

Electric Railway Journal

Consolidation of Street Railway Journal and Electric Railway Review

HARRY L. BROWN, Western Editor HENRY W. BLAKE and HAROLD V. BOZELL, Editors HENRY H. NORRIS, Managing Editor
DONALD F. HINE, Editorial Representative N. A. BOWERS, Pacific Coast Editor H. S. KNOWLTON, New England Editor C. W. SQUIER, Associate Editor C. W. STOCKS, Associate Editor
A. D. KNOX, Editorial Representative G. J. MACMURRAY, News Editor GEORGE BUSHFIELD, Editorial Representative

Volume 57

New York, Saturday, April 16, 1921

Number 16

A Franchise Is Not Always a Contract

THE decision just rendered by the United States Supreme Court in the case of the San Antonio Public Service Company should help materially to clarify the situation in regard to the power of cities in Texas over the rates of fare of the local railway companies. The full printed decision of the court is not available at the present time, but digests received from Washington indicate some of the facts. Briefly, it might be said that the court affirmed a decree of the Texas District Court enjoining the city of San Antonio from requiring the company to carry passengers for 5 cents, with universal transfers, as called for in the company's franchise.

In its decision the court analyzes the franchise of the company and the conditions under which it was granted and whether the two parties thereto had the independent status which would bind each, and it finds that this is not the case with the city, because of a provision existing in the State constitution at the time that the franchise was granted prohibiting any city from making "any irrevocable or uncontrollable grants of special privileges, etc." In these circumstances the court, as in previous cases of a similar kind which have come before it, declared the company was not bound by the rates specified in the franchise but could charge a reasonable rate.

It is difficult to determine the effect which the decision will have on rate cases elsewhere, but at least it seems to sustain the idea of the dependency of the city on the State for power to make franchise contracts with public utility companies and also the right of the company to charge a reasonable rate when there is no franchise or when the city does not have the power to enter into an agreement specifying an irrevocable or uncontrollable rate.

How Can the Efficiency of the Shop Personnel Be Increased?

ALL admit that the efficiency of the various working forces required in electric railway maintenance deteriorated to a considerable extent during the war period when labor was at a premium. Those in charge of the work had to take whatever labor they could get and be satisfied with it. If this waste in efficiency could be computed in dollars and cents it would astound most of us, and the bringing back of this efficiency is a result which is needed today perhaps more than anything else.

The efficiency of any body of men depends to a large extent on the manner in which it is directed. A capable and efficient foreman can do much toward increasing the spirit of co-operation and toward toning up the entire working organization. The selection of foremen should not be left to chance, but the most efficient workmen should be trained to fill vacancies whenever they occur. Of course the most capable workmen do not always make the best foremen, but if

a promising employee has a chance actually to direct the work in the capacity of acting foreman when it becomes necessary for the regular foreman to be absent, a general idea can be formed as to the man's ability to develop team work and to inspire methods that will produce results.

Another thing that is sure to produce efficiency in an organization is the use of a piecework system. A piecework basis is not easy to establish in electric railway work, but some of the large roads have introduced this in a number of their departments with marked success. A piecework basis is also much easier to establish on a large railway property than on a small one, as there are more operations which are similar occurring continually, and unless there is enough of the same or similar work being done the establishment of a piecework basis is almost impossible. Thus, take the various steps in the dismantling and rewinding of an armature. The work and time necessary for stripping similar armatures is almost identical, and this could be readily placed on a piecework basis, but unless there is enough of this work to keep a man almost continually employed the efficiency resulting from familiarity in doing the same class of work is lost. This is an opportune time for railways to analyze their needs and introduce practices that will produce results.

The American Engineering Standards Committee a Going Concern

THE forthcoming annual report of the American Engineering Standards Committee contains evidence that the organization is functioning, and that it has secured the allegiance of enough national engineering bodies to give ponderable weight to its stamp of approval.

It will be worth a great deal to the country's industries, in the way of conservation of material resources and mental energy, thus to have a clearing house for engineering standards and a co-ordinating force tending to rationalize these standards. Various branches of industry have been struggling, largely alone, to save themselves money and effort through standardization. This is illustrated by the standardization work of the American Electric Railway Engineering Association, which centralizes in its committee on standards. A large part of the work of the several committees of this association has to do with standardization. In spots this overlaps and hence partially duplicates the similar work of other associations. Consequently when the plan and scope of the A. E. S. C. were put before the executive committee of the Engineering Association, a request for enrollment was promptly forwarded to the parent American Association, which in due course enrolled. It now heads the list of members (in alphabetical order), which typographical position it is hoped may be symbolic of a leading part in the Standards Committee activities.

When one considers the vast sums which have been

spent in joint committee meetings representing interests which have desired to get together on standardization matters, he cannot but realize that the American Engineering Standards Committee has a real field for its operations. A careful reading of the abstract of the annual report, which is given elsewhere in this issue, will convince even the skeptical that constructive work in this field is actually being done. For its financial support the committee will have to appeal outside of its membership dues, but funds will be forthcoming as soon as the results shall have shown themselves to be immediately or potentially profitable to industry. It is now up to the electric railways and other supporters of the national movement to make use of the results already achieved and to use the committee's facilities to expedite their own standardization plans.

Don't Be Too Mechanical in Rating Men

ON ELECTRIC railway properties, as with all corporations employing large numbers of men, the tendency is toward careful organization of the personnel. This is right and necessary if the best results are to be secured from the large expenditure for labor and administrative talent. On the other hand, system is not good if it is permitted to take the place of that personal contact and human interest which is the basis of first-class organization.

The danger of over-systematization is not only that the relations of men and supervisory officers may become mechanical and hence inefficient, but also that the real qualities of men may not be appreciated. An example of this, which in fact provoked the present comment, came to light recently. It developed that a certain electric railway department head who has now achieved an unusually good reputation for getting things done and done well was formerly employed in an organization in which the men were carefully "card catalogued." This man's record card bore the significant legend, "N. G., Do not rehire." The trouble in this case was simply "too much system." Superficial qualities here apparently had been used as a basis of rating, with the resulting anomalous and false estimate of the real worth of the man, or the wrong label may even have been attached to his record.

The incident just mentioned is quoted to indicate a danger in organization and not to ridicule systems of classification, including those employing the ubiquitous and highly useful card catalog. Not at all! Only the card catalog and the clerical staff behind it cannot be expected to serve as more than mere recorders. They cannot put in the personal touch.

Surface Trunk Lines Make for Speedier Service

IN MOST cities practice has decreed that all routes from the various outlying corners of the city converge at some downtown central point. In order to get the cars through the center of the city with a minimum of delay to the traveling public, through routes are operated connecting the various parts of the city where investigation has proved that there is a large traffic interchange. This plan has developed routes of considerable length. It brings up the question, is there a limit today to the length of urban route that can be operated so as to give adequate service?

Lately much has been said about distributing centers for l.c.l. freight, and this suggests that the idea embodied in the l.c.l. center can be applied with advantage to many urban passenger transportation systems, if passengers will pardon the comparison of themselves, for this purpose only, to l.c.l. package freight. This plan has been recommended in several places in the past for handling what might be termed "the neck of the bottle" traffic.

In Cleveland surface trunk line operation has only recently been suggested as a means of improving the transportation facilities to the northeast factory district. At present all routes serving this section vary in length from 9.6 to 10.6 miles and loop at the public square for the return trip. The routes are becoming so long, however, due to periodic extensions, that it is becoming more and more difficult to maintain the proper scheduled speed. The plan calls for trunk lines operating multiple-unit trains to specific distributing points in the heart of the district served. Such operation makes short routes from the distributing points to the outlying residential districts—routes that can be operated with lighter and smaller capacity equipment on headways determinable only by the traffic originating on each outlying route. Trunk line service can then operate on two bases, either with an all-day fixed headway, with the length of trains varying with the traffic demands, or with service of two or three-car multiple-unit trains running on shorter headway during the rush hours.

Motor Trucking Not Yet a Science

THE discussion at the March meeting of the New York Electric Railway Association covering electric freight and express indicates pretty clearly that all is not well when motor trucking is done at less than cost. To get at the facts of the situation one need only mingle a bit with the motor truckers themselves and listen to stories which are related, from cheerlessness only, to the pious hope that steam railroads will continue to seek higher rates for slower service and thus indirectly give the trucks a chance.

In the congestion and embargo days of the war and shortly thereafter motor trucking went through all the mushroomlike growths made so familiar by the passenger jitney. Any man with \$500 or so had a dozen salesmen on his doorstep ready to sell him a truck on a year or two years' time and then to guarantee him business to boot. For a time all went well. There was no trouble in getting full loads going and coming and at any price a desperate shipper would pay. Yet long before the present depression, the less experienced motor truckers began to fall by the wayside—this period coming when it was necessary to put the truck through its first overhaul. Then the operator discovered that such a thing as "repairs"—not to name the remoter "depreciation" and "interest on investment"—had to be figured into costs.

Today, with 300,000 idle freight cars and no hurry calls for materials, the best of motor truckers are at their wits' ends. Traffic at their rates has dropped to one-fourth or less of the old days, but the overhead goes on remorselessly.

Where there is a chance for the truck to serve better than the rail the motor trucker by profession, *i.e.*, the common carrier, finds the ground cut from under him

by the so-called occupational truckman. For example, a fruit dealer running empty one way will call up shippers and offer to take loads into town for any old price. On his return trip, carrying only his own wares to capacity, he is not interested in soliciting business. There is such an amazing amount of this sort of thing, besides the competition of one-truck operators who are "eating up their trucks," that the only way out is recognized to be the placing of the motor truck on the same basis of regulation as a railway. This is not the place to argue why, but it is safe to say that this desired regulation of motor trucks is one of the logical steps toward placing all freight carriage in a district under one transportation head that can and will find the way to secure the constructive co-ordination instead of the destructive competition of essential transportation media.

He Who Writes Specifications Should Know Materials

IF SPECIFICATIONS for electric railway supplies are to be prepared intelligently the framers thereof must be somewhat expert regarding the materials which they specify. This is particularly true regarding wood, steel, copper, zinc, tin and alloys, insulating material, wood and paint. Even where standard specifications are utilized it is desirable that they be used with full knowledge of the characteristics of the materials involved. Unfortunately for manufacturers and purchasers, the ideal in this direction is not yet reached, and impossible, impracticable or uneconomical designs, dimensions and strengths are frequently demanded by those who write the specifications.

To ameliorate this condition the editors of this paper more than a year ago arranged with Norman Litchfield to prepare a series of articles on electric railway materials, particularly those mentioned above. His experience, both as a railway engineer and an engineer with a car building company, combined with a thorough technical training, gave him an excellent background for this task. His first article appeared in the mechanical and engineering number for Feb. 21, 1920, and the concluding article, on insulating materials, appears this week. Taken as a whole this series forms a notable contribution to the subject covered, because the author has not only gathered together the recommendations of the several engineering associations as to the characteristics of materials and the fundamental data relating thereto, but has blended his own observations and deductions therewith.

Now that the series is complete, the articles should be reviewed by electric railway engineers; they should be recommended for study to ambitious young men in the technical departments; they should be consulted when new specifications are being drawn up or old ones revised; and they should be reread by purchasing

agents who are responsible to a considerable degree for the qualities of supplies which are purchased. There is danger that good reference text like this may be examined approvingly but filed away and forgotten. It does not deserve such a fate, nor is it economical for the railways to allow such a fate to overtake it.

What if There Is No Exhibit This Year?

BY THE TIME this line meets the reader's eye, a decision will presumably have been reached and announced by the executive committee of the American Electric Railway Association as to the holding of an exhibit in connection with the annual fall convention. If the decision is favorable, there is no doubt that the supply men will pitch in with a will to make it the best exhibit in the series. If, however, it has been deemed expedient to postpone the exhibit for a year, as many members believe should be done, there will arise a new query, namely, as to the best location for the meeting. A few reflections based on the no-exhibit contingency cannot be considered academic in view of the circumstances.

Going to Atlantic City for conventions has become a habit with many organizations, including the American Electric Railway Association, partly if not largely because the "Million Dollar" Pier there furnishes a unique and well-arranged structure for a combined meeting and exhibit. There are numerous cities which are supplied with excellent hotels, meeting places and exhibit halls, but there is none which can meet the need for a combination of the three to equal Atlantic City.

When an electric railway convention without an exhibit is to be held the pre-eminence of Atlantic City as a meeting place disappears. There are many reasons for going elsewhere, not the least of which is minimizing of traveling expense. There is some point on the map for which the sum total of this item should be a minimum. The mathematically inclined could figure this out, given the necessary data. Everything else being equal, a convention site somewhere near the "center of gravity" would be highly desirable. Then, again, if the meeting place "happened" to be one where a well-arranged railway was the joy of the local populace, an

opportunity would be appreciated for getting some good points on construction, operation and maintenance, as was pointed out in an editorial last week. In other words, the system would be an exhibit.

A byproduct of a meeting in an electric railway center would be the impression created therein by the gathering of representative transportation men. Undoubtedly a good convention without exhibits could be held at Atlantic City, but the additional advantages already mentioned possessed by a mid-Western city like Chicago, Indianapolis or Cleveland are worth consideration.

Quotation from the *Federal Electric Railways Commission Report*

No. 16

THE original failure of the electric railways to vary their rates of fare for transportation service, based upon the length of the ride, as services in all other lines of business are sold, is, in our judgment, one of the contributing factors to their present financial condition. The electric railway industry is the only public utility which, as an industry, has consistently adhered to a flat basis. Steam and suburban roads charge on a distance basis. Gas, power, electric and water power companies, generally, make their rates upon a measured basis, subject to a minimum charge per month, and the telephone company grades all toll messages on a mileage basis, while observing in most cases a flat rate per month for local service. Whether or not under present conditions it would be to the interest of a community to introduce a zone system of fares, instead of the present flat fare system, is a question which we think should be decided by the community itself, having reference to the social problems involved.

Large Special Trackwork Renewal

The Entire Layout at Fourteenth and U Streets, N. W., Washington, D. C., Was Renewed and Additional Special Work Was Installed by the Capital Traction Company Without Interfering with the Regular Operation — The Surface Work Was Set Up on an Adjacent Lot Before Installation to Insure Rapid Assembling

By E. P. GOUCHER

Assistant Engineer Capital Traction Company, Washington, D. C.

THE Capital Traction Company, Washington, D. C., recently completed a renewal of the entire special trackwork layout at Fourteenth and U Streets, N. W., which, as shown in the accompanying diagram, consists of a double-track crossing and a double-track connected branch-off shown in heavy lines. In addition to the special trackwork, 231.15 feet of single track on U Street was completely rebuilt, as shown by dash lines, and 133 feet of single track on Fourteenth Street and 68 feet on U Street was raised to a new grade, as shown by dotted lines. The entire job was of the underground conduit type of construction used exclusively in Washington.

This street intersection is one of the busiest in the city as regards traffic, both car and vehicular, especially during the morning and afternoon rush hours. It was therefore of extreme importance that the work be completed as quickly as possible. Every effort was made to this end, and as a result the job was completed, including all paving, in sixty-six working days.

The special trackwork was furnished by the Lorain Steel Company, being fabricated from dimensions and angles obtained by a careful survey of the site. The special surface work is of cast steel throughout, with the exception of a few rolled rails in the connecting curves and tangents. All the wheel frogs are made with renewable cast manganese steel center plates. All the yokes, gussets, etc., composing the substructure are of gray cast iron with machined surfaces to receive the surface work.

The outside curve (the one nearer the crossing) was relocated to give more clearance between cars passing on the curves, the balance of the layout remaining practically the same as the previously existing work. The new material was hauled to a large vacant lot one block from the job, and there the surface work was set up complete in the same relative position in which it was to go in the street, as shown in one of the accompanying photographs. Measurements were taken to permit the cutting of the existing work to suit the new; conductor bars were bent, cut and bonded, and make-up rails were cut and drilled. All make-up rails and compromise plates were numbered to facilitate installation work at night.

The removal of the old concrete and steel substructure on renewal jobs of this type of construction is the

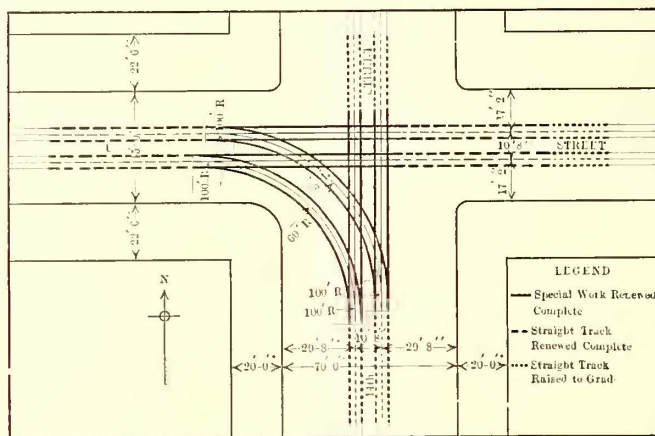
most difficult part of the work, especially at such an intersection as that at Fourteenth and U Streets, where the car traffic is very heavy. At the time this job was under way an average of 725 cars passed on the Fourteenth Street tracks, 492 on the U Street tracks and 107 went around the curves during the eight-hour period in which the gangs were working, making a total of 1,324 cars in all directions, or one about every twenty-two seconds. During the rush hours in the

morning it was necessary practically to suspend all work on the street. By starting work at 6:30 a.m., however, the evening rush was avoided.

