. Englund.

In testing a rail bond, several conditions are necessary in order that the work of repair may render the return circuit the most effective for the least expenditure of money, and consequently the resistance of a bond in terms of the length of the rail, which would be called good, bad or indifferent, will depend on what portion of the rail return system this bond occurs. The current density on the rail being the important factor in determining what will be the permissible drop, and on this basis should the effectiveness of the individual bond be judged. Assuming that the maximum return drop that we wish to allow for a given stretch of road from the power station serving that road, we would just determine the current flow that the rails have to carry back to the power station. The voltage being taken by drop tests or computed for the maxi-

mum load of half the track distance. Assuming that a 60-lb. rail measures .0052 ohms per 1000 ft., this gives us the drop that will occur with the current flowing through the rails, considering it a continuous rail system, with a drop of 20 volts. Subtract the drop thus found from 20 volts and divide this difference by the number of joints occurring to the points on the rails where we assume our drop, this will give the potential difference on the average joint and also give us the length of rail for the average bond, which will be required to be maintained in order to give the drop on the rail joint, which will bring us within the desired potential loss on the return system. There are other considerations that cannot be neglected in this proposition. Where the equipment is large the acceleration becomes an important factor in the copper head and the bonding of the rail return in order that undue heating may not result, and that the schedule may be maintained without over-speeding the equipment on high pressure portions of the system. The foregoing treatment of the bond question leads to a tapering bond as the power station is approached, and this is the correct method where a given amount of money only may be expended in bonding to give the least possible drop. Consequently it is impossible to arbitrarily fix any length of rail in terms of bond resistance without knowing the conditions under which the bond is to be used.—A. B. Herrick.

My opinion is that 3 ft. of rail and joint should be bonded so as to test equal to 6 ft. of rail and that any joint that tests over 12 ft. of rail should be rebonded; this applies to moderately heavy conditions of traffic, but there are very few roads to which these conditions do not apply. Joints which test between these limits should not be allowed to pass if the traffic is extremely heavy, but may be if the traffic is light.—E. W. Conant.

We use a milli-voltmeter, with double needle and scale, and compare the drop between 3 ft. of solid rail and 3 ft. across the joint. When the joint reading is ten milli-volts higher than the solid rail reading, we condemn the bond and replace it.—P. F. Gerhart.

First question, 3 ft. Second question, 5 ft.—R. E. Moore.

251. What is the best method of rebonding tracks in paved streets with the minimum disturbance of pavement, tracks consisting of 6-in., 7-in. and 9-in. girder rails? What is the total cost per joint for such rebonding, exclusive of cost of removal and replacement of pavement?

We have perfected hydraulic punches and compressors for bonding girder rails in paved streets. The punch cuts a tapered hole in that part of the tram projecting beyond the edge of the joint plate. The compressor forces the bond terminal back into the hole against the taper. In asphalt streets, with the usual Belgium blocks against the inside of the rail, it is necessary to remove but two of the Belgium blocks to make room for the hydraulic tools. There are over 100,000 joints bonded in this manner in Philadelphia. Unofficial costs given us by the bonding department show that the Belgium blocks can be removed, two bond holes punched, the bond inserted and compressed, and the Belgium blocks properly replaced for about 18 cents per joint, exclusive of the cost of the bond. This method of bonding has been employed in Harrisburg, York, Norristown and Tacony, Pa.—A. H. Englund.

The method of rebonding track in a paved street economically has not yet been proposed, but from my experience a radical departure has to be made for this class of track work, and I think the solution is to be found along the following lines: Instead of removing the track, to use a cutter or pneumatic tool which will cut away the pavement for ¾-in. from the ball of the rail and cut a slot in the pavement for about 6-in. long. Then a U-shaped bond made of ribbon, the edges of which are presented to the ball of the rail and electrically soldered to the rail, giving a U-shaped loop projecting into the slot cut in the pavement and bridging the joint of the rail. I am designing tools to produce this kind of a bonding arrangement, and I believe that I can reduce the time necessary to put in a bond to less than two minutes and expenditure less than 30 cents. The tools, soldering transformer, being portions of the bonding car, so the work can be done most expeditiously, and after this bond is placed and connected, the slot is to be filled with asphalt or equivalent compound to restore the pavement to its original surface. It is found that disturbing the pavement around a joint disturbs the track at its most critical point, and that patching the paving never restores it to as strong a condition as the original pavement.—A. B. Herrick.

We use a 6-in. tram bond, with a ¾-in. terminal, made by the Protected Rail Bond Company, who furnish us with hydraulic punches and compressors for putting them in place. By this system it is only necessary to open a space on the inside of the rail 6-ins. wide and 18-ins. long; punch the two holes in the rail, insert the bond and compress it. We have only used this type of bond on 6-in. side bearing rails, on streets paved with cobble-stones. The cost of removing and replacing cobble, punching and inserting the bonds is 15 cents per joint. The bonds cost approximately 55 cents each.—P. F. Gerhart.

252. What average life can be expected from bonds put in according to the most modern methods? In what way is the maintenance expense for bonding handled to provide for general overhauling and renewal?

A "Protected" bond, of the proper design, length and cross-section, applied under the plate of any modern "T" or girder rail, should last not less than five years. If the joints are kept up in strictly first-class condition, a "Protected" bond will last as long as the rail.—A. H. Englund.

I have tested bonds which, at the end of five years, showed practically no depreciation, less than 1/5 of 1 per cent of them being defective. The elements surrounding the installation of a bond largely affects its life. Poor track foundations, defective ties and splice-bars which do not fit the rail, and too short a bond to allow for the expansion and contraction of the rail, are causes which contribute to the uncertainty and make bonds succeed in one installation and fail in another, where they are identical in construction and application. I find the same bond in pavements with concrete construction and the rail well grouted, gives much longer service than the interurban track when ballasted according to the Pennsylvania Railroad specifications. Moreover, a longer bond must be used in exposed rails and nothing under a 6-in. expansion should be used in a concealed type of bond, as the contraction and expansion of the rails are passed through the fish-plate and more latitude must be given at joints for expansion and contraction than theoretical considerations would dictate. I believe the test for maintaining bonds are best made by means of pressure wires; in any city where the railroad owns its own telephone system, these wires can be used with pressure wires by placing the telephone wire upon the track, plugging around the exchange by means of the station telephone wires and connecting to the negative bus. This gives the aggregate drop, including the rail and all the bonds, and a criterion of the condition of the ground returns. If a railroad company took these records once a month on each line, it would be in a position to say with surety on what lines the rebonding should be done with the greatest profit and the saving of energy delivered to the cars. When it has been decided to rebond a road, the bonding foreman should be instructed thoroughly in the use of the milli-voltmeter, and should determine for himself the condition of every bond and renew those which show a rail length greater than that which would be determined in applying the rule in answer to question 250. The most economical maintenance of the bonding or railway return is by continuous tests and inspection of these bonds from month to month as an aggregate, by the method here described.—A. B. Herrick.

After two years' to three years' use of compressed terminal bonds, we found no bad joints in the bonds. Where bonds are compressed and rail joints kept in first-class condition, the bond should last as long as the rail.—P. F. Gerhart.

Average life depends on soil, traffic and various other conditions.—R. E. Moore.

253. For new work, are short flexible bonds either under the fish-plates or base of rail more durable than the solid bonds outside the fish-plates?

The fact that flat wire flexible bonds placed under joint plates, or on the base of rail have almost entirely replaced solid bonds outside of the plates, must argue that they are equally durable, and more so.—A. H. Englund.

Flexible bonds under the fish-plate over 6 ins. long are more durable relative to their conductivity and less liable to be stolen than exposed bonds. Bonds under the fish-plate give better life than those under the base of the rail.—A. B. Herrick .

We use flexible bonds on tram and under the fish-plates, and have found them most durable.—P. F. Gerhart.

Yes.—R. E. Moore.

254. Are soldering bonds as satisfactory as the expanded terminal or compressed terminal types?

Soldered bonds, where the edges of the laminations are soldered to the rail, and soldered in such a position that the blow on the rail is given vertically to the lamination, show less drop in their connection as compared with their cross-section than expanded terminals, and the total drop across the bond in this type of bond is less than the compressed terminal.—A. B. Herrick.

We have used only the compressed bonds and have found them to meet our requirements in all cases.—P. F. Gerhart.

No.—R. E. Moore.

255. Can a pin-expanded bond terminal be installed so as to maintain, during a period of five years or the life of the bond if longer, as reliable and as low resistance contact with the rails as a solid copper terminal bond expanded by a hand or hydraulic compressor?

In a pin-expanded bond terminal, it would be absolutely necessary, in order to make a perfect contact, to have the diameter of the terminal exact, and the hole in the rail reamed to exact size

to fit the terminal. Under this condition, the full limit of the expansion of the pin would be obtained, and a good job would result. In practice, however, it is found that hardly any two terminals are exactly of the same diameter, and it is a well-known fact that in rails bored at the mill, there are no two holes exactly the same diameter; and further, many of the holes are not round. To clean out the holes, in order to get them round and free from rust, they are enlarged to such an extent that the bond terminal fits too loosely, and as the expansion of the terminal in the hole is limited to the maximum taper of the pin, it follows that the average contact in pin-expanded terminals is bad. The compressed terminal can always be made to fill the hole, as compression need not stop until the hole is filled.—A. H. Englund.

The comparison of the different modes of connecting bonds to rails rests largely with the man putting the bond in and his ability to do honest work. Under practical operation bonds show an enormous difference in their conductivity in the different parts of the country, so that it is extremely hard to differentiate between them, but a large amount of trouble has arisen from ignorant and cheap labor installing the bonding, and not being instructed in the method of testing the results of their work.—A. B. Herrick.