Pneumatic tie tampers equipped with chisel bits were used in removing the old pavement. Holes were then drilled through the paving base and the concrete tube, using pneumatic drills with 1½-in. bits, and the greater part of the concrete was broken away with bull points and 16-lb. sledges. The concrete remaining on the old yokes

and castings was removed with chisel-bit tie tampers. Pneumatic tools operated by efficient labor and in charge of a foreman who understands his job are almost indispensable on work of this kind.

As excavation progressed, vertical 6-in. x 6-in. timbers were placed under the old rails and castings and wedged tightly in place, and as soon as a section was completely excavated and ready for the new special trackwork a concrete slab or "floor" about 6 in. or 8 in. thick was poured so as to clear the bottoms of the deep-



SPECIAL TRACKWORK RENEWAL IN WASHINGTON, D. C.

DETAIL COSTS OF LABOR AND MATERIAL

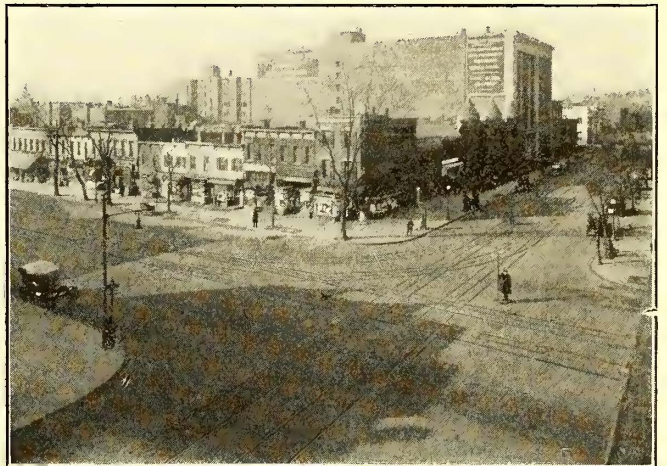
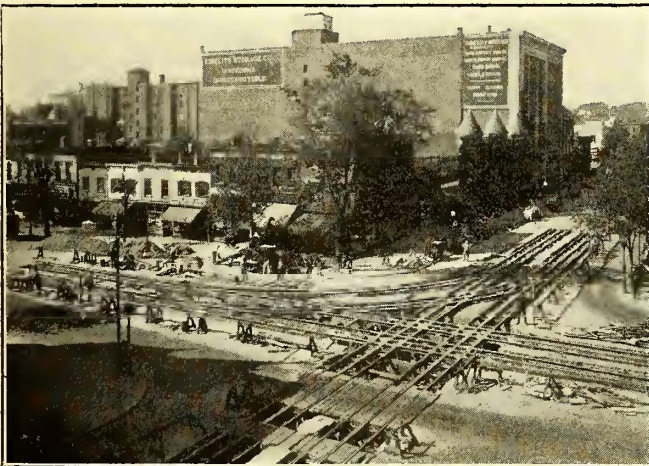
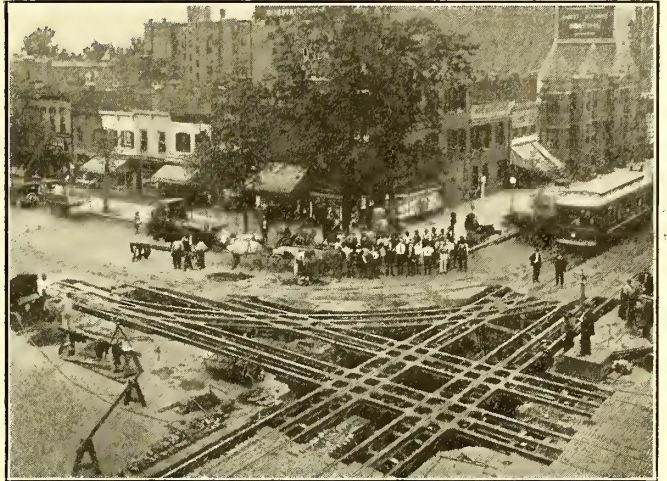
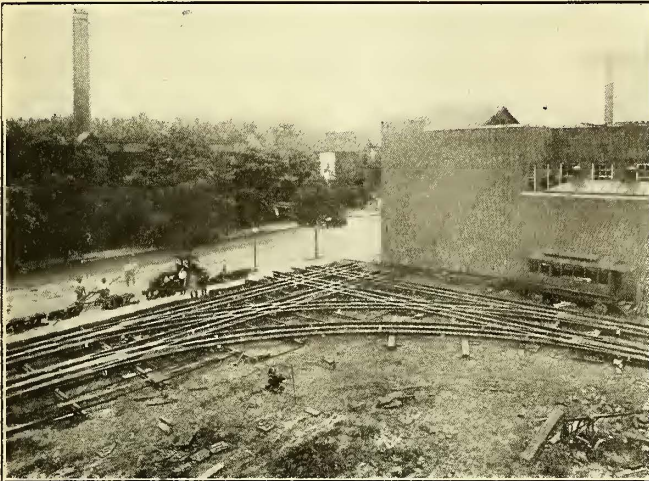
Class of Work	Labor and Hauling	Material	Total
Engineering and superintendence.....	\$648.71	\$67.39	\$716.10
Excavation.....	5,814.08		5,814.08
Special trackwork.....		42,415.00	42,415.00
Steel work at night.....	1,625.07		1,625.07
All other steel work.....	2,307.21	1,313.90	3,621.11
Form work.....	1,460.24	386.53	1,846.77
Concrete tube construction.....	759.37	1,927.28	2,686.65
Conductor bar.....	500.49	1,080.94	1,581.43
Paving base.....	203.63	351.63	555.26
Track drains.....	276.70	81.05	357.75
Watchmen, tools and sundries.....	2,681.82	444.09	3,125.91
Paving.....	452.98	616.94	1,069.92
Raising Fourteenth Street tracks.....	1,615.55	542.50	2,158.05
Underground obstructions.....	22.73	72.22	94.95
Gross total cost.....	\$18,368.58	\$49,299.47	\$67,668.05
Credit from scrap, including cost of handling.....	132.51	1,703.19	1,570.68
Net total cost of special trackwork.....	\$18,501.09	\$47,596.28	\$66,097.37
Rebuilding 231.15 ft. on U Street, including raising tracks on U Street.....	4,883.84	2,625.20	7,509.04
Total cost of entire job.....	\$23,384.93	\$50,221.48	\$73,606.41

est of the new yokes. This necessitated the complete renewal of some of the old yokes before the placing of the concrete, as many of the old yokes were deeper than the new ones to be installed. Forms about 12 in. square were placed around the bottoms of the supporting timbers. The level pouring of this floor greatly facilitated the setting up of the new yokes during installation work at night and also served as a spread footing under the entire job.

It was necessary to install the new work in three sections. The crossing was installed first, the outside curve, including both branch-offs and both curved crossings, next and the inside curve and branch-offs last. As all our installation work has to be done between 1 and

street and grade stakes were set on the "floor" of the excavation at the exact elevation of the bottoms of the new yokes. After the old special trackwork had been removed and the "hole" cleaned out, the new yokes were placed in almost their exact locations by means of a chalk line and tape used in connection with the offset nails. They were then wedged up to the grade of the stakes. As the new yokes were of different depths and the floor was level it was necessary in some places to lay pieces of old girder rail on the "floor" upon which to set the new shallow yokes. These rails were placed to the proper grade, so that it was necessary only to set the yokes to line.

The new work, also supported by the 6-in. x 6-in.



AT TOP, LEFT, SURFACE WORK SET UP ON LOT PRIOR TO INSTALLATION. AT TOP, RIGHT, EXCAVATION IN STREET JUST BEFORE INSTALLATION OF NEW CROSSING. AT BOTTOM, LEFT, NEW SPECIAL TRACKWORK COMPLETELY INSTALLED. AT BOTTOM, RIGHT, ALL WORK COMPLETED, INCLUDING PAVING

5 p.m., it may readily be seen that the installation of the outside curve was quite an undertaking for one night. This was necessary, however, because of the relocation of this curve, as mentioned before. But due to the splitting up of the gangs and their distribution over the entire curve no difficulty was experienced and the first car went over on schedule time, three hours and thirty-seven minutes after the removal of the old special trackwork was started. Car traffic was not delayed at any time during the progress of the job, with the exception of two or three minutes' delay due to stopping of cars on cut-outs.

Night work was greatly facilitated by the preliminary survey work of the company's engineers. Every yoke and gusset was "tied" out by offset nails in the asphalt

timbers placed under the wheel rails, was surfaced and lined as quickly as possible after installation, the grades were checked by the District Engineer Department and concrete was poured around the bottoms of the yokes and gussets. This "sticking," as we call it, is to hold the new special trackwork in position while forms are placed for the conduit construction and the concrete conduit is poured. It is one of the most important phases of the work. The entire weight of the new steel and heavily loaded cars must be carried by the timbering and vibration reduced to a minimum, in order to prevent the yokes "working" while this concrete is setting. Several men with hammers and wedges watch the timbering and at the slightest sign of movement in the rails or yokes tighten the wedges at the proper

point, or place another upright and wedge it securely in place.

Construction of the formwork for the conduit construction on a renewal job of this kind is a very tedious job, as conditions prevent the standardization of forms to any extent, thus requiring special forms almost entirely. The underground conduit or "tube" construction on the special trackwork only of this job required approximately 233 cu.yd. of 1:2.5:4.5 concrete which cost \$8.15 per cubic yard for material and \$3.26 for mixing and placing. The forms for this concrete cost on an average of \$7.92 per cubic yard of finished concrete, \$6.13 of which was for labor. The excessive cost of concrete material as indicated by these figures was due to a cement shortage which occurred at the time this job was under way.

The new paving installed consisted of Durax granite block in the larger areas, with Kreolite wood block in and around the switch and crossing castings. Paving outside the rails was Scoria block laid as headers, with sheet asphalt outside. A total of 680 sq.yd. of new paving was installed. All the block paving was laid on a 1:4 cement and sand cushion 1 in. thick, with pitch as a filler.

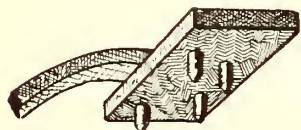
This special trackwork layout was originally installed complete in 1899. In 1910 it was necessary to renew the surface work only of the double-track crossing, but the balance of the surface work and all of the substructure removed in 1920 was part of the original installation, which had been in service under heavy traffic for about twenty-one years. This is rather a long life for special trackwork of this underground type of construction. The original work and also the crossing renewal were furnished by the Lorain Steel Company.

The original installation in 1899 cost about \$9,020 complete, \$6,100 of this being the cost of the special trackwork only. The surface renewal of the crossing in 1910 cost about \$4,058, of which about \$3,200 was for the special trackwork.

The accompanying summary shown on the preceding page gives the costs of the 1920 renewal complete by labor and material on the different classes of work for a total length rebuilt in the special trackwork of 535.23 ft. single track.

Cant Hook for Concrete Poles

THE ordinary cant hook used for wooden poles is not only decidedly unhandy on concrete ones but also is even dangerous to use. The single prong often chips out a large piece and has occasionally caused the ruin of a new pole. To obviate this disadvantage, according to an article published in the January bulletin of the Utilities Mutual Protection Company, a new type of hook with a special foot has been developed. This has four teeth set into the face plate in the manner



STUDDED FACE PLATE FOR A CANT HOOK

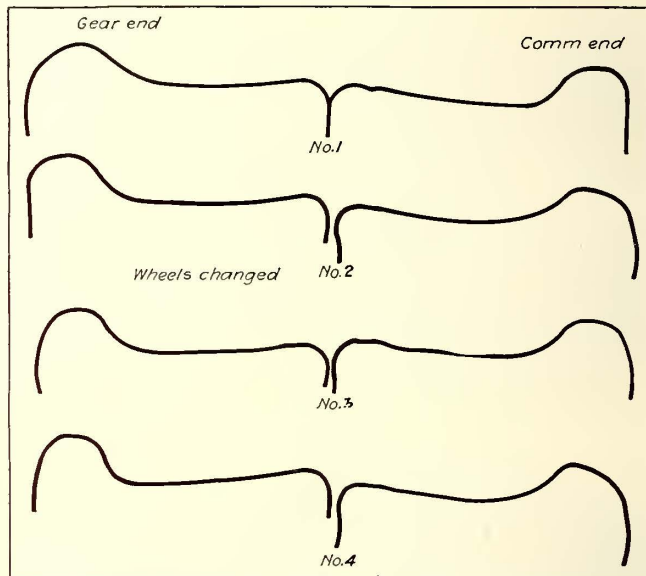
shown in the accompanying cut. By increasing the points of contact and extending the strain on the concrete over a distance of about 6 in., this device will handle even the softest "green" pole without damage and without risk of dropping the concrete pole unexpectedly.

The hook is the invention of Mr. Jennyjohn of the Rochester Gas & Electric Corporation.

Testing Wheels for Flange Contour

A CAREFUL check-up on all cars involved in derailments on the Chicago Surface Lines has been inaugurated by H. H. Adams, superintendent of equipment, with a very good result as to the number of such causes of delay. Whenever a derailment occurs the car crew reports the incident to the company switchboard operator and a daily report of all such derailments occurring over the entire system and giving the time, place, nature of the accident, etc., is made up and copies sent to the track, transportation and equipment departments. The carhouse foremen are called from the equipment superintendent's office each day and asked to report on the condition of the wheels on any cars involved in the derailments reported.

For making these reports a $\frac{1}{8}$ -in. thick lead strip is carefully bent by hand over the wheel tread and flange



INSPECTION REPORT OF WHEEL CONTOUR ON CAR REPORTED DERAILED

in order to get the exact shape of the contour and determine if any of the car wheels were responsible for the derailment. After one of the lead strips is formed over each wheel the eight strips are inked from an ordinary pad and stamped on the report sheet, whereby the contour of each of these wheels is accurately reproduced. If any bad wheels are indicated the foreman notes on the report what he is going to do, if anything, and forwards the report to the main office of the equipment department, through the division master mechanic. If the foreman has not ordered a proper or adequate repair he receives instructions from his superiors. The foreman also inspects the center and side bearings while he is getting the wheel contours and reports on these.

A further step taken in minimizing the derailments was the plotting on a large map of the city the location as reported of all derailments. If these occur in clusters, this fact shows up at once and a special investigation of the situation there follows. Division and system curves showing the number of derailments are also now being maintained, and since the new scheme of inspection was started derailments show a decided downward trend. The moral effect of this follow-up is that the foremen are induced to keep a more careful watch of the wheels on the cars under their jurisdiction in order to avoid the recording of bad wheel accidents against them.

Maintenance Cost Accounting

System Used by San Francisco-Sacramento Railroad Has Proved Invaluable as Means of Supplying Actual Cost Data from Which to Decide Whether Maintenance of Various Parts of Equipment Is Satisfactorily Carried On in Relation to Road Performance

By E. A. PALMER

Manager Railway Division San Francisco Office, Westinghouse Electric & Manufacturing Company

THE "Sacramento Short Line," formerly known as the Oakland, Antioch & Eastern Railway, operates a heavy traction, high-speed, 1,200-volt, direct-current electric passenger and freight service between San Francisco and Sacramento, California, and intermediate points. The rolling equipment comprises twenty passenger motor cars, weighing approximately 46 tons each, equipped with four Westinghouse 120-hp., 600-1,200-volt motors and type HL multiple-unit control, also six locomotives used mostly in freight service and a number of passenger trailers and standard box cars.*

In 1920 this equipment made 1,616,316 passenger car-miles on the 117.2 miles of track with a total of twenty-six delays, averaging 25.7 minutes, from all causes chargeable to the rolling equipment department. This is at the average rate of 62,166

car-miles of service per detention. The distance between terminals, namely, 90 miles, or 164 train-miles per round trip, from the shop in Oakland, necessitates the highest standard of equipment maintenance possible.

A typical train pulling out of the Oakland station is shown in the headpiece of this article. The schedule speed at which these trains operate is approximately 30 miles an hour, including all stops and slow-downs.

Having in mind the service conditions and the management's requirement that superior time-table performance of equipment, combined with comfort and safety, be furnished the traveling public at a minimum expense, Frank A. Miller, superintendent of power and equipment, undertook in 1914 to install a cost accounting system that would fulfill the following conditions:

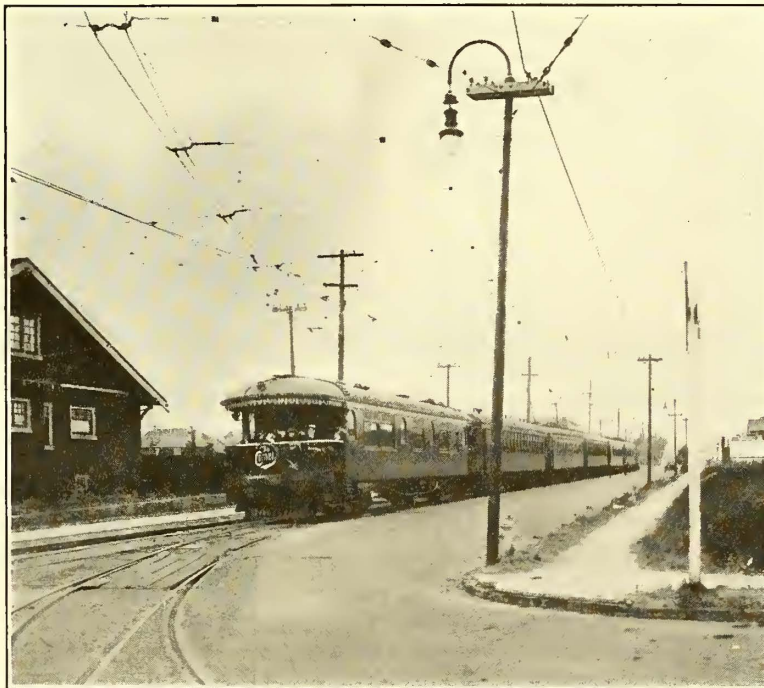
1. Conform to the requirements of the Interstate Commerce Commission.
2. Be acceptable to the auditing department of the railroad by accounting for all money disbursed.

3. Furnish accurate segregated cost data for the analysis of the performance of any desired part of equipment for any day, month or year.

4. Totalize the amounts spent progressively either on payroll or material account from the first of each month so that clerical work would not be greatly increased as a whole or at the end of the month.

The system as now in effect, in addition to fulfilling the requirements, has been invaluable as a means of supplying actual cost data with which to decide whether the maintenance of various parts of the equipment is being satisfactorily carried on in relation to the road performance. The basis of segregation of all charges for labor and material which are expended in equipment maintenance is a blueprint schedule entitled "Shop Order Numbers," as shown.

The list contains fifty-



TYPICAL TRAIN OF SAN FRANCISCO-SACRAMENTO RAILROAD

three main headings, which in turn are itemized into the details upon which specific costs are desired. Each item is given a Shop Order Number, the first two digits of which correspond to the Interstate Commerce Commission account, to which the expense is chargeable. The last two digits give the index to the subaccount. This chart has three features which should be noted:

1. There is a "Shop Order Number" on the chart to which every dollar spent on the annual maintenance budget may be segregated.

2. There are no non-specific "Miscellaneous" Shop Order Numbers to which it is possible to charge expenditures otherwise apparently unaccounted for on the chart. The account numbers under the "Miscellaneous" headings cover definite items on which costs are desired such as—"1,301, Repair to Underpass Pump" or "7,804, Repair to County Tunnel Lights."

3. There are no car or car series numbers on the chart. Costs are kept by parts and types of equipment and the various operations on the same.

A framed copy of the "Shop Order Number" chart is kept in each of the departments of the shop and the

*The characteristics of the Oakland, Antioch & Eastern Railway's cars and equipment were described in the issue of the ELECTRIC RAILWAY JOURNAL for Oct. 11, 1913.

SHOP ORDER NUMBERS

PASSENGER CAR BODY	DYNAMOTOR C.D.M.13	COLLECTORS PASS CARS	BODY LOCOMOTIVES	COLLECTORS LOCOMOTIVES	CROSSING SIGNALS
3201 couplers	3066 changing armatures	3301 pantographs	3401 couplers	3461 pantographs	1601 n'lce crossing signals
3202 pilots	3067 rep & remind armatures	3302 trolley wheel	3402 pilots	3462 trolley wheels & axles	1602 repairs to
3203 doors	3068 changing fields	3303 trolley bases	3403 doors	3463 trolley bases	1603 " relays res & locs.
3204 seats	3069 rep & remind fields	3304 " Pulver	3404 axles		1604 " other wiring
3205 glass		WIRING PASSENGER CARS	WIRING LOCOMOTIVES		1605 " trolley contacts
3206 gongs & signal bells	COMPRESSORS D 2 L	3304 main wiring	3405 gongs & signal bells	3464 main wiring	1606 painting crossing signal & poles
3207 sanders	3070 repairs to compressor	3305 control wiring	3406 sanders	3465 control wiring	
3208 spring buffers			3407 safety chains		AUTOMATIC SIGNALS
3209 safety chains	COMPRESSORS C P 29	CONTROL EQUIP PASS. CARS	IDENTIFICATION AWES	CONTROL EQUIPMENT	7203 n'lce block signals
3210 main body work	3071 repairs to compressor	3306 controllers	3408 identification awes	3466 controllers	1702 repairs to relays
3211 sash		3307 control resistance	3409 steps	3467 control resistance	1703 " relay wiring
3212 window operats	MISCELLANEOUS	3308 operating switch	3410 roofs	3468 operating switch	1704 " other wiring
3213 grab handles	3072 car painting	3309 control coupler socket	3411 floors	3469 control coupler socket	1705 " imp bands & wiring
3214 running boards	7001 labor-car cleaning	3310 control jumper	OTHER BODY EQUIPMENT	3470 control jumpers	1706 " switch boxes
3215 steps	7002 material - "	3311 buss-line jumper	3412 emergency roof covers	3471 buss-line receptacle	1707 " trans & int fuses
3216 ventilators	7003 labor-car ailing	3312 buss-line receptacle		3472 buss-line jumpers	1708 " signals-heads-pole etc
3217 identification boxes	7004 material - "	3313 electric brake	LIGHTING & WIRING		1709 " insulated joints
3218 water tanks	6703 lamps	3075 Control Change Over	3414 headlights	MAIN APPARATUS LOCOS	1710 painting poles & signals
3219 car curtains	6704 drinking cups	MAIN APPARATUS	3415 mid'llt wiring & resistance	3473 circuit breakers	2211 repairs to banding
3220 roofs	6705 toilet paper	3314 circuit breakers	3416 heaters & motor circuits	3474 reversers	1512 bridge circuit controller
3221 flooring	6706 trolley rope	3315 reversers	3417 lights & light circuits	3475 resistance	
3222 toilets	6707 register cord	3316 resistance	3418 air wiring	3476 switch groups	
7007 Insp of safety appliances	6708 register card	3317 switch groups		3477 change over switch	TELEPHONES
OTHER BODY EQUIPMENT	6709 register rolls	3318 change over switch	AIR BRAKES LOCOMOTIVES		1801 n'lce telephone system
6718 registers-repairs only	6710 motor carbons		3419 hand brakes	MOTORS - LOCOMOTIVES	1802 repairs to instruments
6719 cup vendors	6711 ornamental carbons	MOTORS	3420 air piping	3478 arsun holders	1803 " Line
6720 root studs	6712 headlight carbons	3319 brush holders	3421 air hose	3479 motor leads	1804 " submarine cable
6721 fire extinguishers	6713 lamp chimneys	3320 motor leads	3422 brake valves	3480 armature bearings	1805 miscellaneous repairs
6722 marker lamps	6714 oil for lamps & marks	3321 armature bearings	3423 brake valves	3481 motor bearings	
6723 oil lamps	6715 saddle & rod for extinguishers	3322 motor bearings	3424 distributing valves	3482 gear cases	INTERLOCKING
6724 signal cases	6716 inspectors lanterns	3323 gear cases	3425 governors	3483 motor cases	7201 operation of tower
3223 emergency tool boxes	6717 other misc. supplies	3324 pinions	3426 angle cocks	3484 gears	7202 n'lce interlocking plant
3224 tra & catchers	6725 misc. repairs body eqpt	3325 gears	7005 insp of air equipment	3485 pinions	1720 rep. to relays & indicators
7008 genl insp car bodies		3326 motor cases			1721 " merc. wiring & switches
			SIGNAL EQUIPMENT	MOTORS WEST. 321	1722 " series & switches
LIGHTING & WIRING			3427 signal red valves	3486 changing armatures	1723 " signals
3225 headlamps			3428 signal valves	3487 rep & remind armatures	1724 " interlocking machine
3226 headlight wiring		3327 changing armatures	3429 signal whistle valves	3488 changing fields	1725 " track circuits
3227 heaters & motor circuits	REPAIRS TO FREIGHT CARS	3328 rep & remind armatures	3430 whistles	3489 rep & remind fields	1726 " air lines
3228 lights & light circuits	3101 box car body	3329 changing fields			1727 " compressor & motors
3229 air wiring	3102 box car body	3330 rep & remind fields.	TRUCK REPAIRS LOCOS	MOTORS 308 B.6	1728 " storage battery
3230 rep & rem wiring	3103 flat car body		3431 sand hangers	3490 changing armatures	1729 " insulated joints
3231 heat regulators	3104 cabooses body	MOTORS WEST. 321	3432 brake rigging	3491 rep & remind armatures	1730 painting sashes & doors
AIR BRAKES PASS CARS	3105 trucks	3331 changing armatures	3433 turning wheels	3492 changing fields	2214 repairs to rock anchors
3232 hand brakes	3106 changing wheels	3332 rep & remind armatures	3434 changing wheels	3493 rep & remind fields	
3233 train stops	3107 changing wheels	3333 changing fields	3435 changing brake shoes		SHOP EXPENSE
3234 " application valve	3108 brake shoes	3334 rep & remind fields	3436 journal brasses	MOTORS 308 D.7	3601 shop tools & machinery
3235 air hose	3109 journal brasses		3437 truck frames	3494 changing armatures	3702 cleaning shop
3236 brake valves	3110 couplers	MOTORS WEST. 322.	3438 journal cases	3495 rep & remind armatures	3703 lighting shop
3237 triple valves	3111 brake rigging	3335 changing armatures	3439 bolsters	3496 changing fields	3704 heating shop
3238 double check valves	3112 air hose	3336 rep & remind armatures	3440 springs	3497 rep & remind fields	3705 small hand tools
3239 feed valves	3113 hand brakes	3337 changing fields	3441 equalizing bars		3706 other misc. shop expense
3240 air piping	3114 painting	3338 rep & remind fields		MISCELLANEOUS	
3241 gardeners	3115 repairs to foreign cars		DYNAMOTOR LOCOS	3498 misc. elect. repairs	
3242 double cut out cocks	3116 insp freight equipm't	MISCELLANEOUS	3442 dynamotor brush fillets	7006 insp. of elect. equipm't	
3243 angle cocks	3117 cleaning & greasing air	3339 miscel. elect. repairs	3443 " resistance		AUTOMOBILES
7003 inspection of air equip.	3118 Repacking & Oiling	7004 inspect. elect. equipm't	3444 " wiring		3801 repairs to automobiles
			SUB-STATIONS		9601 gas, oil & etc. car tools
SIGNAL EQUIPMENT			DYNAMOTORS Y.E. 3	4801 sub-stations general	
3244 signal relaying valves			3445 changing armatures	4802 repairs-tunnel sub-sto	MISCELLANEOUS
3245 signal valves			3446 rep & remind armatures	4803 " Concord "	401 repairs - roadhouse trails
3246 signal whistle valves			3447 changing fields	4804 " Drawbridge "	402 " track sweeper runways
3247 whistles	3201 Brown hoists		3448 rep & remind fields	4805 " Dezier "	2403 " ferris wheels
	3202 tower cars			4806 " Lisbon "	3504 " Ferry boat
TRUCK REPAIRS PASS CARS	3203 tenders		DYNAMOTORS Y.E. 4.		7801 n'lce Shafter Ave. Arcs.
3248 sand hangers	3204 steam shovels		3449 changing armatures		7802 repairs to "
3249 brake rigging			3450 rep & remind armatures		7803 " sacramento "
3250 turning wheels			3451 changing fields		7804 " county tunnel plants
3251 changing wheels			3452 rep & remind fields		1301 " Underpass Pump
3252 journal brasses					
3253 changing brake shoes					
3254 truck frames			DYNAMOTORS C.D.M.13		
3255 journal cases			3453 changing armatures		
3256 bolsters			3454 rep & remind armatures		
3257 springs			3455 changing fields		
3258 equalizing bars			3456 rep & remind fields		
3259 axles					
3260 Gird & Davis Wheels			COMPRESSORS D.2 L.		
DYNAMOTORS			3457 repair compressors		
3261 dynamotor wiring					
3262 " brush holders			COMPRESSORS D.3 L.		
3263 " resistance			3458 repair compressors		
DYNAMOTORS Y.E. 3			COMPRESSORS C.P.29.		
3264 changing armatures			3459 repair compressors		
3265 rep & remind armatures					
3266 changing fields			MISCELLANEOUS		
3267 rep & remind fields			3460 painting locomotives		

Revised 7-1920
E.D. 114

FORM NO. 11-11-19		DAILY DISTRIBUTION OF LABOR AND MATERIAL																												DEPT	MONTH OF	19					
WORK ORDER NO.	ACCT NO.	ITEMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL	ASCT		
		WAYS AND STRUCTURES																																			
		EQUIPMENT																																			
		POWER																																			
		CONDUCTING TRANSPORTATION																																			
		TRAFFIC																																			
		GENERAL MISCELLANEOUS																																			
		BALLAST COST																																			
		MISC. ACCTS REC.																																			
		SPECIAL JOBS																																			
		CONSTRUCTION																																			

FORM NO. 11-11-19		DAILY DISTRIBUTION OF LABOR AND MATERIAL												DEPT	MONTH OF	19																					
WORK ORDER NO.	ACCT NO.	ITEMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL	ASCT		
3316																																					

FORM NO. 11-11-19
 SAN FRANCISCO-SACRAMENTO RAILROAD CO.
 Sacramento Branch Line
TIME TICKET
 NAME: J. Brown DATE: 1-20 1921
 NUMBER: 1002 RESISTANCE
 VALUE: 3316 COST: .80
 NO TIME CLOVES UNLESS COVERED BY THIS TICKET

FORM NO. 11-11-19
 San Francisco-Sacramento R. R. Co., Record of Material Issued from Stock
 ORIGINAL Date: 1-20-21
 TO BE USED BY: [] TO BE USED FOR: 3316

QUANTITY REQUIRED	MATERIAL	QUANTITY ISSUED	RATE	PER	COST	ACCOUNT TO BE CHARGED TO
4	3317 Res. Guards	4	75	CA	3.00	33
TOTAL						

 Reached by: _____ Ordered by: _____

LARGE FORM, BASIS FOR SEGREGATION OF ALL LABOR AND MATERIAL CHARGES. INSERT, AT LEFT, LABOR DISTRIBUTION FORM MADE UP FROM TIME SLIPS. AT RIGHT, TIME SLIP USED BY SHOPMEN. BOTTOM, MATERIAL RECORD CORRESPONDING TO TIME SLIP

foremen handling work are held responsible to see that the men in making out their time slips are charging the correct shop order number. In another illustration is displayed the form of time slip used. Such slips are made out and turned in daily to the foremen, who approve and forward them to the mechanical department

office not later than 10 o'clock the following morning. The slips are then extended by the clerk according to the men's rates, not less than one hour being charged to any Shop Order Number, and the amounts are distributed on the daily "Labor Distribution" form shown on this page. This develops the total amount

TABLE I--MAINTENANCE OF PASSENGER EQUIPMENT, 1920, SAN FRANCISCO-SACRAMENTO RAILROAD

Item	Labor	Material	Total	Per Cent of Sub-Total	Item	Labor	Material	Total	Per Cent of Sub-Total
Control Equipment (Details)					Motor (Details)				
Controllers (master).....	\$81.14	\$53.00	\$134.14	14.7	Brushholders.....	\$145.06	\$145.57	\$290.63	7.8
Control resistance.....	22.57	15.50	38.07	4.2	Motor leads.....	103.30	238.97	342.27	9.2
Operating switches.....	2.04	.85	2.89	0.3	Armature bearings.....	78.36	454.49	432.85	14.4
Control coupler sockets.....	24.31	12.25	36.56	4.0	Motor bearings.....	173.30	753.97	927.27	25.0
Control jumper.....	87.05	60.49	147.54	16.2	Gear cases.....	33.26	13.43	46.69	1.3
Busline jumper.....	133.87	264.37	398.24	42.8	Pinions.....	24.71	495.56	520.27	14.1
Busline receptacle.....	78.58	40.28	118.86	13.1	Gears.....	108.86	765.28	874.14	23.6
Electric brakes.....	2.91	0.09	3.00	0.3	Motor cases.....	48.50	104.73	153.23	4.1
Control changeover.....	18.23	16.13	34.36	3.8					
Total.....	\$450.70	\$462.96	\$913.66		Total.....	\$715.35	\$2,972.00	\$3,687.35	
Per car-mile.....				\$0.00057	Per car-mile.....				\$0.0023
Control Equipment (Main apparatus)					Wiring				
Circuit breakers.....	19.89	19.69	39.58	1.6	Main wiring.....	108.63	161.79	270.42	51.8
Reversers.....	159.32	145.01	304.33	12.1	Control wiring.....	157.81	93.20	251.01	48.2
Resistance.....	182.27	443.45	625.72	25.0	Total.....	266.44	254.99	521.43	
Switch groups.....	787.48	506.47	1,293.95	51.7	Per car-mile.....				\$0.0003
Changeover switches.....	144.99	74.06	219.05	9.0					
Total.....	\$1,293.95	\$1,188.68	\$2,482.63		Motors West 322				
Per car-mile.....				\$0.00155	Changing armatures.....	329.73	.63	330.36	18.2
Collectors					Repairing and rewinding armatures.....	333.75	770.43	1,104.18	60.8
Pantographs.....	856.90	201.99	1,058.89	33.6	Changing fields.....	77.36	50.70	128.06	7.0
Trolley wheels.....	504.86	974.52	1,479.38	47.1	Repairing and rewinding fields.....	197.30	52.34	249.62	14.0
Trolley bases.....	37.15	58.56	95.71	3.0	Total.....	\$938.14	\$874.10	\$1,812.24	
Trolley poles.....	358.18	249.96	608.14	16.3	Per car-mile.....				\$0.00113
Total.....	\$1,657.09	\$1,485.03	\$3,142.12		Grand total.....	\$5,321.67	\$7,237.76	\$12,559.43	
Per car-mile.....				\$0.00196	Per car-mile.....				\$0.00778