We had been using the expanded terminal bond for about two years, and on making a test on track that had been bonded with them a few months ago, we found the terminals had become loose in the rail and made very poor contact, and have replaced them with compressed bonds.—P. F. Gerhart.

Yes.—R. E. Moore.

256. Of what value is treating bond holes and bonds with Edison plastic alloy? Will such methods prevent the deterioration of contact surfaces and reduce contract resistance?

The application of Edison plastic alloy to a bond where the bond service is rough is an improvement, and seals and prevents the access of moisture, which will by capillary action eat around the terminal when interstices are left between the shank of the bond and the hole in which it is inserted; but with a smooth shank to a bond and the use of a compressor its use is not to be advised.—A. B. Herrick.

According to our experience, treating bond holes and bonds with Edison plastic alloy is of no value.—R. E. Moore.

258. What is the best method of covering, coating or otherwise protecting bonds against corrosion?

A good weatherproof and insulating paint is a desirable coating for copper rail bonds, providing such paint does not possess ingredients that will deteriorate the copper.—A. H. Englund.

Any good asphalt will do it.—R. E. Moore.

The bond under the fish-plate does not need any protection. The exposed bond, if painted with hot asphalt paint, has its life greatly prolonged; but coating with coal tar compounds is a detriment. Some roads practice the method of boxing the bonds where the soil conditions show active corrosive qualities. They groove one piece of board long enough to contain the straight portion of the exposed bond, fill with hot asphalt and nail on a ½-in. capping. The soil conditions that corrode the bond when of copper are where the filling has organic matter in it and exposed to moisture from sub-surface sources.—A. B. Herrick.

259. How frequently should tracks be crossbonded?

Cross-bonding should be done according to the amount of current carried. By using No. 0000, the usual and most satisfactory method is as follows: For 150 amps., cross bond each 1200 ft.; 250 amps., 1000 ft.; 500 amps., 900 ft.; 1000 amps., 540 ft.; 1500 amps., 360 ft.; 2000 amps., 240 ft.—A. H. Englund.

In interurban work cross-bonding should be practiced on single tracks a great deal more than it is, and for a four-motor 50-hp equipment, at least five times a mile, especially where sub-stations and rotary transformers are used, for if the bonding is defective near the sub-stations, it throws the load unequally on the sub-stations. I have recently found two sub-stations adjacent to each other, one operating normally at one-half load and the other at 40 per cent overload. The whole cause of this unequal distribution between sub-stations was due to defective bonding and no cross-bonding. The critical portions of an interurban road, where the bonding becomes defective, is at switches and turnouts, railway crossings and derailing switches, and the only satisfactory solution for bonding around this portion of the track, is to bond in supplementaries having an aggregate section equal to the section of the bonds employed and completely surrounding the special work by the supplementary, tying the four tracks of the turnout together and the two tracks of the main line with this jumper, and at steam road crossings to connect the rail with electric road abutting the steel track. It is well to assume that the bonding between electric rail and steam rail cannot be maintained. Bridges are critical points, and a supplementary wire or double bonding should be used across bridges; but do not use, in case of double bonding, two bonds of the same type. A concealed and an exposed bond in this location gives better results with time than two bonds of the same kind.—A. B. Herrick.

Depends on the number of cars in service. Four to the mile will do for interurban work.—R. E. Moore.

260. What is the best practical method of testing condition of bonds?

The new T-pole testing instrument, made by R. W. Conant, is very popular and seems to meet all requirements for rapid and accurate bond testing. We think so much of it that we have invested in several ourselves, for the purpose of testing out bonds on such of the small roads as do not feel that they can afford to invest in one of the instruments. We have found it extremely satisfactory and entirely accurate.—A. H. Englund.

The aggregate drop method constitutes the best form of inspection of the bonding, but to locate the bonds which are bad and their condition, the milli-voltmeter method, comparing a length of rail with the joint, is effective; also, the Conant method where it is certain that a current flows in the rail while making a test. It is very hard to determine whether a current always flows in the rail, and neither system is useful where the rail is dead. It is very important in my work to determine these conditions, and the method I use may be of interest. On my test car, I use two brushes on each track to take the drop from the rail, as the car moves along about five miles an hour. I use a motor-dynamo transformer, which gives me about 100 amps. through each rail as the car moves along. I automatically record the movement of the Weston milli-voltmeters, one for each track, without touching the hands of the same, on a record which moves at the rate of 1 in. per 100 ft. of track. I have in connection with the drop circuit also a very sensitive automatic, which can be adjusted to work for any relation between rail drop and joint drop. This relation being varied for different portions of the road, depending upon the current density in the rail. This automatic moves a pen on the record where a bond is passed over exceeding a fixed length of rail. In interurban work, when this pen moves it also closes the circuit through an electrically controlled valve, and squirts paint on the track at the defective bond. All intersections of the streets, turnouts, private crossings, are marked by a third pen on the record and a number telegraphed on the record corresponding to this intersection on the list. From this record the resistance of every bond is given, the current flows and its direction on the rail and any bond can be located by scaling from the last intersection or station at the scale of 1 in. to 100 ft. After testing over 1000 miles of road in different parts of the country with this test car, I find I can get the most reliable results and a permanent record, from which rebonding can be done with surety. Another important object for getting up this apparatus was to get a record for the railroad companies in electrolysis cases which could be produced as a court record.—A. B. Herrick.

The Conant rail joint testing instrument is now being gradually conceded to be a very practical, rapid and accurate means of testing the condition of the bond and requires no special skill to operate it. With it an ordinary man can test 100 joints per hour, which covers the ground as rapidly as ordinarily could be desired. —R. W. Conant.

A double milli-voltmeter, as described in my reply to question 250.—P. F. Gerhart.

261. What is the cheapest method of drilling holes in rails for bonds or bolts? What lubricant do you find best for this class of drilling?

For drilling bond or bolt holes in the web of rails, under all ordinary conditions, we do not believe there is anything better or more economical than a good modern powerful hand drill, such as the Buda or Millers-Falls. Where there are a great many holes to drill, a power drill will no doubt prove more economical. If trolley current is available, an electric drilling plant is very satisfactory, but it is hardly economical for less than 5000 holes, if the investment in the plant is to be charged up as part of the cost of drilling.—A. H. Englund.

For drilling holes for rail bonds, both soap, water and oil (heavy mineral oil) are generally used. I find that with either of these lubricants being used, if the hole is carefully cleaned immediately after drilling, it does not affect the resistance or the life of the bond; but the bond should be inserted and fixed in its position as soon after the hole is drilled as possible. No drill hole should be left over night, and this work should not be carried out in damp or foggy weather, as a film of oxide forms on the freshly drilled surface of iron almost immediately and seriously affects the resistance of contact between the bond surface and the rail.—A. B. Herrick.

For our work we use Sweet's hand drill, polish the terminal with sandpaper, and insert and compress bond terminals immediately after drilling the holes. We use no lubricant of any kind. —P. F. Gerhart.

First question, any good track drill will do; second question, soap water.—R. E. Moore.

262. What is the best method of treating bondholes in order to be certain that contact surfaces are thoroughly dry and clean? Is there any merit in smearing bond terminals with thin white lead before inserting in bondholes?

No. Better clean the hole with gasoline.—R. E. Moore.

The best and surest way of getting a good contact for bonds is to ream the holes immediately before placing the bonds, care being taken that no oil or moisture is left on the walls of the holes. If the holes are round and smooth, but rusty, a simple way of removing the rust and getting a bright surface is to take coarse gunnysack, cut into strips about 4 ins. wide, twisting one of these into a rope. Insert one end of this through the hole, and pull the material back and forth rapidly all around the hole. This will produce a result almost the same as a file, and with much more ease and rapidity.—A. H. Englund.

In holes that have been bored or old holes to be rebonded, a reamer is the best method of cleaning this hole, and a reamer which has on it a miller which cleans the surface of the rail against which the head portion of the bond will be compressed, decreases the resistance of contact between the bond and the rail about 40 per cent. The importance of this additional contact is apparent when one considers that in a properly installed cast head concealed bond, 6 ins. long, the resistance at the contacts of the two terminals of the bond average about 75 per cent of the total bond resistance of a No. 0000 stranded bond with 7/8-in. shank. The application of white lead to the bond before inserting is not advisable, and has been abandoned by the railroad companies who instituted it. Plastic alloy in the case of a rough bond being the only intermediary used between the shank and the hole that increases the conductivity of a bond. The alloy should never be used with a bond having anything but a pure copper head, as it will rot out any compound of copper with zinc or tin, as mercury in this case permeates into the body of the bond and destroys its mechanical structure.—A. B. Herrick.

263. What results have been obtained in welding bond terminals to the rails? What equipment is necessary and what precautions must be observed in operation? What is the cost per bond installed?

Welding bond terminals to the rail is the ideal method, especially in the case of electric weld, yet this method has been so surrounded by patents and litigations that the railroad companies are deprived of utilizing this method. The soldered bond can be applied to some rails and not others. The bond underneath the foot of the rail requires suspended joints, and a number of the rail splices used are not adaptable to the use of this type of bond without a special joint being made for the purpose; but the type of soldered bond, soldered to the ball of the rail, gives the ideal method, and I understand the cost is about 35 cents per bond complete. This type of bond has the objection of being exposed and stolen, but I have suggested coating with a paint containing arsenic, so very little value can be obtained where this copper was melted for reduction.—A. B. Herrick.

264. Has practical experience with cast welded rail joints shown that separate rail bonds are unnecessary?

Cast weld joints since 1896 do not require any bond around them, as they average lower than the rail resistance itself. This is the case with the Twin City Railway, Milwaukee Railway, Indianapolis Railway, Rochester, N. Y., Grand Rapids, and other towns where I have investigated this matter, and the same is true of the electric weld made since 1898. Bonding and cross bonding should both be employed where expansion joints are used, but with a concrete grouting rich in lime between the rail and adjacent pavement, assuming that there is a concrete base upon which the rail is laid, either beam or tie construction, no movement of the rail takes place with the temperature changes and expansion joints are unnecessary. Particular care should be taken to maintain the effectiveness of the cast weld rail return at special work by supplementaries at steam road crossings, for I frequently find more drop at a steam road crossing in a cast weld track, than I have in 6000 ft. of track adjacent to this crossing.—A. B. Herrick.

In most cases bonds are necessary.—R. E. Moore.

### DISCUSSION ON BONDING

President Davis—I would ask Mr. Gerhart, who is in charge of the bonding department of the Harrisburg Company, to open the discussion on this subject.

Mr. Gerhart—We have been doing considerable bonding. Where we rebond old tracks, we use the bonds in various lengths from 6-in. trams to 42-in. regular bonds. Wherever it is possible we try to use the 6-in. tram bond. In new work we use bonds which are placed under the fish-plate, but in repair work, we frequently have to carry the bond around the fish-plate. We do not run any separate return wire, but depend entirely upon thoroughly bonding the rails. We consider it a waste of time and money to run any return wire where bonding is properly done.

President Davis—How do you bond in and around special work?

Mr. Hammett—In every case that I have seen, we have been able to use a cross bond, and tie cross bonds together around the special work. You can set your cross bond back far enough to get into the single rail, and a T splice, placed at the center of each cross bond, enables you to tie all the sections together.

Mr. Gerhart—We do that. But the long bonds offer a higher resistance as compared to the rails. It seems to me that there should be some short bond device by which every joint in the special work could be thoroughly bonded. With such short bonds at the joints and the addition of the long cross bonds properly cross connected, a great deal of the trouble with drop in the return circuit would be cut out.

Mr. Hammett—There should not be much difficulty in providing special bonds for this service, provided there is a sufficient demand for them. In my experience, I have had no such demand. The majority of roads seem to prefer cross bonding and then tieing the cross bonds together. In this connection I would like to call attention to our special tram bond. With this bond it is only necessary to remove three Belgian blocks in the pavement. The bond hole is made in the tram of the rail with a hydraulic punch, which makes a tapered hole with the large end of the taper at the top of the rail. The bond is then compressed, using a hydraulic compressor giving about forty tons. With this bond it is unnecessary to remove the fish-plates, and the actual cost of installation, exclusive of the bond itself, is from 17 cents to 18 cents each.

President Davis—Does that cost include anything except labor?

Mr. Hammett—The cost covers removal of Belgian blocks and replacing them, and installation of bond.

President Davis—Mr. Gerhart, can you give us the cost of installing the tram bond?

Mr. Gerhart—With the 6-in. tram bond, where we have to open only a small space, the cost is just about 16 cents per joint for labor. This cost was possible where the paving was cobble-stones and easily taken up and replaced. In other places it cost from 45 cents to 50 cents per bond, depending on the type of pavement and foundation of same.

President Davis—Is it your practice, Mr. Gerhart, to test your bonds periodically?

Mr. Gerhart—We have a double milli-voltmeter that we use very successfully in testing bonds. We have a contact device that simultaneously connects the voltmeter terminals to 3 ft. of solid rail and 3 ft. in which the joint is included. If the instrument readings are the same, the bond section is equal in carrying capacity to the solid rail and is regarded as first class. If the reading across the joint is three or four times as high as the reading on the 3 ft. of solid rail, then the bonding is regarded as bad, and a new bond is put in.

Mr. Faller—I would ask why it is necessary to take a reading of the rail as well as the joint. I use a plain milli-voltmeter, and if the reading exceeds three or four milli-volts, the bond is replaced. In connection with this test, we arrange to have a car run so that we are sure of getting current across the joint.

Mr. Hammett—Mr. Wendle spoke to me a short time ago, relative to a special arrangement for insuring current when testing with the Conant instrument. What results were obtained with this scheme?

Mr. Wendle—We have been unable to complete our arrangement for making a complete test of our bond system, and I am unable to furnish any definite results. Our difficulty was the delay in getting current reading for test, and the uncertainty of the results when made by comparatively inexperienced men. We proposed to equip a small cart with a resistance which would give approximately 15 amps. or 20 amps. when connected to the trolley circuit and the rail. The idea was to have one man observing with the Conant instrument, and the other man was to make the trolley and rail connections. By this means there should be no delay in getting definite results, since current could be applied at the joint tested and the work could be pushed along without the expense of operating a special car back and forth near the test point, and which would more or less interfere with the regular cars on single track.

### OVERHEAD LINE

300. How can trouble with sleet be overcome?

We use sleet wheels, tying them fast to the harp with wire to keep them from rotating. The wheels give longer life and better results. Water being a lubricant, it does not injure the wire.—Chas. H. Smith.

The Easton Transit Company, of Easton, Pa., avoids the use of sleet cutting trolley wheels and trouble from sleet on the trolley wire by greasing the trolley wire late in the fall, which prevents the water from adhering to the wire. The grease is best applied by driving the construction wagon under the trolley wire and having a man apply a stiff lubricating grease by dipping his gloved hands into the grease and letting the trolley wire slip through his hands as the wagon is driven along. In this way two men can cover about 10 miles of wire per day, and one application will last all winter and obviate all sleet troubles.—M. A. M.

We use the regular ice cutting trolley wheel, although this is not entirely satisfactory. We tried greasing the wire some years ago, but found the grease held dust, etc., and gave poor contact at times when there was no sleet.—P. F. Gerhart.

With the trolley wire use sleet wheel; on the third rail use paste made for the purpose.—R. E. Moore.

301. Are any of the so-called preservative paints of any real value for preserving butts of poles? What method of treatment or setting will prolong the life of pole sufficiently to warrant the extra cost?

At present prices of chestnut poles, we have failed to find any treatment that warranted the expense. Our practice has been to use poles 5 ft. higher than actually required, and after the butt has rotted badly, reset pole. On this plan we expect to get about five years to six years' more service, without changing any wires except span wires. We have tried concreting from 3 ft. below ground line to ground surface, but do not find results except in case of expensive junction poles warrants expense. Our pole life has been longest in clay soil, and in case large poles are set in gravelly ground, we consider it desirable to fill the space around butt thoroughly with clay, thoroughly tamped.—J. Shultz.

Tar is good.—R. E. Moore.

303. Does double galvanized seven-strand suspension cable last enough longer than single galvanized to warrant the added cost?

Our experience is that double galvanized pays.—J. Shultz.

Double galvanized pays.—P. F. Gerhart.

No.—R. E. Moore.

304. Does modern safe construction require a strain insulator in span wire on each side of trolley wire, where wooden poles are used?

Yes.—P. F. Gerhart.

305. What size span wire is regarded best practice?

One-quarter inch, 7-strand, No. 14 double galvanized wire.—P. F. Gerhart.

We use 5/16-in. 7-strand, double galvanized wire.—J. Shultz.

306. Are metal-top trolley hangers or bells of the West End or Keystone type more durable than the cap and cone type?

Yes. There is not as much danger of hanger dropping from span wire and being carried off, as with caps and cones.—J. Shultz.

Yes, the Keystone type hanger is more durable, as the insulation is protected from the weather and bell cannot get loose from cross suspension.—P. F. Gerhart.

307. On single track interurban roads with turnouts, is the use of two separate trolley wires more satisfactory than a single wire of the same total carrying capacity, with turnout wires and overhead switches?

Yes, two wires are more satisfactory. The conductors do not have to bother with the trolley while entering or leaving turnouts. It also saves the extra cost of repairing trolley wires at overhead switches and the wear and tear on overhead switches.—P. F. Gerhart.

308. Is grooved or figure 8 trolley wire more durable than regular round wire of the same gage?

Figure 8 wire offers advantages in smooth running and in furnishing more contact with the usual narrow groove trolley wheel as compared with plain round wire. This surface contact amounts to about one-third more with figure 8 than round. By using U-shaped groove, the surface contact is further increased.—Editor.

Grooved wire best of all.—R. E. Moore.

309. Does the use of grooved or figure 8 trolley wire cause less wear on trolley wheels than round wire?

Yes.—R. E. Moore.

310. What type of ear is the most satisfactory for grooved or figure 8 trolley wire:—Regular soldered; mechanical with paired halves screwed together; or mechanical with interlocking helves which are forced tight by special mechanical devices?

Two halves secured together.

311. What length of mechanical ear gives the best service on grooved or figure 8 wire?

We use a 9-in. ear on straight track and two short ears coupled together for curves. This combination holds 2-0 General Electric grooved wire without bad kinks and provides ample supporting surface.—J. Shultz.

Five inches to 7 ins. on a straight line; 9 ins. to 12 ins. on curves.—R. E. Moore.

312. What are the relative advantages of plain malleable, galvanized malleable and brass for mechanical trolley ears?

Plain malleable ears rust and break; while brass stands exposure indefinitely without serious deterioration.—P. F. Gerhart.

313. In trolley hangers of the West End or Keystone type, are brass tops worth the excess cost over galvanized malleable tops?

We do not think so.—P. F. Gerhart.

No.—R. E. Moore.

314. How frequently should lightning arresters be placed on trolley lines?

We use four to the mile.—Chas. H. Smith.