LABOR DISTRIBUTION.		192	
501 02		501 02 03 04 05 06	
11		501 17 21 22 23	
501 02 03 04 05 06		501 02 03 04 05 06 07	
4702 03 04 05 06 07 08 09 10 20 21 22 23 24 25 27 29		7201 02 03	
1501 02 03 04 05		55	
21A		55	
21B 2403		522	
3001 02 03 04 05 06 07 08 09 10 12 13 14 15 16 17 18 19 20		JOB ORDERS	
3011 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44		SIGNALS AND SUBSTATION	
3011 42 53 54 55 56 57 58 59 60 61 62 63 72 73 75		1512	3101 02 03 04 05 06
3101 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18		1508 02 03 04 05 06	7201 02 03
3201 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21		1502 03 04 05 06 07 08 09 10	7201 02
3401 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		1125 21 22 23 24 25 27 29	JOB ORDERS
3402 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36		1103 02 03 04 05	57
3504		2211 2214	3101 02 03 04 05 06

OPERATING EXPENSES		1 to 15	
Dept. Roll		16 to 31	
I. WAYS AND STRUCTURES			
1. Superintendence of Ways and Structures		45. Superintendence of Trolleys	
2. Earth		46. Power Plant, Structures, Frames and Grounds	
3. Ties		47. Station Equipment	
4. Rail Fencing and Posts		48. Traction System	
5. Special Work		49. Station Buildings	
6. Fuel and Firebricks Labor		50. Subways, Sidings and Loops	
7. Maintenance TOL and Building Expenses			
8. Fuel			
9. Oil and Greasing Trolleys			
10. Tracks and Signals			
11. Tracks and Signals			
12. Signals, Trolleys and Contacts			
13. Contacts, Frames, and Signs			
14. Signals and Signals			
15. Trolleys and Trolley Cars			
16. Alighting Ways, Ladders			
17. Police and Forces			
18. Maintenance Electric Line Expenses			
19A. Buildings, Frames, and Grounds			
19B. Buildings and Sheds			
A. POWER			
A. CONDUCTING TRANSPORTATION			
20. Superintendence of Traction and Trolleys		51. Fuel and Gas Costs, Materials and Supplies	
21. Fuel and Oil		52. Station Equipment	
22. Maintenance Car-Service Expenses		53. Signals, Equipment	
23. Police and Forces		54. Carriage Expenses	
24. Carriage Expenses		55. Operation of Saw and Machine Shop	
25. Maintenance of Saw and Machine Shop		56. Operation of Traction and Traction Lines	
26. Maintenance of Traction and Traction Lines		57. Operation of Office and Shop	
27. Office and Shop			
A. EQUIPMENT			
28. Superintendence of Equipment		58. Maintenance System for Equip.	
29. Expenses and Commissions Equip.		59. Other Transportation Expenses	
30. Fuel, Lubricants, and Rail Cars			
31. Spare Equipment			
32. Electric Equipment of Cars			
33. Expenses			
34. Building Expenses			
35. Shop Expenses			
36. Vehicle and Trolleys			
37. Maintenance Equipment Expenses			
A. TRAFFIC			
38. Superintendence and Structures			
39. Expenses			
40. Fuel, Lubricants, and Rail Cars			
41. Expenses			
42. Building Expenses			
43. Shop Expenses			
44. Vehicle and Trolleys			
45. Maintenance Equipment Expenses			
A. GENERAL AND MISCELLANEOUS			
46. Salaries and Expenses of General Officers			
47. Salaries and Expenses of Gen. Clerks			
48. General Office Supplies and Expenses			
49. Maintenance General Expenses			
50. Trolley and Dispatch			
51. Signaling and Forces			
52. Sign Expenses			
53. General and Public Expenses			
54. Rent of Buildings			
Total			
Grand Total			
Prepared by: Examined and found correct:			

AT LEFT, FORM USED TO RECORD LABOR EXPENSE CHARGEABLE TO I. C. C. ACCOUNTS. AT RIGHT, ALL AMOUNTS FOR LABOR ON INDIVIDUAL SHOP ORDER RECORDED ON THIS CARD

spent daily on each of the Shop Order Number accounts and also the Interstate Commerce Commission accounts. These must balance daily with the payroll amount. The amount for each Shop Order Number daily on account of labor is entered up progressively from the first of each month on a 5-in. x 8-in. card having space for each day in the year. There is one "Labor" and one "Material" card for each Shop Order Number of the form shown as an insert on page 717. The material card record is handled the same way through the entering up of the storeroom requisitions, charged to the proper Shop Order Number daily. From these cards progressive records are available of the amounts spent on each account for either labor or material. From the daily labor distribution sheet, which is filed with the time cards after the payroll has been made out, the amounts of labor expense chargeable daily to the Interstate Commerce Commission accounts are entered up on another form, shown at the top of this page. This is carried forward to the end of the month progressively so that the total figure charged to each account appears on the last day of the month. The purchasing and stores department handles the material account in the same way. At the end of the month the form shown on page 717, giving distribution of mechanical and power department payroll by the Interstate Commerce Commission accounts, is filled in and forwarded to the auditor. Throughout the year special items such as trolley wheels, brake shoes, lubrication, wheels, etc., are taken from the Shop Order Number cards and the cost per

1,000 car-miles for each month computed for plotting in a curve book. At the end of the year all of the data from the cards are totaled and tabulated into an annual report, with relative per cents of the total and cost per car-mile for the fifty-three main items. In the report are included the operating record of the equipment, changes made, extraordinary worth, etc., as well as the detailed cause of all delays. The cost of maintaining electrical equipment on passenger cars for the year 1920 is given in Table I. This represents two pages out of the forty-two-page report and will serve to illustrate the methods of keeping and tabulating the various costs. In Table II will be found rolling equipment performance data for the years 1915 to 1920 inclusive, also electrical equipment maintenance costs for the same period of time. The latter shows the effect of war-time wages and material during the past three years on delays to service and cost per 1,000 car-miles. This system gives very complete data and is applicable to any electric railway or electrification where accurate detailed costs are desired. It serves as a check on the cost of maintenance and alleviates numerous troubles by indicating the cause, thus permitting a slight change in equipment or operating conditions. The writer has attempted merely to outline the method that has been used very successfully by F. A. Miller, superintendent of power and equipment of the San Francisco-Sacramento Railroad.

Table II—ROLLING EQUIPMENT PERFORMANCE DATA

Year.....	1915	1916	1917	1918	1919	1920
Passenger Equipment						
Total mileage including trailers.....	1,562,264	1,435,183	1,569,075	1,429,346	1,556,932	1,616,316
Total number delays—all causes.....	37	35	37	43	25	26
Total minutes delay.....	806	736	1,118	1,625	562	668
Average length delay minutes.....	21.7	21	30.2	37.8	22.4	25.7
Car-miles per delay.....	42,273.3	41,005.2	42,677.0	33,240.0	2,277.0	62,166.0
Number delays per 1,000 car-miles.....	0.023	0.024	0.0234	0.03009	0.016	0.0163
Minutes delay per 1,000 car-miles.....	0.516	0.513	0.707	1.1371	0.361	0.4182
Electrical maintenance cost per 1,000 car-miles.....	\$3.13	\$5.35	\$4.45	\$8.07	\$6.37	\$7.78

Electrical Insulating Materials*

The Most Essential Characteristics of Insulating Materials Are High Dielectric Strength and Ohmic Resistance, but Ability to Withstand Considerable Mechanical Stress and Heat Is Also Desirable

BY NORMAN LITCHFIELD

THE old analogy of electricity to water under pressure, flowing through a pipe, while not scientifically accurate, has served well to give a general idea of some electrical functions and properties, and may equally well be used to show the relation between electric current, the conductor and the insulator, the first being analogous to the fluid, the second to the bore of the pipe and the third to the walls of the pipe. It is with the last named that we are concerned in this article, and an attempt will be made to sketch the nature and properties of some insulating materials which are in general use in the electric railway field. The insulator, like the pipe walls in the conduction of water, must prevent the electricity from bursting violently through so that it is all lost, before arriving at its proper destination, and it must not permit small quantities to ooze through, thus losing in the aggregate a considerable amount. If the former occurs, we have what is designated a "short" circuit, because the electricity has taken a short path back to the source of supply, without traversing the long path through the working machine as intended.

Furthermore the insulating materials must continue to fulfill these functions over reasonably long periods, despite the adverse and deteriorating conditions to which it is naturally subjected in its place of use.

The ability of the material to resist the tendency of the electricity to burst through is known as the dielectric strength; that preventing leakage is the ohmic resistance.

Again, just as water is conducted through pipes of iron, wood, stone, concrete, glass, brass, copper, rubber, etc., depending on some particular mechanical quality of the conducting substance, so it has been found by long and costly experimentation that certain insulating materials possess particular electrical, mechanical and other qualities which render them more suitable for use under some specific set of circumstances than others. The chief of these characteristics are the following: (1) Dielectric strength, (2) ohmic resistance, (3) tensile strength, (4) resistance to abrasion, (5) flexibility, (6) stability under heat, (7) stability under moisture, (8) stability under vibration, (9) ability to be molded into a given shape, (10) ability to take high surface polish, (11) ability to withstand climatic conditions, (12) fireproof qualities, (13) resistance to electric arc, (14) cost.

For general use rubber has proved to be the material most generally adaptable. In fact, rubber may be said to go hand in hand, as it were, with copper in differentiating the electrical industry from other indus-

tries. Copper's influence was already mentioned by the writer in a recent article in the ELECTRIC RAILWAY JOURNAL on the nature and uses of that metal. Copper as a conductor and rubber as an insulator, together with iron as the magnetic material, form the material backbone of the electrical industry. It is interesting to note that the name "rubber" as applied to caoutchouc is a purely colloquial one, the origin being the suggestion of the English chemist Priestly, toward the end of the eighteenth century, that caoutchouc was useful for "rubbing out" pencil marks. It was immediately used for this purpose and became known as "India rubber."

SOFT RUBBER INSULATION FOR WIRES AND CABLES

The basic material of the rubber insulation used in cables, etc., is India rubber, or caoutchouc. This is the milky juice which oozes out and then coagulates when the skin of the plant is punctured. The grade of the rubber varies with the plant and with locality, the highest grade coming from Para, in Brazil, produced by plants of several kinds of that class known to botany as Hevea. This grade is therefore sometimes called Hevea rubber, but its usual designation is Para rubber. It is of course not always necessary to use the highest grade of rubber, but practically all specifications for insulation require a certain percentage of "pure Para rubber."

Rubber in its natural state, as it comes from the plant, becomes hard and stiff when cold, and it is therefore unfit for most commercial purposes in its untreated condition. One of the great epoch-making discoveries in this field was that by Charles Goodyear, in 1844, of the process known as "vulcanizing" rubber. In this process the rubber is mixed with sulphur in a light powdery state (flowers of sulphur) at low heat, and is then "cured" in superheated steam at about 300 deg. Fahr. The whitish natural rubber by this process becomes gray and hornlike, and in this state is but little affected by cold. By variation in the amount of the sulphur and the degree of heat, various different graduations of hardness are obtained up to the hard grade known as hard rubber, vulcanite or ebonite, the varying shades of color being the result of additions of mineral matter and old rubber.

Rubber insulation, even in the best grades, contains but little more than 30 per cent of new rubber. Thus the tentative specifications of the American Society for Testing Materials for insulated wire permit, in addition to new Hevea rubber, "waxy hydrocarbons consisting of ceresin or refined paraffin, sufficient sulphur properly to vulcanize any inorganic mineral matter," the rubber content being from a minimum of 30 per cent to a maximum of 33 per cent.

The amount of rubber in the insulation practically determines its price, 30 per cent and up being the

*This is the last of a series of seven articles prepared by Mr. Litchfield to bring about better co-operation between users and makers of electric railway equipment. The previous articles appeared in issues of this paper for Feb. 21, 1920, page 366; April 17, 1920; page 803; June 19, 1920, page 1247; July 17, 1920, page 115; November 20, 1920, page 1051, and December 18, 1920, page 1229.

highest commercial grade. Lower percentages are often used, however, it being quite common on car equipment to use 20 or 25 per cent. The equipment committee of the American Electric Railway Engineering Association in 1915 put itself on record as follows: "There can be no question but that 30 per cent pure Para rubber would give the best results, and its use may be advisable in special cases, as where cars are operated in subways, and there is a liability to small short circuits which might cause smoke, fire or a possible panic. However, the wire referred to by manufacturers as containing 20 per cent pure Para rubber is giving general satisfaction and it is felt that 30 per cent makes an insulation probably more expensive than is necessary. Especially does this seem to be the case in view of the fact that car wiring is often removed after a few years, in which event if 30 per cent compound were used the benefit of longer service for the extra expense would not be obtained." The committee then calls attention to the specification for rubber-insulated wire for power distribution purposes given in section Dw8a of the Engineering Manual of the Engineering Association, and gives as its opinion that the specification covers a quality of insulation satisfactory for car equipment purposes.

Since the publishing of the above opinion the power distribution committee has revised its specification to Dw8b, which "is the result of a demand for low grades of wire and cable, insulated with Para rubber compound, that can be used for line and equipment purposes," the 30 per cent compound being entitled "Grade A" and the 20 per cent "Grade B." For Grade A, the composition required is the same as that already quoted from the A. S. T. M. tentative specifications, namely, rubber, sulphur, inorganic mineral matter and refined solid paraffin or ceresin.

Both the A. E. R. E. A. Grade A and the A. S. T. M. specifications are the result of the work of the joint rubber insulation committee, a full report of whose work is given in the 1914 Proceedings of the American Institute of Electrical Engineers, which not only laid down the desired composition but also the exact method of analysis, as it was found that with different methods quite widely varying results were obtained from the same material. This method is given in detail in the A. S. T. M. and A. I. E. E. publications, and as it is not of general interest to the user of the insulation will not be quoted further. It may simply be stated that the method finally adopted was that which all agreed would show whether pure Para rubber had been used, and in what amount.

For the Grade B insulation the A. E. R. E. A. specification does not require pure Para rubber, but simply that the insulation shall contain not less than 27 per cent of rubber gum. Five chemical tests are prescribed, namely, acetone extract, alcoholic potash extract, chloroform extract, ash and total sulphur. It is required that the sum total of the results of these five tests shall not exceed 73 per cent by weight of the total compound, the tests to be made in accordance with the Underwriters' Laboratory specification. Obviously the specification for the Grade B material is much less exacting than that for the Grade A.

In passing it may be said that the making of rubber analysis is a difficult matter, requiring the services of an expert chemist. It is, therefore, somewhat expensive and for this reason a chemical analysis is not always resorted to by the user.

For physical properties the A. S. T. M. specification requires the following: Tensile strength, minimum, 1,000 lb. per square inch; set, maximum in 2 in., $\frac{3}{8}$ in.; elongation, minimum before rupture, 2 to 9 in.; test specimen to be 2 in. long between bench marks, and to be stretched at the rate of 20 in. per minute until the specimen breaks.

For testing the set, another 2-in. specimen is stretched at the rate of 20 in. per minute until the bench marks are 6 in. apart, and released within another five seconds. The set is determined one minute after the beginning of release. The elongation test is made on the same specimen used for the set test, and after the completion of the latter. It is stretched at the rate of 20 in. per minute until it breaks.

The physical requirements of the A. S. T. M. specification as given above, are somewhat different from those of the A. E. R. E. A. in its specification Dw8b already referred to, which requires as follows: Tensile strength, minimum, 1,000 lb. per square inch; elongation at break, five times original length, or four times original length if specimen is over $\frac{1}{4}$ in. thick; elongation five seconds after release when stretched at rate of 12 in. per minute to three times its original length, 20 per cent.

For convenience we may set the equivalent values one against the other, as follows:

	A. S. T. M.	A. E. R. E. A.
Original length.....	2 in.	2 in.
Tensile strength.....	1000 lb. per sq. in.	1000 lb. per sq. in.
Rate of stretch for tensile test	20 in. per min.	12 in. per min.
Elongation measured on.....	"set" specimen re-stretched after set test to rupture	"tensile" specimen at rupture
Elongation (times original length).....	5, or 4 if specimen is over 12/64 in. thick
Elongation.....	2 to 9 in.
Set in per cent of original length	18 $\frac{1}{2}$	20
Set in inches.....	$\frac{3}{8}$ in.	2/5 in.

It therefore appears that the two sets of requirements are very nearly alike, and it would seem that in the interest of standardization the two specifications should be brought to agree, inasmuch as either one probably insures the desired qualities.

With regard to electrical properties the chief, in addition to chemical and physical features already outlined, are, first, dielectric strength, which is the property of resisting the puncturing of insulation by high voltages, and second, ohmic resistance, which is the property of resistance leakage.