Five to the mile is a safe number.—P. F. Gerhart.

315. What type of line lightning arrester has given the best service?

The Garton arrester is giving us good results.—P. F. Gerhart.

Our experience has been principally with various types of Westinghouse and General Electric arresters. With the Wurt's non-arcing arrester, we have had difficulty with arcing across and grounding the system; but with the General Electric magnetic blow-out type, we have had no occasion to cut or replace arresters due to breakdown.—J. Shultz.

316. Are splicing ears as satisfactory as splicing sleeves for joints in trolley wire?

We find splicing sleeves give better satisfaction than ears.—Chas. H. Smith.

No.—P. F. Gerhart.

With splicing ears, we had trouble with the wire breaking at the upward bend in ear, due to bend somewhat and weakening of wire because of trolley wheel pounding it. We now use hard drawn copper splicing sleeves exclusively and find no difficulty with wire breaking or pulling out of sleeve. Further, the trolley wheel moves over the sleeve smoothly.—J. Shultz.

317. What is the best form of strain ear or hanger?

We use the General Electric form of strain ear, with very good results.—P. F. Gerhart.

We have experimented some with the Strain Platetype made by the Ohio Brass Company, and so far our results have been satisfactory.—J. S. Shultz.

318. Which is the better practice in anchoring trolley wire at the ends of curves—anchor all four ways at each end or only two ways, both toward the curve, tending to hold all slack in curve?

We anchor our curves at end of curves two ways, to hold the curves.—Chas. H. Smith.

On level track we anchor two ways toward the curve, keeping slack in the curve. On grades, we anchor all four ways, keeping slack in curve.—P. F. Gerhart.

319. How frequently should trolley wire be anchored on straight line?

Our lines are anchored every ten poles, both ways.—Chas. H. Smith.

We anchor every half mile.—P. F. Gerhart.

Every 1000 ft.—R. E. Moore.

320. What is the most accurate method for locating overhead switches?

We use a tower car for construction work on the lines, and test each switch location with the trolley on that car.—P. F. Gerhart.

The variation in length of poles, freedom of movement of trolley base, and other considerations in actual operation of cars, is so wide that cut-and-try is about the only practical method available. In the majority of cases we find it advantageous to cut some off of the pan end of the straight out-going tongue of switch, leaving the side turnout tongue full length and giving the side tongue the advantage in catching the trolley wheel.—J. Shultz.

321. What type of section insulator is most satisfactory as regards durability and ease of renewal of wearing part?

We find the General Electric section insulator entirely satisfactory.—A. F. Rexroth.

We have tried the Macallen, General Electric and H. W. Jones' Philadelphia types, and find that the later type of Philadelphia section insulator meets our requirements and at less cost than any one of the other makes.—J. Shultz.

322. Of what value are systematic insulation tests on the overhead system?

We test frequently at night when all load is off the line, and are able to locate grounds, which, if allowed to go, would result in continuous loss of current.—P. F. Gerhart.

323. What is the relative cost per mile of iron poles as compared with wooden poles? What is relative depreciation on the two kinds?

The cost of placing iron poles is about five times greater than wooden poles. The life of wooden poles is about seven years. We have lately moved iron poles which have been in the ground eleven years, and there was no evidence of deterioration.—P. F. Gerhart.

324. Is it advisable to connect the various sections of trolley

line together through 100 amps. to 150 amps. fuses at section insulators? What difficulties are experienced?

I do not think it advisable. If any of the circuit breakers should open at the station, that section would take current through the fuses at section insulators, which would blow these fuses, rendering them useless.—P. F. Gerhart.

The advantage of inter-connecting various trolley sections is in obtaining the full benefit of all feeder copper. In our tests, we found that with a fuse of size sufficient to materially realize the advantages, when trouble came on any section, it resulted in pulling out the feeder and generator circuit breakers at the station. This condition we considered was due to the relatively small size of our generating plant. In a station with large units and ample power, there should be no more difficulty in inter-connecting trolley wires than with Edison three-wire networks, especially if time limit circuit breakers are used on the generators.—Editor.

325. What is the most economical repair or construction equipment for line repair department on small roads, twenty cars to thirty cars?

I think a line construction car, with an adjustable tower platform, with a place to carry 1 mile of trolley wire, and equipped with ladders, pike poles and tools of all kinds, the most economical kind of construction and repair car.—P. F. Gerhart.

## MANAGEMENT

350. What is the experience relative to carrying United States mail? What is a proper basis of charge to ensure a fair return from this service?

The United States Government have adopted a uniform rate for carrying mail, which is very low; but in our case, we handle two routes by simply carrying the pouch on the front platform, which causes us very little trouble.—P. F. Gerhart.

351. What is a fair annual charge per man to be made the government for carrying mail carriers while on duty?

A contract was made to carry regular and substitute carriers, "while in uniform and on duty," for $250 a year, and special delivery letter messengers for $15 a year each, in a town of 35,000 population. During the year ending June 30, 1903, twenty-one carriers and two special messengers used 26,386 tickets, or an everage of 1147 rides per employee per annum, at a charge of about one cent a ride. Evidently the contract has been abused. Contracts should be limited to transportation of carriers while on duty and with mail pouch. From a business standpoint, it would be difficult to make a contract with the government at profitable figures.—Ernest H. Davis.

352. Is there any reasonably cheap method by which the improper use or issuance of transfers can be checked and surely detected?

We have no system in daily use. Periodically, attempts have been made to check up transfers for three or four consecutive days with some benefit, but the results have not been very satisfactory.—Ernest H. Davis.

353. Should conductors be required to note on their reports at the end of each trip the number of transfers issued and the number of tickets, transfers and passes received? If so, why?

Yes. Conductors should be required to note on their reports at the end of the last trip—the number of transfers issued and collected, and all transfers collected and deposited in envelopes at each trip end. In this way you can compare the number of cash fares on any particular trip with the number of transfers he issued. —P. F. Gerhart.

354. Should conductors be required to deposit at the end of each trip a bag or envelope containing all tickets, transfers and passes received during said trip? If so, how should checking be managed and what system provided for conductors running on lines not passing the receiving station?

This is not our practice. The method specified should be beneficial, especially if some cheap way of daily checking the transfers, etc., deposited per trip, could be enforced.—Ernest H. Davis.

Under our system every car on the line passes our office on each trip. The conductors deposit an envelope at the end of each trip, consecutively numbered, and marked with his car number, time trip ends, route and name. In this envelope he deposits all the transfers and tickets collected on the trip. In this way we are able to see if he accepts dead transfers.—F. B. Musser.

355. What conditions can a company agree to fulfill for a franchise in small cities and boroughs?

Depends upon local conditions. All companies are subject to the usual police regulations and taxes, which may amount to considerable. In addition, paving between the track, and to the ends of the ties, and keeping such parts in repair, should be the limit, except under unusual conditions.—Ernest H. Davis.

A fair consideration on the part of the company for a franchise in a small city or borough would be to keep in repair the part of the street occupied by its tracks and ties; and perhaps a small tax per pole for all poles used.—F. B. Musser.

356. In interurban roads, less than ten miles long, and running through a district not heavily populated, is a half-hourly service too much or too little?

Half-hour service is too often. We give hour service to suburban homes, except on special days, when we increase to half hour. —Chas. H. Smith.

I would say hourly service would be ample, except during the summer months, when half-hourly service would probably pay. This would depend upon the amount of traffic.—F. B. Musser.

357. Where interurban roads connect one or more towns, what provision, if any, has been found advisable to make for carrying packages, trunks, sample cases and traveling men, and similar articles?

We carry packages on regular cars, charging the usual fare.—Chas. H. Smith.

We do not carry packages expect when accompanied by a passenger; but it would be profitable business for a company to do. I see no reason why this traffic cannot be properly handled by running a car, especially equipped for the purpose, every two or three hours.—F. B. Musser.

358. What additional expense, if any, should be incurred in the construction of an interurban road, to secure a private right of way in preference to the use of part of a highway?

As much as possible, private rights of way are preferable, especially if the road in time is likely to be part of a through system. The higher the speed, and the greater the mileage, the cheaper the operating expense, and the greater the receipts per car mile. The proportion of extra construction cost justifiable must be determined by local conditions.—E. H. Davis.

All would depend upon local conditions; but when a road can be kept upon a private right of way, adjacent to a highway, a fair price to pay for such right of way would be from $1,000 to $1,500 per mile of track.—F. B. Musser.

361. Is it customary or advisable to charge extra fare for late running cars? If so, how much and under what conditions?

We charge $2 per car per hour besides the regular fare for cars after midnight.—Chas. H. Smith.

We make it a rule to charge double fare on cars that leave the city for suburban town after 12:30 a. m.—F. B. Musser.

362. Is it better to punish an employee for breach of rules by suspension or fines—or to warn first and then discharge upon being satisfied as to his indifference or incompetency?

We suspend our men for breach of rules—discharged when reported too often.—Chas. H. Smith.

I think it better to warn first; then if no sign of improvement is shown, dismiss.—F. B. Musser.

363. Is the offering of premiums or extra pay conditioned on good service and freedom from accidents, conducive to satisfactory results? What has been your experience in this matter?

Our experience has not been very satisfactory. It is very difficult to keep the record of employees so as to avoid dissatisfaction on the part of those who do not share in the bonus, but who think they are entitled to. Give the employees longest in the service the best runs, and pay a fair rate of wages, is the practice we have adopted.—E. H. Davis.

364. Should conductors and motormen be rated according to length of service or quality of service? How should such rating be rewarded—more pay or better runs?

We promote our men to the best runs.—Chas. H. Smith.

I think men should be rated according to length of service and rewarded by graduated pay and selections of runs.—F. B. Musser.

365. What has been your experience with the Brown or other merit system of rating employees? How do you carry out system in practice?

We have never tried the Brown system.—F. B. Musser.

366. What is the maximum number of hours per day conductors and motormen should be called to work regularly?

Our cars work eighteen hours each day; three men to a car, each making twelve hours, allowing them take their meals at home; changes every week, i. e., their hours are changed.—Chas. H. Smith.

The men on best runs make about ten and one-half hours per day. We prefer to have our men on best runs work not more than eleven hours.—E. H. Davis.

368. Is it advisable to charge an employee with damages caused by gross or ordinary carelessness? If so, to what amount in dollars?

I do not think it advisable to charge an employee for damage, as it is apt to cause him to neglect to report accidents which might lead the company into lawsuits.—F. B. Musser.

Our men are held responsible for all damages caused by their neglect or carelessness.—Chas. H. Smith.

370. To what extent are sprinkling systems used in car houses? Are the interest and maintenance charges on a sprinkler system greater than the saving in insurance?

Sprinkling systems have been applied to car houses with considerable reduction in insurance rates. This is a matter that I think can be profitably looked into.—E. H. Davis.

## A DISCUSSION ON ECONOMIZERS

A discussion on the relative value of economizers took place at the meeting of the New York Railroad Club on Oct. 16. The first paper was read by E. B. Katte, who claimed that in an installation of economizers with a mean output of 7250-kw, the net annual gain by the use of economizers would be $200. The reasoning followed is as follows:

He assumed that 10 per cent of the steam generated would be used in the feed-pumps, air-pumps, etc. Taking the vacuum of the condenser at 28 ins., the equivalent temperature of the condensed water in the hot well is 98 degs. If 10 lbs. of feed-water at 60 degs. is mixed with 100 lbs. of water from the hot well at 98 degs., the resulting temperature is 94.5 degs. The efficiency of the auxiliary feed-water heaters is taken at 95 degs., and since each pound of exhaust steam liberates 965.7 B. T. U., the total feed-water temperature is 186.2 degs. Allowing 3 degs. for radiation, the final temperature is 183.2 degs. The boiler installation is assumed to be 19,200 b.hp, and as 3.25 sq. ft. of economizer surface is allowed for each boiler hp. there will be a total of 62,400 sq. ft. Assuming 20 lbs. of gas per pound of combustible, 30 lbs. of feed-water per b.hp, 3.7 lbs. of coal per b.hp per hour, and an initial temperature of gases in the stack of 548 degs., the economizers will raise the feed-water temperature 84.7 degs.: 33,305 B. T. U. per b.hp the saving from an increase of 84.7 degs. is 1305 hp. If economizers are not used, the additional coal required to heat the feed-water to this temperature, with coal at $2.52 a ton, would be $14,350. Assuming 19 lbs. of water per kw-hour, 30 lbs. of water per b.hp-hour, a 30,000-kw normal output of six generating units, and 27,000 kw the peak of the load, the economizers will save at the peak 1305 b.hp. The cost of economizers is assumed at $15 per tube, or $72,000 for a total of 4800 tubes. The additional floor space required for the economizers is assumed at 4000 sq. ft, which at $5 per sq. ft. is $20,000. The writer then figures out the height of each of four stacks required to give 0.70-in. draft at boiler wall, with and without economizers, and assumes with economizers a 220-ft. stack 10 ft. in diameter, and without economizers a 140-ft. stack 11 ft. in diameter. The addition in cost for each stack would be $5,000, or a total of $20,000. The total cost of the economizer plant is then made up of economizers, $72,000; additional piping, $5,200; additional floor space, $20,000; additional stack capacity, $20,000, making a total of $117,200. The additional amount of boiler if economizers were not used would be 1450 b.hp., which at $18.25 per b.hp equals $26,500. Adding the additional floor space (1040 sq. ft. at $5) would make a total of $31,500. Estimating interest, depreciation, operation, taxes, and insurance at 19 per cent for the economizers, piping and boilers, and 13 per cent for the stacks and floor space, gives the value of coal saved annually by the economizers as $14,150, as compared with $14,350 value of coal saved by them.

Summing up the other advantages, Mr. Katte points out that the economizers secure less wear and tear on the boilers due to higher feed-water temperature; provide a large storage for hot water to take care of a sudden increase of load, and catch some of the impurities in the water at a point where they are not subjected to extreme heat and are consequently easily removed. The disadvantages are "additional complicated apparatus to get out of order."

A. H. Blackburn, in discussing the subject, differed from the first speaker in several points. He estimated first that the steam used in the auxiliaries should not exceed 5 per cent of the total, and that if the heaters are done away with, their piping, the piping thus dispensed with, would equal approximately that required with the economizer. The heat of the less amount of exhaust steam would be, of course, lost, but this would be partially offset by the increased effect attained in the economizer due to the lower temperature at which the feed would enter. He also disagreed with the basis of 3.25 sq. ft. per b.hp required for the economizer and in the amount of space required by the economizer. He presented a number of diagrams showing different arrangements of economizers with the cost of economizer construction worked out on the basis of the same capacity assumed by the first speaker and showed a net saving in fixed charges, due to the use of the economizer rather than additional boilers, varying from $1,320 to $190. He then figured out the saving from the use of an economizer of 4800 tubes with an average station load of from 7250 to 10,000-kw, amounting in the case of 10,000-kw to $5,320. He then discussed a different arrangement of economizers by which much greater economy could be secured, varying from 13 per cent to 33 per cent of the total investment.

William Downs then made a comparison between the Seventy-Fourth Street station of the Manhattan Elevated Railway with the plant of the Clark Thread Mills, at Newark, N. J. In the former the boilers are of 520-hp, arranged with four to the battery, with which is installed a fuel economizer of 512 pipes. In the thread mills the boilers are of 205-hp, and each boiler has an economizer of 240 pipes. The cost and the fixed charges in each case were given.

R. D. Tomlinson then gave some particulars of the economizers of the Manhattan Railway power station, which he reported during August effected a saving in the coal bill of 9.17 per cent, or a return on the initial outlay of 30.5 per cent.

J. E. Moulthrop also gave some particulars of the economizer plant of the Edison Electric Illuminating Company, of Boston.

## OCTOBER MEETING OF NEW ENGLAND STREET RAILWAY CLUB

On Oct. 22 the New England Street Railway Club met at the American House, in Boston, and enjoyed a neatly served luncheon, after which Professor A. H. Sabin, of New York, gave an interesting lecture on "Paint and Preservatives." He took up the subject of varnishes, paints and japans, described the elements which enter into their composition, and showed how each is affected by contact with the atmosphere. Pieces of oxydized linseed oil were passed around among those present, to illustrate the fact that this substance oxydizes when it comes in contact with the atmosphere, becoming entirely different from its original composition and forms. Pieces of rosin were also passed around to give an idea of the form and appearance of this substance as it comes from the trees which produce it. The composition, mixture, thickness, durability and different uses to which paints and preservatives are put were entered into with minute thoroughness. A very interesting discussion on Professor Sabin's lecture followed, during which several questions were asked by members of the club and answered in a lucid and thorough manner by Professor Sabin.

There were about 150 members of the club present, as well as a goodly number of supply men. President H. E. Farrington, of the club, presided.

## ELEVATED ROAD AND SUBWAY ORDINANCE IN ST. LOUIS

An ordinance was introduced in the City Council of St. Louis on Oct. 23, authorizing the construction and operation of an elevated railway and a subway. The proposed route is a subway, extending from Third Avenue and Washington Avenue, and then an elevated structure westward to Taylor Avenue and ultimately extending to Watson Road. The compensation offered to the city is $25,000 a year for the elevated franchise and $5,000 for the subway. Those mentioned in the bill as interested in the project are: H. K. Gilman, of the Western Electric Supply Company; J. E. Longworth, of the American Storage & Moving Company; S. L. Langsdale, a retired capitalist, and H. S. Doyle, a civil engineer.

## ANOTHER NEW RECORD ON THE ZOSSEN LINE

On Friday, Oct. 23, the astounding speed of 140 miles an hour was attained on the Berlin-Zossen experimental railway. Dr. W. H. Siemens, who was on the train, is quoted as saying: "I don't think an attempt at any higher speed is desirable. No system of installing yet invented could insure safety even at the speed we have just traveled. It was like fifty thousand hammers at work to us sitting in the car, which was simply bounding along the joints of the rails. It needs a continuous and perfectly smooth rail to make such a rate of traveling comfortable or possible. Speed really is not any longer the question to be considered; it is safety and practicability."

The cable report of the run says that the car when traveling at the highest pace was scarcely visible as it flashed past the onlookers; that it came suddenly into sight, grew larger and larger as it thundered and clattered along the track, seemingly enveloped in flame, and that electric sparks flew out all around, while the overhead wire was a continuous stream of fire like a huge torch.

## FINANCIAL INTELLIGENCE

Wall Street, Oct. 28, 1903.