Both of these tests are made after immersion in water for a given period and while the specimen is still submerged. Of the two, the breakdown or dielectric strength test is the more important. It is usually made on the basis of twice the normal voltage plus 1,000 volts. Detailed figures are given in both the specifications already referred to.

It may not be amiss to point out that the purpose of the foregoing tests and requirements is to provide a material that will (1) stand high voltages without puncturing, (2) prevent leakage, (3) bend without cracking, (4) not become hard or otherwise deteriorate with reasonable age, (5) not absorb moisture and (6) withstand reasonable temperatures.

Reference to fireproofing has been omitted for the reason that the application of a fireproof covering has generally the effect of giving a tendency to absorb moisture, thus causing liability to short circuit and thereby to starting fires where no fire existed. Fireproof insulated wire is made and is used successfully in places

where the temperature is so high that the ordinary insulation will not stand up. It cannot be exposed directly to moisture.

Much more could be said in relation to methods of manufacture, braid coverings, cotton separators, etc., but these subjects are hardly germane to the purpose of this article, which is simply to give an outline of the nature of the common insulating materials. Emphasis should nevertheless be laid (as the writer has done in connection with other materials) on the skill and integrity of the manufacturer, without which no specification is effective.

COTTON AND PAPER INSULATION FOR WIRES AND CABLES

Small wires, such as are used in small armature and other coils, are quite generally insulated with cotton, either wound on the wire in the form of thread or in woven tubular form. Cotton insulation needs no special comment other than that it is used only where the differences in potential are small. It is often impregnated with some insulating varnish, the nature of which will be discussed later.

For lead-sheathed cable for power distribution purposes the insulation is composed chiefly of paper. A good description is given in the A. E. R. E. A. standard specifications for three-conductor cable, an extract from which follows:

The cable is to be composed of three copper conductors, each separately covered with paper tape to the required thickness and then twisted together with a suitable lay. The interstices are to be rounded out with jute and the whole wrapped with a paper belt to the required thickness.

The paper, soaked in a suitable insulating compound, is to be covered with a lead sheath of the required thickness. The highest grade of pure manila rope paper tape shall be applied helically and evenly to each of the conductors until the required thickness of paper is obtained.

All moisture shall be expelled from the paper and jute by baking in suitable ovens; they shall then be thoroughly saturated with the insulating compound of the required kind and quality.

This arrangement makes a tough, resistant insulation which bends the conductors tightly, keeping them from shifting and wearing into the insulation.

LINEN AND SILK USED WHERE MECHANICAL STRENGTH IS NECESSARY

Linen and silk are generally used as cloth, treated with linseed oil or some insulating compound. Being of a finer texture and greater mechanical strength than cotton, they are used in places where these qualities warrant the extra expense.

Glass and porcelain are excellent insulators, but have only a limited field on account of lack of mechanical strength. Both are used extensively for line insulators, porcelain being preferable. The latter is also used for commutator brush supports and cores for heater coils. Its chief requisite is that it shall maintain an unbroken surface, as when the glaze becomes cracked dust and dirt and moisture soon accumulate and the insulator breaks down.

Wood, though a fairly good insulator when dry, absorbs moisture readily, and unless used in large masses must be painted or impregnated with some protecting paint or varnish. Familiar uses are line poles, cross-arms, pins, trolley stand boards, contact shoe beams, etc.

The use of mica as the separator between the bars of commutators is familiar to all. It is universally employed for this purpose. Chemically it is a crystalline salt of aluminum and potassium or sodium. The

crystals easily split up into thin sheets. Its color varies from white to amber, the latter being the softer grade.

Besides being used in its natural state, it is often used in composition with other materials. Thus "mica plate" is made up of small pieces of mica and paper treated with a special binding material and steamed under pressure. Other compounds of mica are micanite, micarta, etc.

The chief uses of mica and its compounds are in places where the temperature is apt to reach a point where other materials would not stand up or where a high degree of insulation must be maintained in very small thicknesses. While the white mica is the better insulator, the amber mica is the softer and is therefore used on commutators which are not slotted and in which the mica must wear down as quickly or more rapidly than the copper itself.

Asbestos, found chiefly in Canada, consists mainly of silicate of magnesia, fibrous in its nature, and capable of being woven if combined with cotton or other material, the fiber of the asbestos being too short to give the necessary strength alone. Its dielectric strength is not great and its chief use as an insulator comes in places where a high temperature or arcing occurs. It is familiar to all in the form of tape, cloth, paper, wall-board and "lumber" or "shingle," the latter being compounds of asbestos and portland cement.

Shellac, which is used as a binder, is a peculiar form of resin, the name being in reality a combination of the two words, shell and lac; that is to say, shellac is a shell-like form of lac. Lac is formed by an insect or parasite that lives on a tropical tree. The female sucks the juice from the tree, digests it and exudes it over herself, finally incrusting herself entirely with it, and lays her eggs in this envelope. In true India fashion she dies therein and her progeny eat her carcass and break their way out through the lac envelope. The twigs of the tree are covered with these envelopes and in this form are known as stick-lac. The lac is rubbed off the twigs and washed in water and in this form is called seed lac. These seeds are placed in cotton bags before a fire and the bags squeezed, the lac dripping out in much the same fashion that the housewife strains fruit juice for jellies. The lac drops on rollers or sticks to which it adheres in a thin shell, hence the name of "shell-lac."

MOLDED INSULATION HAS MANY FORMS

Molded materials derive their names from the fact that they are formed in molds and generally under pressure. They thus can be given practically any form, often with a high surface finish and of accurate dimensions. In many cases the molding process also permits the inclusion of brass inserts which are locked in by the compound around them and which can be tapped for screws, etc. They consist of mixtures, sometimes chemical compounds, of some of the materials already mentioned, rubber, asbestos, mica, fiber, shellac gums, asphaltic compounds and the so-called "synthetic resins." They are composed essentially of a filler and a binder, either of which may be the actual insulator, the other being included to give the desired form and mechanical properties.

Practically all are "trade compounds," the exact nature of which is kept more or less secret, but it is possible to give the reader a general idea of some of the better known materials. Those who are more particularly interested in the detailed chemical analysis

will find several books and technical articles in the chemical press, to which they are referred.

The question is sometimes asked as to which is the best insulator among the molded materials, and in answer it may be generally said that that depends on the service to which it is to be put. Sometimes the need for great dielectric strength is paramount, at other times the electric stresses are not excessive, but the part must withstand considerable mechanical stress. At still other times heat is the controlling feature, or moisture may be the determining factor. Various compounds have been developed to meet these particular conditions, it being more or less true that one form of excellence is usually obtained at the expense of other points.

Thus, according to one authority, "compounds using the various grades of shellac as a binder are as a rule of low heat-resisting qualities, and owing to the nature of the filling materials, such as fiber and ground mica, will not take a practically high finish. These same fillers, however, impart to the stock relatively high mechanical and dielectric strength."

On the other hand some of those compounds using rubber as a binder "have relatively low mechanical strength of one sort, but have great strength of another sort, in that they successfully withstand blows and sudden shocks, being slightly elastic; that is to say, not at all brittle. On the other hand, they will not readily take inserts, such as screws and small metal parts. Their flexibility, however, permits them to be readily molded into large heavy shapes, and they are particularly adaptable, owing to their high resisting qualities for such parts as grid resistance frame bolts, fingerboards, division plates, arc chutes, coil and switch boxes. The flexibility also permits this class of material to be used for parts that are bolted or clamped to uneven surfaces of any kind, as, for instance, busbar installations.

In mechanical strength the synthetic resins, such as "Bakelite," stand alone among the molded compounds. Furthermore, they do not absorb moisture and they resist the action of nearly all acids and alkalis and can be used in the presence of oil.

In determining the relative value of the various materials four chief tests are made in the laboratory. The first of these is the dielectric strength test, in which it is customary to immerse the piece in oil, to decrease the surface leakage by increasing the dielectric surrounding the test piece. This permits the piece to be punctured before it arcs over. When the piece is punctured its thickness is measured in thousandths of an inch and the dielectric strength is calculated in volts per mil.

The second test is that for mechanical strength. The tensile strength is determined on a flat piece $\frac{1}{2}$ in. thick and of shape approximating the figure 8, with the use of special clamps in an ordinary tensile test machine. The compressive strength is obtained on a specimen molded in the form of a cube in a hardened steel mold, 1 in. on edge. The transverse strength is determined on a $\frac{1}{2}$ -in. square specimen, 5 in. long. The maximum fiber stress is calculated by the formula
$$S = \frac{3PL}{2BD^2}$$
 in which S = maximum fiber stress, P = load applied, L = distance between supports, B = width of specimen and D = depth of specimen.

The third test is that of distortion under heat, in which a test specimen is used for the same size and

shape as that used in the transverse test. A special apparatus is used in which the specimen is supported on two steel supports, with a load applied on top of the specimen vertically and midway between the supports. The vessel in which the specimen is placed on these supports is surrounded with oil in another outside vessel. Arrangements are made for raising the temperature of the oil gradually. The machine is so arranged that the deflection of the specimen at the center can be measured on a scale, and is equipped with a thermometer so that the temperature of the specimen can be recorded at any time.

The fourth test is that of the effect of moisture, in which the original weight of the specimen is obtained, the dry weight after heating in an oven for a specified time and the saturated weight after immersion in water for 100 hours. Record is also taken of the percentage of moisture in the specimen as received, and the percentage of moisture absorbed during 100 hours, taking the dry weight as 100 per cent.

In the tensile and compressive test specimens are tested under three different conditions, namely, (1) In condition in which they are received, (2) after heating in an oven for one hour at a temperature 10 deg. C. below the distortion point of the material, as determined by the distortion test, and (3) after being entirely immersed in distilled water for forty-eight hours at normal room temperature.

In the transverse test specimens are tested as received, and also after immersion. Dielectric tests are made of specimens as received, after heating in oven and after having the rim immersed in melted paraffin for a depth of 1 in. and been entirely immersed in distilled water.

Further details of the tests will be found in "Tentative Tests for Insulating Materials," published by the American Society for Testing Materials, and from which the above was taken.

MOLDED MICA, ETC., USED FOR OUTDOOR WORK

The mica compounds use shellac as a binder, and often contain a certain amount of asbestos, which by virtue of its fibrous character gives the composition a mechanical strength which the mica alone does not possess. All of the materials being weatherproof, this composition lends itself to outdoor work.

The word "Vulcabeston," while a trade name, has been in use so long as practically to represent compounds of asbestos and rubber which are vulcanized.

"Bakelite" is the name given by Dr. Bakeland, the inventor, to a material made by his patented formula. It is essentially a product of the modern chemist, it being what is known as a synthetic resin; that is to say, a resin not found in nature, but one put together from certain definite materials according to a special process. The chemist tells us that it is a compound of formaldehyde and phenol, which admittedly does not convey much information to any one but a chemist. Suffice it to say that they are both organic compounds (not mineral) and are constituents of coal tar, that marvelous substance which results from heating coal with insufficient air and from which have sprung the extraordinary series of aniline dyes, perfumes, medicines, high explosives, etc., with which the modern chemist has astonished the world. These two compounds when properly treated combine to form the remarkable transparent substance "Bakelite," with which we have all become familiar in the form of pipe stems, fountain

pens and toilet articles. In molded insulations it is used as a binder with wood or asbestos as a filler and is colored with various dyes.

PHYSICAL AND ELECTRICAL PROPERTIES

According to the authority already quoted, the dielectric strength and other properties of various compositions are as follows:

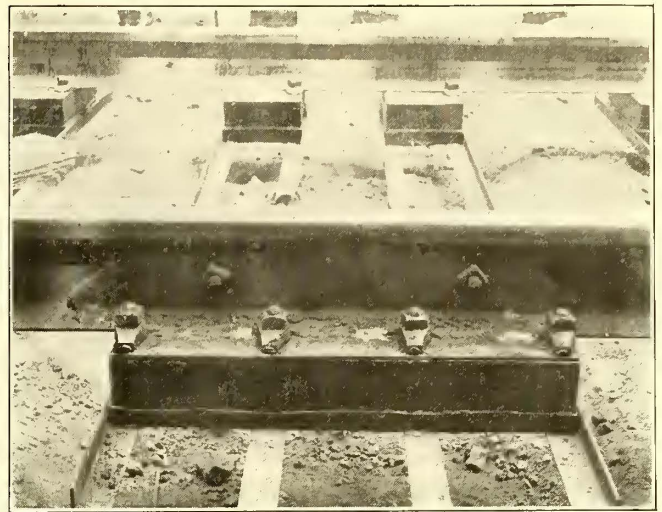
	Dielectric Strength, Volts per Mil	Transfer & Strength Lbs. per Sq. In. Cross-section	Heat Test, Deg. F.	Absorption After 48 Hours in Cold Water, per Cent
Shellac—mica compounds	300-330	7,000-11,000	120-185	0.2-5.0
Asbestos—rubber compounds	90-180	3,600-9,000	300-500	1.5-0.6
Bakelite compounds	230-300	13,000	225-300	0.6-0.1

No attempt has been made in this article to cover all the materials for insulating purposes or to give more than a bare outline of some of the more salient characteristics thereof. But the subject is one which has received but little attention in the electric railway press, and this article may therefore serve to throw some light on these very interesting materials.

Resilient Track Laid in Wausau

Company Operating in Small Wisconsin City Free from Paving Burden—Constructs Track Ahead of Paving Work Which Is Done by the City

THE Wisconsin Valley Electric Company, which operates the local street railway system in Wausau, Wis., built 1 mile of double track last year, making use of a monolithic concrete paving and substructure construction and Dayton mechanical ties. As the company was relieved from doing any paving on streets occupied by car tracks, the pouring of the concrete paving in the trackway as well as at the sides of the streets was done by the city. The street railway company therefore assembled the ties and rails, welded the joints and brought the track to grade and alignment ahead of the paving work, and then had the city pour the concrete for the substructure as well as for the paving in the trackway. The concrete pavement was made 8 in. thick outside the car track, while the thickness of concrete in the track-



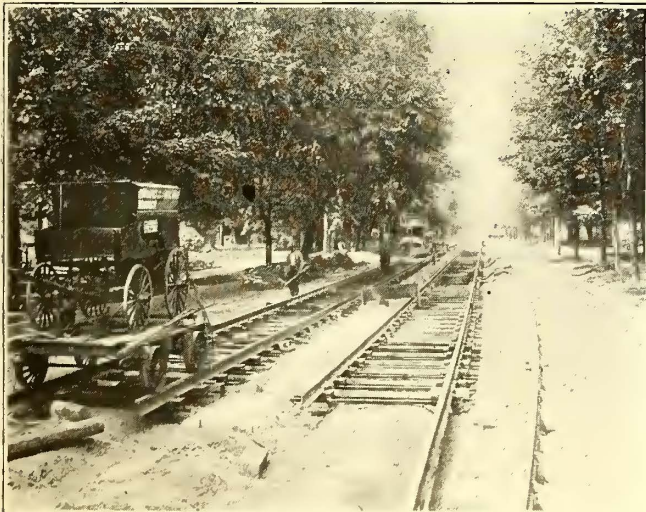
CLOSE-UP VIEW OF JOINT CONSTRUCTION SHOWING APEX WELDING AND RESILIENT MECHANICAL JOINT TIE

way ran to 15 in. The company then simply reimbursed the city for the additional 7 in. of concrete placed in the track foundation. While the track construction was going on, the old track was thrown over to one side of the street and operation continued, as shown in one of the accompanying pictures.

The type of construction used, employing T-rail, with the "Apex" welded joints of the Indianapolis Switch & Frog Company and the patented ties and special joint ties of the Dayton Mechanical Tie Company, are shown in the accompanying pictures. In speaking of the results obtained with this type of construction, N. C. Rasmussen, superintendent, made this comment:

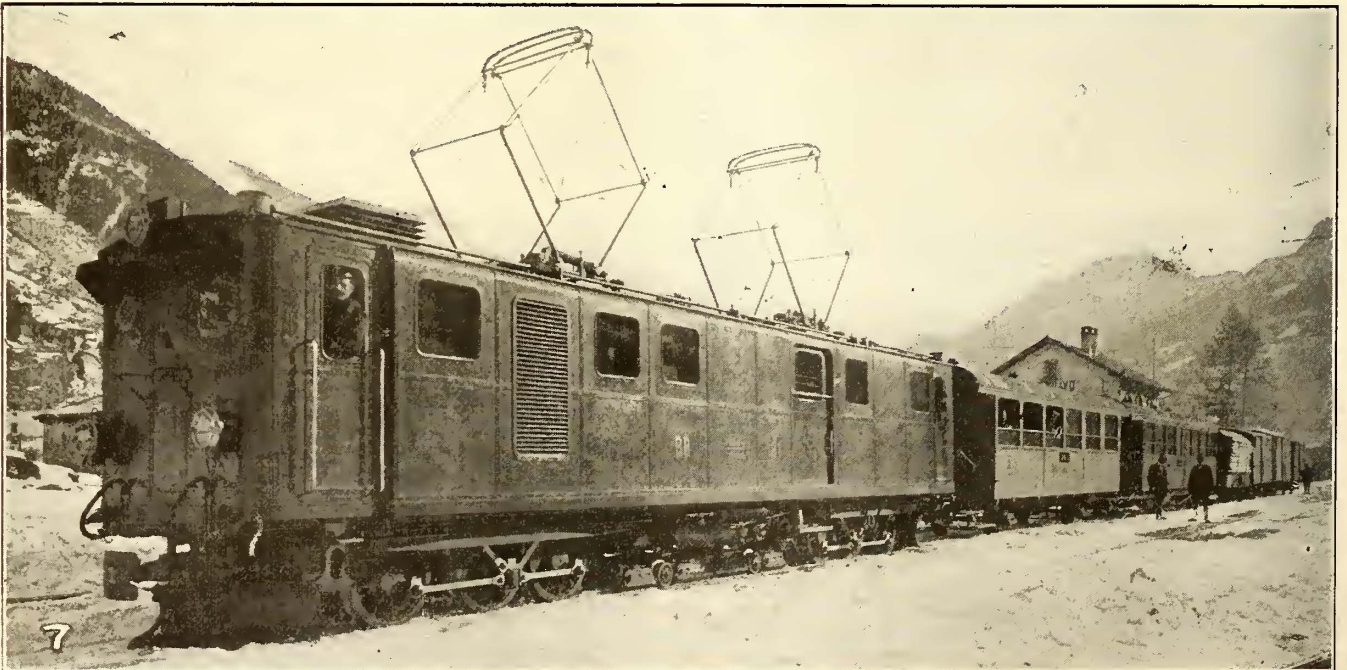
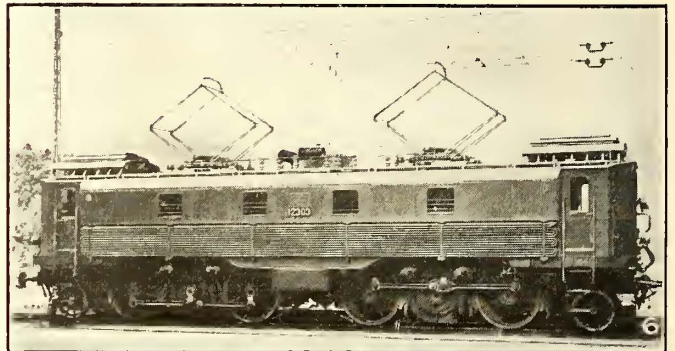
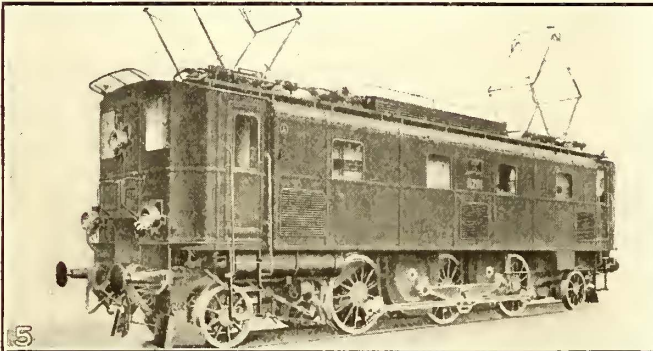
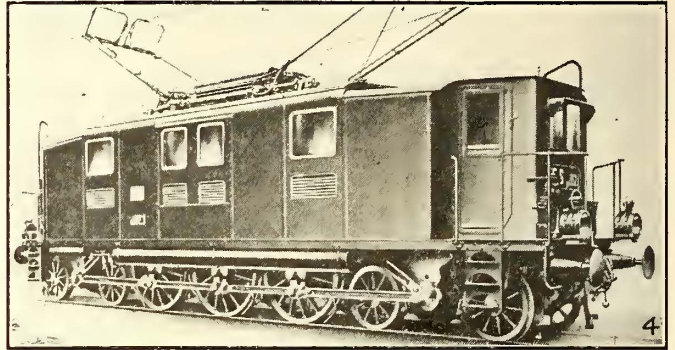
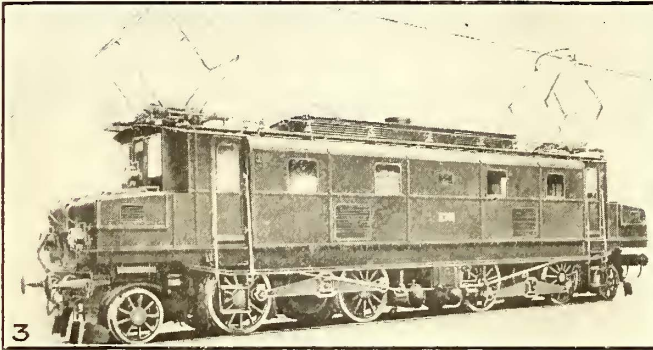
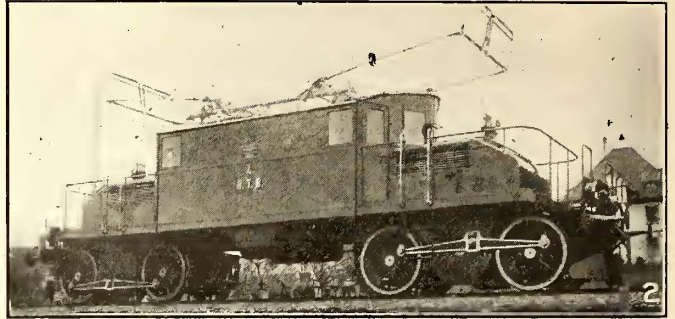
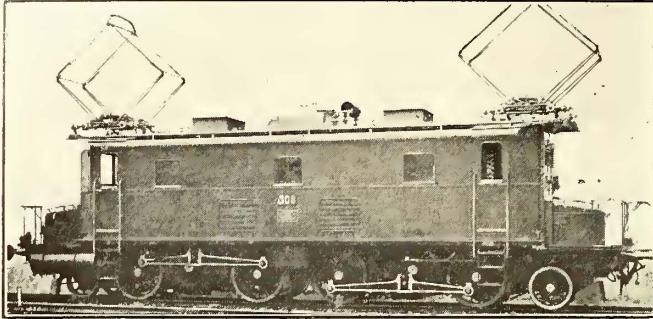
"It is of course too early to say how this track is going to stand up under traffic, as it has not been in service long enough, but from the indications thus far it is all right. It rides smoothly and quietly and we believe it is the coming thing in track construction."

In the accompanying picture showing the completed track construction it will be noted that the concrete paving has been crowned between the rails to make the flangeways. The black jagged appearance along the flangeways is sand and refuse and not chipped concrete, as one might be led to believe.



AT LEFT, TRACK CONSTRUCTION BLOCKED UP TO GRADE, SHOWING MECHANICAL TIES IN PLACE READY FOR POURING CONCRETE BASE AND PAVING, AND, AT RIGHT, APPEARANCE OF COMPLETED CONSTRUCTION

Representative Types of Swiss Electric Locomotives



No. 1—Single-phase locomotive for the Bernische Dekretsbahnen made by B. B. & Cie.

No. 2—Latest three-phase type BB locomotive (BBC) for the Burgdorf-Thun Railway.

No. 3—Swiss Federal Railways locomotive—an Oerlikon type 1-B-B-1.

No. 4—A three-phase Oerlikon locomotive, Italian State Railways.

No. 5—A-1-C-1 type Oerlikon locomotive used on the Swiss Federal Railways.

No. 6—One of the type 1-B-B-1 locomotives (BBC) used in the St. Gotthard Railway electrification.

No. 7—Bernina Railway type CC single-phase freight locomotive made by Brown, Boveri & Cie. with a 100-ton train at Poschiavo station.



A TYPE 1-BB-1 OERLIKON LOCOMOTIVE OF THE BERNESE RAILWAY

Swiss Electric Locomotive Progress

Details Are Given of Recent Locomotives Equipped by the Leading Two Builders of Electrical Apparatus in Switzerland—Particular Attention Is Given to the Machines for the Federal Railways—Some Experiments with New Types of Drive Are Included, Indicating a Leaning Toward Gears as a Substitute for Side Rods

THE electrification situation in Switzerland was briefly summarized in the issue of this paper for Jan. 1. For that issue the important Swiss manufacturers of electrical equipment, Brown, Boveri & Cie., Baden, and the Ateliers de Construction Oerlikon, Zurich, had arranged to furnish the latest information on the electric locomotive construction of these companies. However, owing to the post-war slowness of the mails the information arrived too late for the annual statistical issue, but it is given in part below. The purpose of this article is to give interesting detail regarding some of the latest commercial and experimental locomotives, for the purpose of indicating the nature of the problems which the necessity for immediate electrification has imposed on the engineers of Switzerland.

LOCOMOTIVES FOR ST. GOTTHARD

Pre-eminent at the moment is, of course, the St. Gotthard electrification, now in partial operation. An illustrated and detailed description of the freight locomotive furnished by the Oerlikon Company appeared in the issue of this paper for Aug. 7, 1920, page 256. Of this type, 1-C-C-1, thirty-three machines have been ordered up to about Jan. 1. This company is also furnishing locomotives of two other types for fast trains, 1-C-1 and 1-B-B-1. Data regarding all of these are given in Table I, and the appearance of the 1-B-B-1 machine is shown in the photographs reproduced.

A number of locomotives have also been furnished for the St. Gotthard electrification by Brown, Boveri & Cie. The plan of the State Railways before the war was to conduct extensive experiments on the Loetschberg line with several types of locomotives for the St. Gotthard electrification, but the critical coal shortage forced the prompt completion of the initial installation.

Brown, Boveri & Cie. are building two types of locomotives for this line, one for express passenger trains, the other for freight trains. Following are some details of the former:

The running gear of the machine is in two sections, each containing two driving axles and a pony axle. The two trucks are connected by means of a flexible coupling. Two motors of a truck drive, through pinions, a gear mounted on a jackshaft which is connected by connecting rods with the driving axles. To reduce the vibration due to the single-phase current all pinions are provided with rims flexibly mounted on the centers. This also insures uniformity in contact of the gears on the two sides, the transmission being bilateral, with a 90-degree angular displacement of the two drives.

The cab rests on two supports on each truck. The center plate of one is fixed, while longitudinal movement of the other is provided. This prevents any transmission of force from truck to truck through the cab. There are also auxiliary points of support for the cab to distribute the weight properly. These are near the interior motor axles.

The locomotive is equipped with Westinghouse air brakes, four brakeshoes to the driving axle. The compressed air for brakes, sanders, whistles and electrical

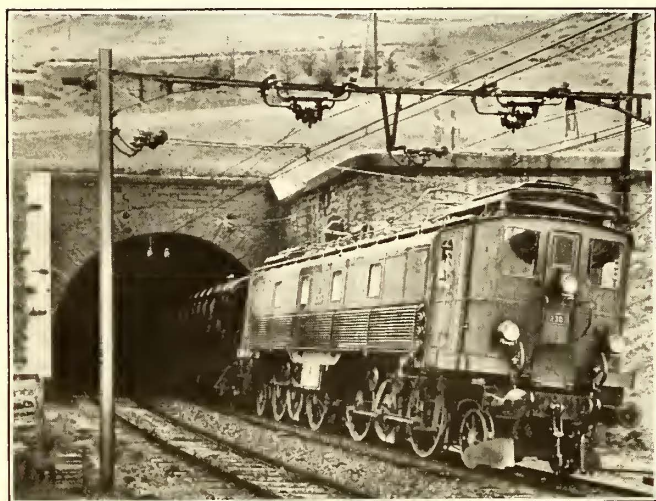
TABLE I—DATA OF OERLIKON LOCOMOTIVES FOR ST. GOTTHARD ELECTRIFICATION

	1-C-1	1-B-B-1	1-C-C-1
Maximum tractive effort, pounds.....	24,800	39,600	52,900
Horsepower at wheel rim (1½ hour).....	1,650	2,250	2,200
Normal speed, miles per hour.....	32	32	21.7
Maximum speed, miles per hour.....	66.6	66.6	40.4
Trailing load on 2.6 per cent grade at normal speed, tons.....	237	330	475
Weight complete with equipment, tons.....	100	125	141
Maximum wheel pressure, tons.....	10.7	11.0	10.0
Total length.....	44 ft. 4 in.	53 ft. 2 in.	63 ft. 7 in.
With or without regeneration.....	Without	With	With

apparatus is furnished by two type-BBC compressors. The total weight of the express locomotive is 118 tons and the freight locomotive 133 tons. The mechanical parts of the locomotives are under construction by the Swiss Locomotive Works at Winterthur.

In the arrangement of the electrical apparatus, all of the principal control equipment is so related to the transformer as to form a complete group which can be installed or removed through a hole in the roof. The tank of the transformer is designed for the support of the apparatus, its sides being constructed of strong plates reinforced with angle irons. The transformer oil is circulated by means of a pump through cooling pipes mounted on the side walls of the cab. This arrangement is said to provide a transformer system no heavier than one involving air cooling. The transformer, of 1,730-kva. capacity, lowers the voltage from 15,000 or 7,500 to 1,325. Its weight without the cooling coils and pump is 27,560 lb.

Current is taken from the line through two independent pantographs. After flowing through the lightning arrester installed on the roof, it passes through



TRAIN LEAVING THE ST. GOTTHARD TUNNEL AT AIROLO

the high-tension circuit breaker and the transformer, thence by way of the motors and the trucks to the rails. The high-tension breaker is installed in an opening provided in the roof.

The four motors of one locomotive form two groups, connected in parallel, the two motors of each group being in series. The series connection is permissible because the motors are mechanically coupled. The motors are of the series compensated type, with a commutating field. Between the armature inductors and the commutator are resistors so placed as to be well ventilated. Regulation of speed is by variation of voltage in eighteen steps from 237 to 1,325 volts (for two motors in series). The voltage is varied by means of an ingenious commutator resembling a storage battery regulator, but with auxiliary switches which break the local circuit as the brushes pass from contact to contact. The locomotives are provided with multiple-unit control so that two can be operated as a unit.

An essential feature of these locomotives will be provision for electric braking for the purpose of reducing brakeshoe wear and the consequent dissemination of iron dust in and about the machine. It was not considered necessary to provide for return of power to the line. A sample locomotive has been provided with re-

sistors, shown mounted on the roof in one of the illustrations, which absorbs on down grades the direct-current power produced by the motors. The location of the resistors was selected to provide maximum natural ventilation. If this type of braking process is satisfactory other locomotives will be similarly equipped.

The locomotives mentioned above are designed for the Erstfeld-Chiasso section of the St. Gotthard electrification, which will be next equipped. For this work the passenger locomotive must climb a 2.6 per cent grade with a 330-ton train at 22 and 31 m.p.h., and the freight locomotive must draw the same load up this grade at 31 m.p.h. or 473 tons at 22 m.p.h. The power developed on the grades is 2,500 hp., with tractive efforts for the two locomotives respectively of 27,500 lb. and 37,400 lb. On the maximum grade the values are 35,200 lb. and 48,400 lb.

NEW TYPE OF LOCOMOTIVE WITH INDIVIDUAL DRIVE OF AXLES

A locomotive which has been in experimental use on the Loetschberg line for nearly two years is equipped with two varieties of individual axle drive. This form of drive has not yet been generally employed in Europe, although it has been popular in America. In Europe the preference has been for few motors of large power rather than many of small power. The designers of this experimental locomotive recognized as ideal the form of drive used on tramway cars, as it gives a uniform rather than a pulsating transmission of torque, and they applied it here in principle. They found it possible to design a single-phase machine with 300 hp. per axle for a speed of from 22 to 28 m.p.h. A motor of this kind weighs, with gears, about 13,200 lb. Application of direct drive of this sort is difficult, however, for express train locomotives. For European conditions three motor axles are in general sufficient, while for the greatest exigencies in express traffic, four driving axles, with 700 to 800 hp. each, are sufficient. This is too much for tramway drive, but even if it were not the necessary speed would be too high.

The present experiment in drive is due to Chief Engineer Tschanz of the Federal Railways. One axle of the locomotive has a drive invented by him, while a second has one designed by Brown, Boveri & Cie.

Both of the schemes involve the placing of the gears outside the driving wheels to insure the maximum space for the motor. In the Tschanz plan the motor is "elastically mounted" on the locomotive underframe. The motor torque is transmitted through an intermediate axle located on about the same level as the motor axle and nearly over the driving axle. Thence the torque is transmitted by means of gears to another axle carried inside the hollow driving axle to a flexible driving coupling on the far side.

In the "BBC" drive the motor is mounted on the locomotive frame directly above the driving axle. The motor torque is transmitted by means of pinions, one on each end of the axle, to gears carried by the locomotive frame and located outside of and directly opposite the driving wheels. Thence it is transferred over to the latter by means of an ingenious link and gear coupling which permits relative vertical movement of the driving gear and the locomotive driving wheel. With this design it would be possible to use a motor as large as 1,000 hp. The external arrangement of gear is said to be particularly advantageous with respect to inspection.

The experimental locomotive has given satisfaction in service and both types of drive have worked well.

Among other interesting recent Swiss locomotives is the new three-phase machine built by Brown, Boveri & Cie. for the Burgdorf-Thun line. This is of extremely simple mechanical construction, with two swivel trucks, each carrying one motor; a design which could be adopted on account of the small power capacity required. In the middle of each truck is a 260-hp. motor geared to a jackshaft, which, through cranks and connecting rods, drives the two axles. As in other drives of this general type the driving pin on the crank works in a vertical slot in the center of the connecting rod so as to permit some vertical movement of the pin with relation to the connecting rod, thus providing for displacement of the truck springs.