### The Money Market

The developments of the week in the money situation have scarcely added any fresh material for comment. In all respects conditions remain about as they were a week ago. Bank reserves, contrary to general expectation, showed a further improvement in the report of last Saturday, cash holdings keeping stationary, loans decreasing and surplus reserve gaining another $800,000. It was the general opinion that the Saturday figures were altogether too favorable and that the actual position of the banks was not as strong as it was made out to be. Nevertheless the present surplus stands at the highest level reached at this particular period since 1898, and quotations for the use of money are taking their cue accordingly. Call loans are easily obtainable on the Stock Exchange at 2½ per cent. Sixty-day money is quoted at 4½, while loans for three months, which carry over the first of the year, are being made freely at 5 per cent. Partly owing to these easy money rates, and partly owing to the heavy European selling in our stock market, sterling exchange has recovered rather sharply. There is still some talk that later in the season we shall get gold from Paris, but there is certainly no warrant for any such expectation so far as the immediate future is concerned. The plain fact is that with our own money market as easy as it is now the movements of international exchange and the fluctuations of the markets abroad have lost their practical interest. What our situation is more particularly concerned with is the question of the interior demands during the next two months. At length the outgo of currency, so long and mysteriously delayed, has set in, in its normal volume. Yesterday alone $1,125,000 was transferred through the Sub-Treasury to New Orleans, St. Louis and Chicago. New York exchange at all these centers has fallen very rapidly during the last ten days, indicating that from now on the demands upon this city will be very heavy. Not all the cash that is now going out is designed for crop-moving purposes; part of it is undoubtedly due to the desire of the interior markets, which have become entangled in unfortunate speculative committments, to fortify themselves against any extraordinary demand. At this writing trouble is reported in St. Louis of a similar nature, and due apparently to similar causes, as have been witnessed already in Baltimore and Pittsburg. In their present unusually strong position, the New York banks can look forward, even to a very heavy outflow of currency, with equanimity. Some more or less substantial decrease in surplus reserve, and some hardening of money rates in consequence are quite to be expected during the next few weeks. But these changes are only temporary. In the judgment of all competent observers the money market is shaping itself for a period of decided ease, which will be prolonged indefinitely.

### The Stock Market

The really important event in this week's financial markets has been the continued activity at rising prices in the bond department. There is a good deal of significance attaching to this circumstance, because it was the cessation of demand for high-grade bonds which first gave warning of the retirement of investment capital from the market twelve months ago. At that time it was explained that investors were no longer willing to put their money into securities paying only 4 per cent and 4½ per cent, while money interest rates were ruling continuously around 6 per cent. Not only did it seem then that the higher money level would last indefinitely, but a great many people feared that with the course of the present autumn a severe stringency would develop in the money market, and that capital, if held in readiness for this contingency, could be used much more profitably than if it were tied up in bonds and stocks. Remembering all this, it is fair to assume that the resumption of investment purchases in the bond market indicates both that the fear of a money stringency has entirely passed, and what is more, that people with ready money believe that the conditions have been so far reversed that from now on the market for securities offers the more tempting field for employing the funds. Past experience teaches that an upward movement, such as we have seen during the last fortnight in high-grade bond issues is often the forerunner of a similar movement in the general stock market. To infer this much amid the present complications of the financial situation would, however, be quite unwarranted. All that may safely be said of the recent movement in bonds is that it has done much to restore confidence, and that it gives the whole Wall Street position an appearance of greater strength than it has enjoyed at any previous time this season. So far as the general stock market is concerned the present disposition is plainly to proceed with the utmost caution. The public is not ready to buy, that is clear enough, and the large financial interests seem content to let things take their course. As a result, the current dealings have resolved themselves into a simple trial of strength between two sets of professional operators, one of which is trying to put prices up, while the other is opposing the advance. The bull party has had the best of it this week, thanks to the fact that the outstanding short interest had extended itself further than it should. There is no doubt that the petty speculators had committed themselves pretty generally to the short side, and it has not been difficult to force their retreat. An advance, however, based almost entirely on short covering and manipulative buying cannot be expected to go very far. Few people really expect a much further improvement at the present time. The conservative idea is that the market is entitled to an interval of rest, and that while the low prices for the season have undoubtedly been seen, no considerable movement in the opposite direction is probable yet awhile. The money problem may be said to have been eliminated in the sense that present bank reserves are sufficient for all ordinary purposes. But there remains the fact that business through the country is slowing down, that many of the railroads are preparing themselves by dint of reducing expenses, for a less prosperous season, and that a general demand must be made very soon upon labor to accept lower wages, the consequences of which appear by no means certain. Until it can be seen just how serious these portents of commercial reaction are likely to be, a waiting attitude on the part of the market seems by all odds the safest.

The local traction stocks have benefited as much, if not more, than any other group by the change for the better in the general situation. Metropolitan Street Railway has had the sharpest rise of any, because the position of the short interest in this stock has been exceptionally weak. The speculative theory for Monday's rapid advance was that it measured the somewhat more promising outlook for a Tammany victory at next Tuesday's election. This view, of course, was the superficial one, and simply reflected the usual disposition in Wall Street circles to accept the explanation lying readiest at hand. Covering purchases were the basis for most of the advance in Brooklyn Rapid Transit. The strength of Manhattan Elevated gave the impression of being more genuine than that of any of the other traction stocks.

### Philadelphia

All the local Philadelphia traction stocks have shown decided strength during the week. There is no especial reason for this in developments affecting their individual properties. But for some time past it has been apparent to watchers of the market that the position of the traction group was unusually strong, and that a quiet accumulation of all these shares was in progress, which must lead to higher prices as soon as the pressure of liquidation had ceased in other quarters. Union Traction has risen on the week from 42⅞ to 44¼. Philadelphia Rapid Transit from 11¾ to 12⅜ and Philadelphia Traction from 93¾ to 94. Philadelphia Company stock sold down from 36¾ to 35⅝, when the suspension of the Federal Bank of Pittsburg was announced last Wednesday. The selling was not heavy, however, and the stock has since recovered to 36⅜. The preferred after selling at 44 declined to 43¼. Other Philadelphia sales for the week include American Railways at 41¾ and 42, Consolidated Traction of New Jersey at 60, and Chicago Union Traction common from 5½ to 7½.

### Chicago

Dealings on the Chicago Stock Exchange have been somewhat more active than they were last week. The principal feature was the advance in Union Traction, which rose from 4½ last Saturday to 7½ yesterday. To all appearances the move originated on the New York Stock Exchange, where the stock for a time was unusually active. There is no reason to believe that the rise was anything more than a piece of market manipulation, but some attempt was made to connect it with the announcement that the traction interests of Chicago are ready to take up the question of a franchise with the city, and that so far as they know there is

nothing to hinder a speedy adjustment of this vexed controversy. The bondholders of the underlying companies of the Union Traction now say they will not aid in bringing about a reorganization unless the negotiations are carried on unequivocally in their interests, which they claim are paramount. It may be noted that sales of North Chicago stock were made as low as 99 this week, which is the low record for the season. Union Traction preferred rose from 30 to 32, Metropolitan common sold at 78, the preferred at 57, City Railway at 170 and South Side Elevated at 92. On the somewhat surprising announcement of a receivership for the company, Lake Street Elevated sold down from 4¾ to 4. This action has given a sudden and severe blow to the plans for reorganizing the company, which were seemingly well on their way to completion.

**Other Traction Securities**

All the Boston traction specialties have moved forward smartly during this week's general recovery. Boston Elevated has been the feature at an advance from 138⅜ to 140½. Massachusetts Electric common also rose sharply from 19 to 20½ and the preferred, after selling as low as 77¼, rallied to 78. West End common improved a point from 90 to 91, but later lost its gain. The preferred sold at 109. In Baltimore the strongest issue on the list this week has been the United Railways general mortgage 4s, which are up a point from 90 to 91. The junior securities of the company have been rather inclined to hold back. The stock has changed hands between 8¾ and 9 and the income bonds between 58 and 58⅝. Other Baltimore sales include City & Suburban of Washington 5s at 90, Anacostia & Potomac 5s at 89⅞ and 89¾, Knoxville Traction 5s at 101, and Baltimore Traction conversion 4s at 91. There has been no particular feature in the traction division on the New York Curb. Single transactions have been reported in St. Louis Transit at 16, Interborough Rapid Transit at 83, New Orleans preferred at 28½, Washington Traction preferred at 29 and Brooklyn Rapid Transit 4s at 77½.

Detroit United was practically the only active issue at Cincinnati last week. About 700 shares sold in small lots, opening the week at 61, striking a low mark at 58½ and closing the week at 61½. There is a strong demand for this stock whenever it goes below 60, as it has been doing at intervals during the past few weeks. Cincinnati Street Railway was firm at 128. One lot of Toledo Railways & Light sold at 18½ and another at 20—remarkably low figures compared with quotations of a few months ago. Cincinnati, Dayton & Toledo 5s were firm at 82 and three lots sold. It is common talk that C. W. Wetmore, president of the North American Company, of Philadelphia, was here recently for the purpose of disposing of 4000 shares of Cincinnati, Newport & Covington Light & Traction preferred, and that it was offered to large local stockholders of the company. The local people are said to have expressed a willingness to buy, but at a considerably lower price than that at present asked on the local market—84½. The deal has not yet been effected.

Cleveland Electric again was the feature in Cleveland, about 500 shares selling at 65 to 67. It appears that the stock is being taken up by large holders to protect its value. Northern Ohio Traction & Light was in good demand at 15 to 15½, but only 185 shares were dislodged at these prices. A small lot of Northern Texas Traction sold at 30¼.

**Security Quotations.**

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

| | Closing Bid | |
|---|---|---|
| | Oct. 20 | Oct. 27 |
| American Railways | 41¾ | 41¾ |
| Aurora, Elgin & Chicago | — | 12 |
| Boston Elevated | 137 | 140 |
| Brooklyn Rapid Transit | 33½ | 34⅞ |
| Chicago City | 170 | 169 |
| Chicago Union Traction (common) | 3½ | 7¼ |
| Chicago Union Traction (preferred) | 25 | 32 |
| Cleveland Electric | 65 | 64 |
| Consolidated Traction of New Jersey | 60 | 60 |
| Consolidated Traction of New Jersey 5s | 103¾ | 104½ |
| Detroit United | 58 | 60¼ |
| Elgin, Aurora & Southern | a45 | a56 |
| Lake Shore Electric | 5¾ | — |
| Lake Street Elevated | 4 | 3½ |
| Manhattan Railway | 133¼ | 134¾ |
| Massachusetts Electric Cos. (common) | 18¾ | 19 |
| Massachusetts Electric Cos. (preferred) | 77 | 77½ |
| Metropolitan Elevated, Chicago (common) | 18 | 17 |
| Metropolitan Elevated, Chicago (preferred) | 55 | 55 |
| Metropolitan Street | 105½ | 110 |
| New Orleans Railways (common) | 7½ | 7¼ |
| New Orleans Railways (preferred) | 28 | a28½ |
| North American | 73¾ | 75 |
| Northern Ohio Traction & Light | 15⅛ | 15 |
| Philadelphia Rapid Transit | 11¾ | 12⅛ |
| Philadelphia Traction | 93⅝ | 94 |
| St. Louis Transit (common) | 14½ | 14 |
| South Side Elevated (Chicago) | 90¼ | 92 |
| Syracuse Rapid Transit | — | — |
| Syracuse Rapid Transit (preferred) | 73¾ | — |
| Third Avenue | 103 | 105 |
| Toledo Railway & Light | 17½ | 18¼ |
| Twin City, Minneapolis (common) | 83 | 86 |
| Union Traction (Philadelphia) | 42⅞ | 44¼ |
| United Railways, St. Louis (preferred) | 61 | 61 |

a Asked.

**Iron and Steel**

The movement to restrict the output of pig iron continues to be pushed with much vigor, particularly in the central West, where it is now said a further reduction to about 40 per cent of the former product is being considered. Less is being done in the East in the way of forced curtailment, but a considerable number of furnaces in this section are reported to have shut down. The only drawback upon the efforts to reduce the output of pig iron has come through the disruption of the old Southern selling pool and the consequent lowering of prices in that market. Some of the principal Southern companies have decided that it is better under the new conditions to run at full capacity, proposing thereby to lower the average cost of production. A little anxiety is felt lest the railroads will curtail their orders for new steel rails unless some concession is made in prices. As for the other branches of the iron industry, a satisfactory business is reported in structural material, but against this some depression is noted in the plate and bar trades. Attempts are being made to stimulate the export trade as the best means for keeping down the surplus product at home, but according to the best authorities the relative position of home and foreign prices is not favorable to this endeavor. Quotations are as follows: Bessemer pig iron, $15.85; Bessemer steel, $27, and steel rails, $28.

**Metals**

Quotations for the leading metals are as follows: Lake copper, 13¾ to 14 cents; tin, 26¼ cents; lead, 4½ cents, and spelter, 6⅛ cents.

## NEW COMPANY TO TAKE OVER CHICAGO UNION TRACTION

The rumor of a new company in Chicago to take over the Union Traction Company, of that city, was confirmed on Wednesday, Oct. 28, by R. Govin, receiver of the Union Company. The report is that a new company, headed by Alfred Skitt, of New York, will be formed next week to lease or act as trustee of the Chicago Union Traction and underlying companies, and will make franchise agreement with the city regarding the operation of the street railways on the north and west sides. The new company is said to be backed by ample capital from Gould and Rockefeller interests. The plan for reorganization as at present reported embraces the following points:

1. The new company will, by arrangement, take over whatever rights Union Traction and underlying companies have.
2. It will obtain from the city a twenty-year franchise for streets now covered by Union Traction system.
3. Provision will be made by which the city can terminate the operation of the franchise at any time by paying the leasing company the equivalent of the sum actually invested.
4. The new company will, by means of capital backing it, at once install modern equipment.
5. The new company will greatly simplify the traction situation by acting as intermediary between the city and the old companies, and could go before the Council and ask for a franchise on terms which the city says it is determined to exact.

There would be no question of waiving the ninety-nine-year claims, because there would be none to waive. The company would have no franchise rights of any kind more than those given it in any ordinance the Council might pass. By virtue of this ordinance it would have authority to operate.

## STRIKES AT WACO AND SAN ANTONIO, TEX.

The strike of the employees of the Citizens Street Railway Company, of Waco, Tex., has been broken. The full quota of cars is now in regular operation, but patronage is light, because of the threats of intimidation made by the strikers and the open violence that has been resorted to. The City Council actually lent the employees aid. In the face of public opinion, soon after the declaration of the strike, the Council passed an ordinance requiring that motormen have thirty days' experience in operating cars. The courts thwarted the action of the Council, however, by granting a temporary injunction, restraining the ordinance from being made operative. Judge Surrat, before whom the application for an injunction was brought by the company, said that when a law was not reasonable, it was unconstitutional.

The strike at San Antonio against the San Antonio Traction Company has also been broken. The company filled the places of the strikers at once, and immediately resumed service. There has been considerable disorder, but the high-handed practices resorted to at Waco have not been attempted.

## SENATOR FORAKER ON THE ROGERS LAW

Senator Foraker, of Ohio, has sent to the chairman of the Ohio Republican State executive committee a long letter of explanation of the Rogers law. In transmitting his letter, the Senator says he was urged to action by the many misrepresentations of the act by Tom L. Johnson and others who have attacked the amendment. The condition of affairs in Cincinnati when the act was passed was similar to that in many other cities to-day. The operating street railway companies held some twenty franchises granted under different administrations, and these grants all expired at different times. Some one of them expired almost every year, yet the maximum of expiration of the last grant was twenty-one years. All the companies to which these various franchises were made had since that time been brought under one management, and as the conversion of the lines was being urged by the city and the company was fully awake to the advisability of the change, the passage of the ordinance was absolutely necessary in order to raise the funds with which to make the change.

It was, therefore, provided by the Rogers law that the municipal authorities should have the right to extend all the franchises by so much time as might be necessary for each one to make them all expire fifty years after the date of the passage of the law. The average the different franchises, taken altogether, had to run at the time the law was passed was sixteen years. Consequently, the Rogers law extended the franchises not for fifty years, but only for thirty-four years. Fares ranging from 4¼ cents to 8 cents per ride were charged, but under the new act provision was made for a uniform fare of 5 cents, and a transfer system was required to be established.

Before the passage of the Rogers law the company paid taxes on all its property according to a tax valuation fixed by appraisement just the same as all other property is appraised, and in addition, on some of the routes the company paid to the city 2½ per cent on its gross earnings and also a car license fee. Under the Rogers law the company was required to pay, not only on all its property the same as anybody else, but also to pay 5 per cent on its gross earnings to the city, and also the same car license fee, in lieu of which latter tax, under a law passed recently, the street railroad now pays to the city an additional 1 per cent on its gross earnings, making a tax of 6 per cent altogether on its gross earnings. It also pays to the State what is called an excise tax of 1 per cent on its gross earnings, making a total, in addition to the regular tax on its property, of 7 per cent on its gross earnings.

While the Rogers law provided all these requiremnts and imposed all these burdens, it also further provides that at the expiration of twenty years from the time when the Rogers law was passed the city shall have the power again to revise all the terms and conditions of the grant, including the rate of fare to be charged, so as to make it less if the city officials then in office shall think it right and proper to do so, and this revision by the city at that time is to take effect and go into operation, and continue in operation, whether the company is satisfied or not, unless the company shall see fit to sue in a court of equity, and it shall be held by such court, upon full hearing upon both sides, that the changes made by the city in the terms and conditions of the grant are unreasonable.

This revision at the end of twenty years has all the effect of a new grant, except only that the company is saved from public bidding for the right to remain in the streets against would-be competitors, and this revision, which the city is thus authorized to make, and which is the equivalent of a new grant, since the city is authorized to make any changes it sees fit to make, is to come only four years later than the expiration of the average time of sixteen years that the grants already had to run when the law was enacted.

It is further provided in the Rogers law that every fifteen years after the first revision there shall be another revision of the same character, and with the same consequences.

The street railway company is obligated to pave and keep paved and in condition the streets between its tracks and for a foot and a half on each side beyond their outside rails.

## ELECTRICAL COURSE FOR BROOKLYN RAILWAY MEN

As stated in the Street Railway Journal of July 11, the Brooklyn Rapid Transit Company has opened an evening school at the Jamaica Avenue headquarters for the use of its employees. The most interesting and important feature of this school will no doubt be the course in practical electrical engineering which has been established.

The course embodies a training in the principles, handling and testing of electrical apparatus especially applicable to street railway work. The instruction is given in the form of experimental lectures, recitations and laboratory work, the time being divided into two nights of laboratory work to one night of recitations. All of the electrical measurements are made with controller storage batteries on the 550-volt circuit.

Instruction began Oct. 5, and so far fifty-two students have registered. To handle this number of men at one time in the laboratory it has been necessary to select four assistants from the classmen. The laboratory is large, well lighted and can accommodate one hundred men. It has been equipped from stock apparatus of the Brooklyn Rapid Transit Company.

The first half of the year will be spent considering instruments, motors, circuits, etc. For the latter part of the year an elaborate series of train tests have been prepared, during which speed time curves will be taken and the results calculated. The course is being supplemented by separate instruction in practical mathematics. It is open only to Brooklyn Rapid Transit men, and the tuition is $6.00 for the complete course of forty-eight evenings.

This course is under the direction of Sydney W. Ashe, B. S. Mr. Ashe is a graduate of the Cooper Union Institute, New York, is instructor in physics and electrical engineering at the Brooklyn Polytechnic Institute, and has had considerable practical experience in engineering work, making him well fitted for the important work which he has undertaken.