The electrical equipment is designed for the mean line voltage of 750, but provision is made for an increase to 1,500. The frequency is 40 cycles per second. Four speeds are provided by means of pole changes as follows: 8.7 m.p.h., 12 poles; 12.4 m.p.h., 8 poles; 18 m.p.h., 6 poles; 27.3 m.p.h., 4 poles. The respective tractive efforts on an hourly rating are 21,300, 15,000, 10,200 and 6,800 lb. The rotor is of the "squirrel-cage" variety, regulation of starting voltage applied to the stator being provided by means of two auto-transformers connected in "V," with taps for various voltages from 214 to 900. At the lower two speeds the stator is "delta-connected"; at the higher speeds, "star-connected." It has two independent windings to permit the changing of the number of poles.

The locomotive is provided with a roomy cab which is available for the auxiliary apparatus, the smaller parts of which are inclosed in cabinets along the walls. Projecting from each end of the cab is a hood which covers the motors and transformer and commutating switch. The total weight of the machine is 96,600 lb., almost equally divided among the four axles.

The Burgdorf-Thun Railway, which is the most important three-phase line in Switzerland, has also ordered two motor cars of an entirely new type from the Oerlikon works. As this article, however, deals with locomotives, details of the motor car will not be given here.

The accompanying illustrations of typical Oerlikon and "BBC" locomotives have been selected to indicate the present trend in Swiss design.

Hunters Find a Canvas Back

A RAILWAY company that had been accustomed to the operation of the old style non-ventilated motor placed in service a number of safety cars equipped with the modern light-weight ventilated type of motor. Recently this company had several cases of roasted armatures develop on these motors and there was no apparent cause for the trouble, as all motors were operating under the same service conditions.

About this time, in connection with service tests that were being made on these cars, the temperatures of the motors were taken at the end of the test run, and to the surprise of the testing force it was noted that the temperature of the No. 2 armature on one of the cars was 35 deg. above that of the No. 1 armature. It was at first thought that perhaps the No. 1 motor was cut out by the operator due to some temporary trouble, but this was not the case. It was then intimated that probably there was some error in the car wiring that had overloaded the No. 2 motor, but the car wiring was found to be O.K. Finally, during the making of a care-

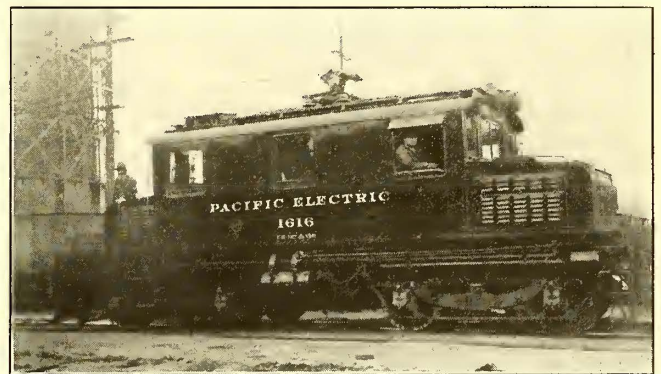
ful inspection of the motors, it was discovered that the No. 2 motor had a strip of canvas under the ventilating covers at the air outlet of the motor frame, thus choking the ventilation of this motor and accounting for the dangerous operating temperatures.

When the carhouse men were questioned it was found that on account of the heavy snows all motors had been closed in the above manner to keep out the snow and water during the winter season. This canvas was supposed to be removed from all motors when the warm weather set in, but apparently this frame was missed, and this carelessness on the part of the carhouse men was responsible for the roasted armatures.

This incident helped to drive home a very important point regarding the keeping of records on armature failures, as it was suggested that if such information had been available on this property the cause of the trouble might readily have been run down by tying up all armature failures to a particular motor frame in position No. 2 on a definite car.

New Locomotives in Service on Pacific Electric Railway

THE Pacific Electric Railway has recently purchased from the Westinghouse Electric & Manufacturing Company two 1,000-hp. locomotives to be used in its interurban freight service. The volume of this traffic has been steadily increasing, especially on the heavy hauls from Los Angeles harbor to the city of Los



NEW INTERURBAN FREIGHT LOCOMOTIVE ON THE PACIFIC ELECTRIC RAILWAY

Angeles, and these two locomotives, together with the fifteen original ones, were needed to handle the traffic.

The new locomotives, weighing about 129,000 lb., are 3,000 lb. heavier, although similar in class to those already in use. They are of the steeple double-truck type, having four 250-hp. motors.

The principal improvement is the use of two air compressors having a combined capacity of 150 cu.ft. of air per minute, compared with a total capacity of

CHARACTERISTIC DATA FOR LOCOMOTIVES

Maximum tractive effort.....	30,000 lb.
Normal tractive effort at 18 m.p.h.....	21,000 lb.
Continuous tractive effort with forced ventilation	11,520 lb.
Maximum trailing load.....	1,200 tons
Average trailing load.....	600 tons
Maximum speed on level with 600-ton load..	25 m.p.h.
Maximum speed on 4 per cent grade with 600-ton load.....	10 m.p.h.

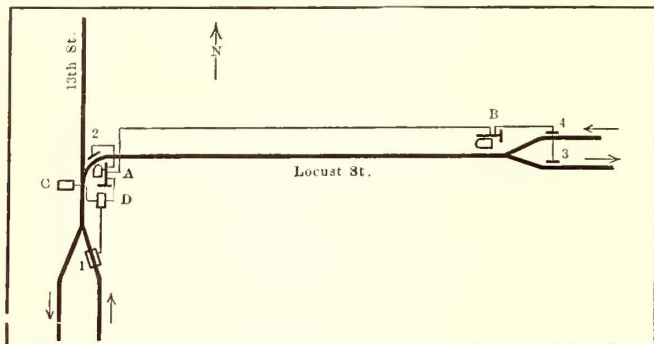
100 cu.ft. per minute of the compressors on the older locomotives. The improved and larger compressors are of the three-stage intercooler type driven by a compound dynamotor.

Combined Signal and Switch Installation

Somewhat Novel Equipment Consisting of an Electric Track Switch Operating in Conjunction with Block Signals on a Single Track Installed by the Terre Haute Company

AMONG the latest additions to the equipment of the Terre Haute Traction & Light Company of Terre Haute, Ind., is an electrically operated track switch which works in connection with a block of automatic signals.

As is indicated in the accompanying diagram, a line of cars runs north and south on Thirteenth Street through a short block of single track that is not signaled. At the corner of Thirteenth and Locust



SWITCH AND SIGNAL INSTALLATION IN TERRE HAUTE

A, B, Signals. 3, 4, Signal contactors non-directional shunt type. 2, Signal contactor uni-directional shunt type. 1, Contactor for switch and signal, non-directional series type. C, Ground box for switch. D, Circuit changer for switch and signal.

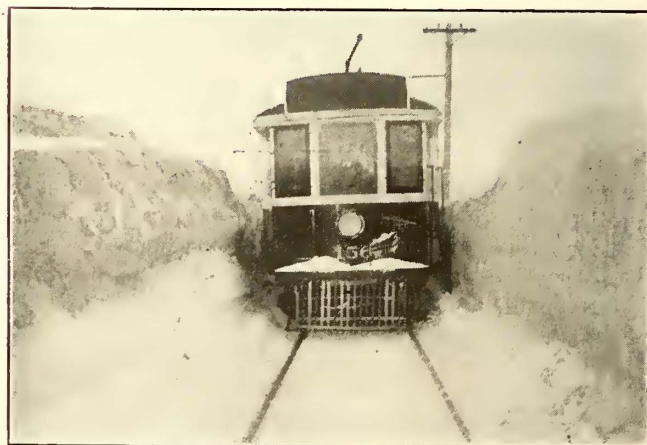
Streets a single-track line turns east on Locust Street. This block is provided with Nachod signals which prevent opposing movements through the block but permit several cars to follow at the same time. A northbound Thirteenth Street car drifting under the current selective contactor 1, which is located about 75 ft. back of the switch point, will not operate the block signals on Locust Street, but will insure the switch point being thrown for the straight track on Thirteenth Street. In order to throw the switch point for the diverging route into Locust Street, a car passing under the selective contactor 1 must apply two or more points of power. This throws the switch point for the turn into Locust Street and also sets the signals. Signal B, at the opposite end of the block on Locust Street, will indicate "Stop" and signal A, located an observation distance ahead of contactor 1, will then show "Permissive." As the car leaves the block at the other end on Locust Street, in passing under contactor 3 it restores both signals to the normal neutral or clear indication.

A Locust Street car coming west will set signal A at "Stop" and prevent an opposing movement while passing under contactor 4. Signal B will also be set at "Permissive." As the car passes under contactor 2 it will clear the block, providing, of course, that a second car has not followed the first at the permissive signal B, in which case the signal will not be cleared until the same number of cars have passed southward out of the block under contactor 4. Contactor 2 is inoperative when traversed in the opposite direction. The signals give indication by lights and disks of the same color for each indication.

The Cheatham switch used consists of a powerful double solenoid having a single armature so connected to the switch point as to throw it to either position according to which coil is energized. Each solenoid of this switch will exert a pull of over 400 lb. These solenoids are installed in a waterproof cylinder housed in a ground box with a removable cover. A relay or circuit changer is mounted on a pole near the switch. The contactor is of the series type without moving parts, the front and back contacts on the armature being connected respectively to the two switch operating solenoids. The current selective relay is adjusted so as not to pick up its armature with the current used for light, heaters and the compressor motor, but it will pick up on application of one or two points of power through the car motor. The circuit changer box also contains a time limit relay which will open the circuit to the operating solenoids and thus prevent their burning out if the car stands on the contactor for a period of more than five seconds. In operating with the Cheatham switch the motorman need not observe the switchpoint, but will always draw power under the contactor for the diverging route and will drift for the straight route irrespective of the previous position of the switchpoint.

Should it be desirable to signal the single-track block on Thirteenth Street contactor 1 may still be connected so that cars drifting under it will throw the switch and set the signals for Thirteenth Street and cars using power under this contactor will throw the switch and set the signals for Locust Street. With the installation of this equipment every important switching point on this property has been equipped with the heavy type of switches and locks. The signals used were furnished by the Nachod Signal Company, Inc., and the switches by the Cheatham Electric Switching Device Company. The installation was supervised by an engineer from the manufacturers.

Spring Snow in Winnipeg



SNOW CONDITION IN WINNIPEG

THE accompanying illustration shows the conditions with which the Winnipeg (Canada) Electric Railway is contending this spring. The snowstorm which caused the snow banks shown fell on March 16, and the photographs were taken on March 29, 1921. There had been no thaw or additional snowfall between those dates. The snowfighting equipment used by this railway was described in an article in the *ELECTRIC RAILWAY JOURNAL* for Feb. 19, 1921. It rendered efficient service in combating this belated storm.

Determination of Forces on Eccentric Levers and Bell Cranks*

Methods for Determining the Forces Developed by Eccentric Levers and Standard Bell Cranks Are Given, Also General Methods of Applying the Leverage Rule, Together with Simplified Solutions and Rules for Solving Brake Leverage Problems by Using the Proportional Lengths of Levers Instead of Their Actual Length

By H. M. P. MURPHY

THE eccentric type of lever was previously described and illustrated in the first article of this series published in the ELECTRIC RAILWAY JOURNAL for Jan. 15, 1921. It may always be treated as a modified form of the straight-line lever when the subject of force multiplication is involved, providing that the following instructions are carefully observed. The reasons for this will be made apparent by the subsequent illustrations and examples.

When an eccentric lever is in the exact position in which it is to perform its duty, the forces acting upon it may be determined thus: Extend the straight line, passing through the middle point and one end point of the lever, till it meets the line of action of the force acting at the other end point, then consider this straight line as a simple straight-line lever and apply the same rules to it as to any straight-line lever. The three points of such a lever are, of course, the middle point, and the end point of the eccentric lever through which the straight line passes, and the point at which this line meets the line of action of the force acting at the other end point of the eccentric lever. It is important to note here that the forces acting on an eccentric type of lever must be parallel, just as in the case of the straight-line lever.

FORCES DEVELOPED BY ECCENTRIC LEVERS

In order to illustrate the use of the preceding rule, consider the eccentric lever shown in Fig. 1 and let a weight of 6½ lb. be suspended from the point *a*, then to find the weight which must be suspended from the point *c* (i.e., to find the force developed at the point *c*) in order to produce equilibrium, draw a straight line through the points *a* and *b*, and extend it till it cuts the line of action of the left-hand weight at a point *d*. Now consider the line *a b d* as a straight-line lever, then by applying the "Leverage Rule" and considering the middle point, *b*, as the fulcrum,

The desired force =

$$\frac{(\text{the known force}) \times (\text{the lever arm of the known force})}{\text{the lever arm of the desired force}}$$

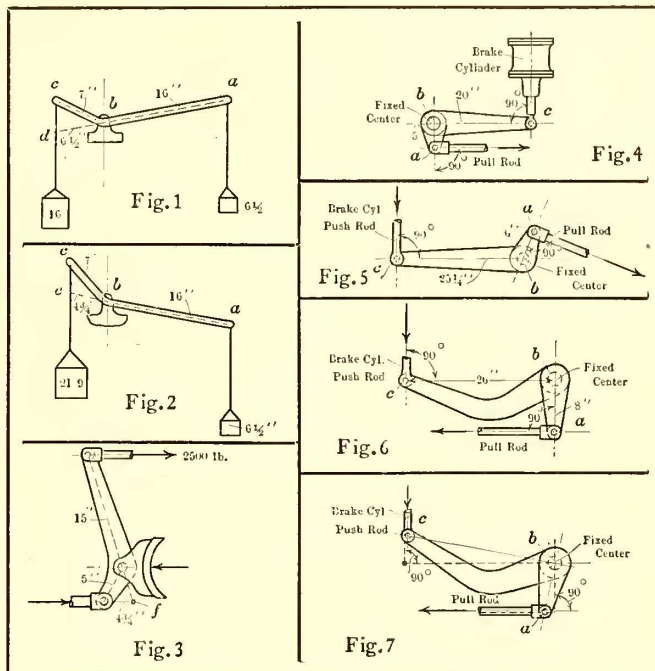
or

Force acting at *d* (or *c*) =

$$\frac{(\text{Force acting at } a) \times (\text{Lever arm of force at } a)}{\text{Lever arm of force at } d \text{ (or } c)}$$

$$\text{Force acting at } d \text{ (or } c) = \frac{6.5 \times 16}{6.5} = 16 \text{ lb.}$$

The length of the lever arm, *b d*, is, of course, ob-



COMMON FORMS OF ECCENTRIC LEVERS AND BELL CRANKS

Figs. 1 and 2—Diagrams to illustrate forces developed. Fig. 3—Practical form of eccentric lever. Figs. 4, 5, 6 and 7—Various forms of bell cranks.

tained by measuring the actual rigging or a scaled drawing. The force acting at the point, *b*, may also be found by the same method, thus, applying the "Leverage Rule" and considering the point *d* as the fulcrum,

$$\text{Force acting at point } b = \frac{6.5 \times 22.5}{6.5} = 22.5 \text{ lb.}$$

which is correct for force at *a* plus force at *d* must equal force at *b* (see Article 1), that is $6.5 + 16 = 22.5$ lb.

Now suppose that the eccentric lever shown in Fig. 1 is swung through a slight angle, about the point *b*, and is thus brought into the position shown in Fig. 2, and let it be required to find what weight (that is, force) must be applied at *c* to balance a weight of 6½ lb. applied at *a*. To solve this problem, draw a straight line through the points *a* and *b* and produce it till it intersects the line of action of the left-hand force at the point *e*. It will be readily seen from the construction of the lever (shown in Figs. 1 and 2) that the line *b e* is much shorter than the line *b d*, consequently a greater force must be applied at the point *c* to balance the 6½-lb. weight applied at *a* in the case under consideration than in the preceding example. To find the force acting at

*This is the fourth of a series of articles on forces developed in brake riggings. Others appeared in the Jan. 15, Feb. 19 and March 19 issues of this paper.

c, Fig. 2, consider the middle point, *b*, of the straight-line lever, *a b e*, as the fulcrum, then,

$$\text{Force acting at } e \text{ (or } c) = \frac{6.5 \times 16}{4.75} = 21.9 \text{ lb.}$$

and in this case the force acting at *b* is 28.4 lb.

IMPORTANT FACTS DEDUCED FROM EXAMPLES

The preceding examples show that when considered in some specified position the forces acting on an eccentric lever may be easily found by the simple method outlined in the first part of this article, but that, although the force acting at one point of an eccentric lever may be constant, the forces acting at the remaining points depend not only on the dimensions of the lever but also on the position of the lever. It should be noted here that as previously pointed out, this is not the case with the straight-line type of lever, the forces acting on which are entirely independent of the position or angle of the lever, and which, therefore, always bear the same fixed relation to each other, this relation depending only on the dimensions of the lever. For these reasons it is obvious that an eccentric type of lever is an extremely undesirable form to use in brake riggings, because as the brakeshoes wear, the leverage ratio will continually change, either becoming greater or less than the amount desired.