## LAKE STREET ELEVATED OF CHICAGO IN RECEIVER'S HANDS

The Lake Street Elevated Railroad Company, of Chicago, was placed in the hands of the Equitable Trust Company, of Chicago, as a receiver, on Oct. 24. The receiver was appointed by Judge Tuthill, of the Circuit Court, upon application by James Bolton and Daniel F. Crilly, both large stockholders. The bill applying for the receivership was rather sensational in its nature, charging gross mismanagement of the road and an attempt to wreck the property on the part of those in charge of the management, so that the minority stock could be purchased at a low figure.

Among the specific charges made in the bill applying for the receivership were that Charles T. Yerkes and associates still have a controlling interest in the stock of the Lake Street Elevated and are attempting to wreck the property. President Knight, of the Lake Street Elevated, was named as the personal representative of Mr. Yerkes. Mr. Knight claims, however, that Mr. Yerkes does not own any stock in the company. Blair & Company, of New York, are large bondholders, and it is believed that the receivership will be opposed by them and by President Clarence A. Knight. T. A. Walton, representing the Equitable Trust Company, took possession of the property of the road, and established offices at once in the rooms of the Equitable Trust Company, at 152 Monroe Street.

It is claimed that the application for a receiver was made to secure to the Lake Street Elevated stockholders certain rights in connection with the north side of the Union Loop, which was originally built by the Lake Street Elevated Railroad and turned over to the Union Loop by agreements made in 1894 and 1896. By these agreements it is claimed that the Lake Street company obtained no better terms for the use of the Union Loop than the other companies using it, although it owned a part of the loop mileage.

## REMARKABLE INCREASE IN INTERURBAN EARNINGS

Among the remarkable financial statements issued recently is that of the Chicago & Milwaukee Electric Railroad Company. This road has been in operation several years, under approximately the same conditions as to mileage and territory. The earnings for the first nine months of 1903 are 32 per cent higher than for the same period of 1902. For the month of September the gross earnings showed an increase of 90 per cent over September, 1902. During last September, however, it should be said, by way of explanation, that a 6 mile branch to Libertyville was in operation. This company operates from Evanston to Waukegan, serving the suburban towns along the shore north of Chicago. It is paralleled by the excellent steam road suburban service of the Chicago & Northwestern Railway. The earnings are as follows:

| | 1903 | 1902 |
|---|---|---|
| Gross earnings | $40,921 | $19,347 |
| Expenses | 9,820 | 6,988 |
| Net earnings | 31,101 | 12,350 |
| From Jan. 1 to Sept. 30, 1903— | | |
| Gross earnings | 194,636 | 137,407 |
| Expenses | 66,935 | 59,847 |
| Net earnings | 127,700 | 87,559 |

## NOTTINGHAM MUNICIPAL TRAMWAY

In a report to the Department of Commerce and Labor, United States Consul Mahin, at Nottingham, England, says the electric railway service of that city is an illustration of what is possible, though not always accomplished, in municipal ownership.

Electric cars have now been in use in Nottingham about two years. Previously, horse cars and omnibuses were in use. The present system is well constructed, and covers practically the entire city. The cars are large double-deckers, kept scrupulously clean and run at intervals of three to six minutes at the rate of 8 miles to 10 miles an hour. The fares, varying with the distances ridden, are about 2 cents a mile. The length of route is now 15½ miles, with 30 miles of track. During the year just past the cars carried nearly 25,000,000 passengers—a traffic equal to the transportation of the whole population (250,000) twice a week throughout the year.

The receipts for the year were $560,733, of which the operating expenses were slightly over 50 per cent. The gross profit was 11.41 per cent of the capital employed. After deducting loan charges, the net profit amounted to $150,141, from which the rates received $87,597 and the reserve fund the balance. During the two years the railway has contributed $145,995 to the city rates and has established a reserve fund of $98,089.

Power for operating the system is provided by the city's electric supply plant.

## STREET RAILWAY PATENTS

[This department is conducted by W. A. Rosenbaum, patent attorney, Room No. 1203-7 Nassau-Beekman Building, New York.]

UNITED STATES PATENTS ISSUED OCT. 20, 1903

741,613. Third Rail Conductor; Frank T. Bailey and Charles S. Michey, Baltimore, Md. App. filed March 4, 1903. A conductor apparatus consisting of an insulated conductor way and insulating material held by tie-clamps which are adapted to be fastened to the ties of a railway.

741,644. Mechanism for Operating Railway Switches; George W. Fernside, Hartford, Conn. App. filed Oct. 28, 1901. Means for throwing the switch from the car platform regardless of whether the car is going forward or backward.

741,662. Electric Heater for Cars; Edwin M. Herr, Pittsburg, Pa. App. filed Feb. 14, 1901. The heating coil constitutes the controlling resistance of an electric car, and is movable from its position inside the car to another outside, depending upon whether or not it is desired to heat the car.

741,719. Electric Railway; Frederick W. Rochler, New York, N. Y. App. filed May 6, 1903. Relates to means for regulating the friction between the contact-shoe and third rail and means for securing the shoe to its supporting arm.

741,744. Automatic Switch; Melvin D. Van Why, East Stroudsburg, Pa. App. filed April 1, 1903. A device for locking and unlocking the switch throwing mechanism, from a car or train.

741,785. Non-Arcing Clamp; Henry L. Fritz, Jersey City, N. J. App. filed March 6, 1903. Consists of an inclined clamp for trolley wires forming a hood to prevent ice from gathering on the wire.

741,786. Trolley stand; John J. Goodrich, Methuen, and James H. McPherson, Haverhill, Mass. App. filed Nov. 20, 1902. An arrangement of springs whereby the upward pressure on the pole is maintained uniform regardless of the angular position of the pole.

741,917. Car Truck; Frederick W. Luedke, Philadelphia, Pa. App. filed June 25, 1903. A car truck having a non-revolvable axle with hubs thereon, wheels rotatable on the hubs and means for holding the hubs and wheels out of transverse alinement with each other.

741,955. Electric Railway Signal; Howard Brooks, Wheaton, Ill. App. filed Nov. 14, 1902. Details.

741,971. Inclosing Casing for the Driving Gear or Car Dynamos; Patrick Kennedy, New York, N. Y. App. filed April 27, 1903. Details.

## PERSONAL MENTION

MR. C. O. ANDERSON has been appointed superintendent of the line department of the Los Angeles Railway Company, of Los Angeles, Cal.

MR. E. M. WALKER, of Boston, has accepted the position of general manager of the Bristol Gas & Electric Company and the Bristol Belt Line Railway Company, of Bristol, Tenn.

MR. F. A. BOUTELLE, formerly superintendent of the Hudson Valley Railway, of Glens Falls, N. Y., has been appointed superintendent of transportation of the Columbus, Buckeye Lake & Newark Traction Company, with headquarters at Newark, Ohio.

MR. WILLIAM AKINS, formerly with the Western Ohio Railway, has succeeded Mr. J. M. Merrill as general manager of the Ohio Central Traction Company. Mr. Akins was general manager of the Tuscarawas Traction Company, of New Philadelphia, Ohio, up to the time that property was sold to Tucker, Anthony & Company, of Boston.

DR. HANS GOLDSCHMIDT, who is a large maufacturer in Essen, Germany, and who is also inventor of the "Thermit"process of rail welding by means of powdered aluminium, is to visit this country during November. Dr. Goldschmidt has accepted an invitation, while in this country, to deliver a lecture on the "Thermit" process at Columbia University.

MR. HENRY C. FOGLE, a prominent business man of Canton, Ohio, died at Chicago of a stroke of paralysis, a few days ago. Mr. Fogle founded the street railway system in Canton and between Canton and Massillon. From 1896 up to two years ago, when the property was sold to Tucker, Anthony & Company, of Boston, Mr. Fogel was general manager, purchasing agent and superintendent of the Canton-Massillon Electric Railway Company.

THE MEMBERS of the Royal Commission on London Traffic sailed for home last week, after a six weeks' visit on this side. They inspected the electric railway systems of New York, Boston, Philadelphia and Chicago. The party included Lord Ribblesdale, Sir John Poynder Dickson-Poynder, Sir George Christopher Trent Bartley, Mr. George Stegman Gibb (general manager of the Northwestern Railway, whose suburban traffic is to be handled by electricity), and Mr. Lynden Macassey, secretary. An exhaustive report will be drawn up by them, which will be read in due course in the House of Commons.

PROFESSOR R. H. THURSTON, whose death was reported at Ithaca, N. Y., last week, was for many years one of the most prominent writers and lecturers on steam engineering in this country, and deservedly ranked high as an instructor in that branch. Dr. Thurston was director of Sibley College, Cornell University, and was sixty-four years old on the day of his death. While awaiting the arrival of Mr. Andrew D. White, Mr. Dean Huffcut, Professor Hewitt and other colleagues who were to celebrate his anniversary by taking dinner with him, he sank into a stupor and passed away before medical aid could be summoned. The deceased was a native of Providence, and received his education at Brown University. He served in the engineering corps of the navy during the Civil War, and at its close was assigned to the faculty of the Annapolis Naval Academy. In 1871 he became professor of engineering at Stevens Institute of Technology, and in 1885 went to Cornell to take the directorship of Sibley College, then being organized. He was the author of many engineering treatises and was a member of the leading scientific societies of Europe and America. Dr. Thurston early recognized the possibilities of the steam turbine, and gave this subject special attention long before it attracted the general interest it commands to-day. One of his most valuable contributions was a paper on this subject, read before the American Society of Mechanical Engineers at the New York meeting in December, 1900.