A practical form of eccentric lever is illustrated in Fig. 3. This type is found most frequently in traction service where the clearances are small and therefore where it is sometimes quite impossible to use the straight-line lever. As an example, let it be required to find the force delivered to the brakeshoe, in Fig. 3 when a force of 2,500 lb. acts on the pull rod attached to the upper end point of the lever. By drawing a straight line as indicated through the upper end point and the middle point of the lever and continuing it till it meets the line of action of the lower end force, and then measuring the length of this line (4 $\frac{3}{4}$ in.), and considering the point of intersection *f* as the fulcrum, we have:

$$\text{Force on brake beam} = \frac{2,500 \times 19.75}{4.75} = 10,395 \text{ lb.}$$

PRINCIPLES OF BELL CRANKS

It is important to state here that an eccentric lever must not be confused with the form of force-multiplying device known as a "bell crank," the standard form of which may be defined as follows:

A standard bell crank is a force-multiplying device which is adapted to maintain a fixed relation between the forces involved, and which consists of two rigid arms or bars securely connected with each other through the medium of a shaft. The standard form of bell crank must always be so constructed and installed that both arms will be acted upon at their free ends by independent forces which maintain constant directions, such that their lines of action will simultaneously form 90-deg. angles with the center lines of their respective arms.

It will be readily seen from the preceding definition that the forces acting on a bell crank of standard design are parallel only when the shaft center and the two end points lie in the same straight line. Bell cranks of various forms are illustrated in Figs. 4, 5, 6 and 7, where it will be noted that the center line of each arm is simply a straight line drawn through the end point (or pin center) of the arm and the shaft center, whether

the arm is straight or curved between these points. It will also be seen that the angle made by the center lines of the two arms may have any value whatever, as shown in Fig. 5, but usually for railway brake riggings this angle is given a 90 or 180 deg. value because of the location of the brake cylinders on locomotives, where the bell crank is most frequently used.

In this connection it should be pointed out that as the force action on the shaft of a bell crank is quite complicated and as the shaft is always supported by a fixed bearing, only the two forces acting at the free ends of the arms will be considered in the following discussion. The bearing forces are, of course, of no importance in any problem involving the subject of braking power. It should, moreover, be noted that a standard bell crank will always maintain a fixed relation between the forces acting on it, regardless of the position of the crank, providing that the lines of action of the various forces remain parallel to their own standard directions. Thus, if in Fig. 6, a given force be applied to the brake cylinder push rod, a certain definite force will be developed on the pull rod, and this force will remain constant no matter what angle the bell crank may be swung through, providing that the line of action of the push rod force remains vertical and the line of action of the pull rod force remains horizontal, as shown in Fig. 7. Of course, in practice it is impossible always to maintain these exact ideal conditions, but when they are obtained approximately the forces concerned will differ so slightly from the desired values that the variations produced need not be considered. This is also true of the "straight-line" type of lever.

DEFINITION OF "LEVER ARM" FOR A STANDARD BELL CRANK

The fixed, or shaft, center of a bell crank should always be considered as the fulcrum, or point about which the crank turns, for the end forces are the only ones which it is necessary to determine in braking power computations. Keeping this fact in mind the following definition will be readily understood:

The lever arm of a force acting at the free end of one of the arms of a standard bell crank is simply the straight line distance between the fulcrum (*i.e.*, shaft center) and the point of application of the specified force.

In order to obtain a clear understanding of the preceding definition, it will be well to refer to Figs. 4, 5 and 6, and to note that in each case when the point *b* is considered as the fulcrum the lever arm of the pull rod force is the line *b a* and the lever arm of the brake cylinder force is *b c*.

If the definition of the term "lever arm" for a standard bell crank is kept clearly in mind and if either one of the two end forces acting on the crank is known, the remaining force may always be found by aid of the "Leverage Rule" which was previously given for straight line levers (see article 1); that is,

$$\text{The desired force} = \frac{\text{(The known force)} \times \text{(The lever arm of the known force)}}{\text{The lever arm of the desired force}}$$

To illustrate the method of determining the forces acting on a standard bell crank let us consider the standard bell crank shown in Fig. 4 and let it be required to find the force acting on the pull rod when the dimensions are as indicated and a 14-in. diameter

brake cylinder is used, the air pressure being 50 lb. per square inch.

The table previously published in article 3 of this series gives the total force on the push rod as 7,697 lb., then by applying the "Leverage Rule" and considering the shaft center (or middle point) as the fulcrum,

$$\text{Force on pull rod} = \frac{(\text{Force on push rod}) \times (\text{lever arm of force on push rod})}{\text{lever arm of force on pull rod}}$$

$$\text{Force on pull rod} = \frac{7,697 \times 20}{5} = 30,788 \text{ lb.}$$

Now consider the standard bell crank shown in Fig. 5, and let it be required to find the force acting on the pull rod, when the force on the brake cylinder push rod is equal to 6,786 lb.

To solve this problem, consider the shaft center as the fulcrum, then, by applying the "Leverage Rule,"

$$\text{Force on pull rod} = \frac{6,786 \times 25.25}{6} = 28,558 \text{ lb.}$$

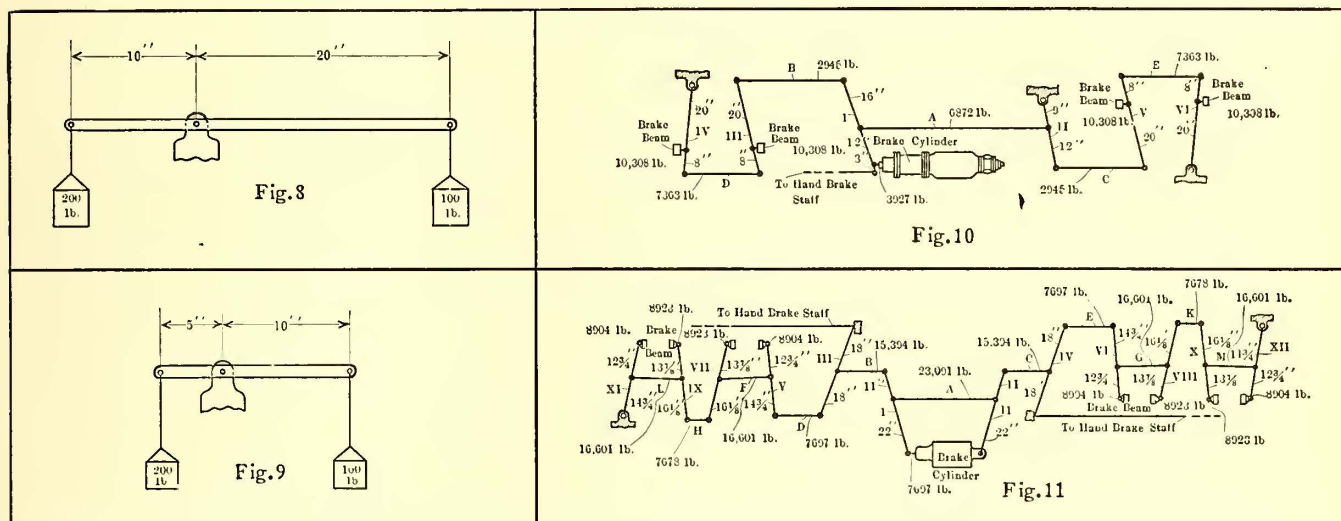
Next consider the standard bell crank shown in Figs.

This rule may, as previously stated, be expressed in the following mathematical form:

$$\text{The desired force} = \frac{(\text{The known force}) \times (\text{the lever arm of the known force})}{\text{the lever arm of the desired force}}$$

In order properly to apply the "General Leverage Rule" it is merely necessary to remember that the lever arm of any force always depends upon the location of the point considered as the fulcrum and is simply a straight-line distance which must be measured in the manner described in each case. It is also essential to note that the shaft center of a bell crank is the only point which it is ever desirable to select as a fulcrum, but that any one of the three points of a lever may properly be considered as a fulcrum whether there is a fixed point or not.

Attention should, moreover, be called to the fact that the "General Leverage Rule" is based on the assumptions that the three forces acting on a lever are always parallel to each other and that each of the end forces acting on a bell crank remains parallel to its standard



FIGS. 8 AND 9. DIAGRAMS TO ILLUSTRATE LEVER RATIOS. FIGS. 10 AND 11. BRAKE RIGGING DIAGRAMS

6 and 7 and let it be required to find the force acting on the pull rod, when a force of 10,053 lb. acts on the brake cylinder push rod.

To solve this problem, consider the shaft center as the fulcrum, then, by applying the "Leverage Rule,"

$$\text{Force on pull rod} = \frac{10,053 \times 26}{8} = 32,672 \text{ lb.}$$

The preceding discussions of levers and bell cranks have shown that in order to determine the forces acting on (or developed by) these types of multiplying devices it is merely necessary properly to apply the "Leverage Rule" given in article 1. Consequently, it will now be well to restate this rule in a more general way and to give a brief summary of the simple but important considerations involved in its correct use.

When the force applied at one of the points (or pin centers) of a lever or bell crank is known and it is desired to find the force developed at a second point, consider the third (i.e., remaining) point as the fulcrum, then the desired force may be found by multiplying the known force by its own lever arm and dividing this product by the lever arm of the desired force.

direction. It is, therefore, essential that these conditions be fulfilled as closely as possible in practice, in order that the forces concerned may bear the proper relations to each other. Slight variations from this desired state of affairs are always met with in actual constructions, but the degree of variation is so small in all good designs of brake riggings that it may be neglected.

LEVER RATIOS AND SIMPLIFIED METHODS FOR THE SOLUTION OF BRAKE LEVERAGE PROBLEMS

In all of the preceding discussions of the subject of leverage the actual dimensions of each lever and bell crank were always given when the forces developed were required, but obviously this is not absolutely necessary, as it is simply the comparative lengths of the lever arms that are essential: For example, as shown in Fig. 8, if a weight of 100 lb. is suspended from the end point of a lever at a distance of 20 in. from the middle point, a force of 200 lb. will be developed at the other end point, if it be located at 10 in. from the middle point. It is also equally clear, as indicated in Fig. 9, that if a weight of 100 lb. act at one end point of a lever at 10 in. from the middle point, a force of 200 lb. will also

be developed at the other end point if it be located at 5 in. from the middle point. These facts may be demonstrated by aid of the "Leverage Rule" as follows:

In the first case:

Weight on short arm =

$$\frac{100 \times 20}{10} = 100 \times \frac{20}{10} = 100 \times 2 = 200$$

And in the second case:

Weight on short arm =

$$\frac{100 \times 10}{5} = 100 \times \frac{10}{5} = 100 \times 2 = 200$$

It is therefore perfectly obvious that the relation existing between any two forces acting on a lever depend only on the comparative lengths of the lever arms concerned; that is, on the ratio of one of the lever arms to the other. Consequently it is quite common practice to speak of a lever as being divided in a certain ratio if it is distinctly understood that a certain definite point is considered as the fulcrum. When using this expression (*i.e.*, "lever ratio") it should, however, be emphasized that it is positively absurd to do so unless the assumed fulcrum be clearly specified; for example, the lever shown in Fig. 8 has a ratio of 2 to 1 when the middle point is considered as the fulcrum, a ratio of 3 to 1 when the left-hand end point is considered as the fulcrum and a ratio of 3 to 2 when the right-hand end is considered as the fulcrum. Much confusion is, therefore, apt to arise from an improper use of the term "lever ratio," and consequently it is strongly recommended that such an expression never be employed unless a positive means of reference is furnished, such as a sketch, when the ratio of one clearly specified lever arm to another may be mentioned without any possibility of confusion.

If the points mentioned in the preceding paragraph are kept clearly in mind, the following rules or laws will prove of much value in simplifying leverage problems.

First—When any two levers are divided in the same ratio with respect to two corresponding points considered as fulcrums these levers will also be divided in equal ratios with respect to all corresponding points.

To illustrate this, consider the levers, I and II, shown in Fig. 10, neglecting the 3-in. extension on lever I for the hand-brake attachment. These levers have the following ratios with respect to the corresponding points mentioned, considered as fulcrums:

With respect to the pull rod end:

$$\text{Ratio of lever I} = \frac{28}{16} = 1\frac{3}{4} \text{ to } 1$$

$$\text{Ratio of lever II} = \frac{21}{12} = 1\frac{3}{4} \text{ to } 1$$

With respect to the tie rod, A, or middle point:

$$\text{Ratio of lever I} = \frac{16}{12} = 1\frac{1}{3} \text{ to } 1$$

$$\text{Ratio of lever II} = \frac{12}{9} = 1\frac{1}{3} \text{ to } 1$$

With respect of cyl. end of I and fixed end of II:

$$\text{Ratio of lever I} = \frac{28}{12} = 2\frac{1}{3} \text{ to } 1$$

$$\text{Ratio of lever II} = \frac{21}{9} = 2\frac{1}{3} \text{ to } 1$$

Second—When all of the levers connecting with the

right-hand truck of a car are divided in the same ratios, with respect to similar points considered as fulcrums, as the corresponding levers connecting with the left-hand truck, the sum of the forces delivered to the brake beams of one truck will always be exactly equal to the sum of the forces delivered to the brake beams of the other truck.

As an illustration of this again consider the brake rigging shown in Fig. 10, and compare all corresponding levers with each other by considering similar points as the fulcrums; for example, with respect to their middle points, the ratios are:

$$\text{Lever I } \frac{16}{12} = 1\frac{1}{3} \text{ to } 1 \quad \text{Lever II } \frac{12}{9} = 1\frac{1}{3} \text{ to } 1$$

$$\text{Lever III } \frac{20}{8} = 2\frac{1}{2} \text{ to } 1 \quad \text{Lever V } \frac{20}{8} = 2\frac{1}{2} \text{ to } 1$$

$$\text{Lever IV } \frac{20}{8} = 2\frac{1}{2} \text{ to } 1 \quad \text{Lever VI } \frac{20}{8} = 2\frac{1}{2} \text{ to } 1$$

The levers I, III and IV, connecting with the left-hand truck, are divided in the same ratio with respect to similar points (the middle point being considered in each case as the fulcrum) as the corresponding levers, II, V and VI, respectively connecting with the right-hand truck. Consequently the sum of the forces delivered to the brake beams of each truck will be the same. The work of solving this example may therefore be reduced about one-half, for after having found that the sum of the forces delivered to the brake beams of the left-hand truck is equal to 10,308 + 10,308 lb.; that is, to 20,616 lb., the sum of the forces delivered to the brake beams of the right-hand truck is also known to be 20,616 lb., by aid of the foregoing reasoning.

Third—When the live and dead levers on a truck are all divided in the same ratio, with respect to similar points considered as fulcrums, the forces delivered to each of the brake beams will be equal to each other.

To illustrate this again consider the brake rigging shown in Fig. 10. Now the force delivered to the brake beam of lever III is equal to 10,308 lb. Consequently as the truck levers III and IV are divided in the same ratio with respect to similar points, the force delivered to the brake beam of lever IV will also be equal to 10,308 lb., this being determined by aid of the third rule just given, instead of by the long method of calculation given in the third article of this series.

The construction shown in Fig. 11 may also be used to illustrate this principle, for although the ratios of the truck levers are not exactly the same they are so nearly alike that the slight variation is of no practical importance; thus, considering the middle points of levers V, VII, IX and XI as the fulcrums, the ratio of each is:

$$\text{Lever V } \frac{14.75}{12.75} = 1.157 \text{ to } 1$$

$$\text{Lever VII } \frac{16.125}{13.875} = 1.162 \text{ to } 1.$$

$$\text{Lever IX } \frac{16.125}{13.875} = 1.162 \text{ to } 1$$

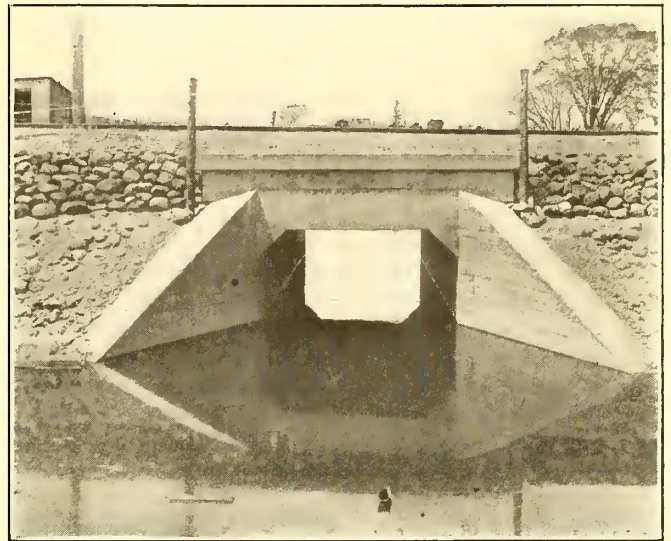
$$\text{Lever XI } \frac{14.75}{12.75} = 1.157 \text{ to } 1.$$

Consequently, as the force delivered to the brake beam of lever V is equal to 8,904 lb., the forces delivered to the beams of levers VII, IX and XI are also known to be approximately equal to 8,904 lb. by aid of the third law in question. Of course if the ratios of the

levers V, VII, IX and XI had been exactly equal, the forces delivered to each of the brake beams would also have been exactly equal. In all cases where the ratios of the truck levers are not equal, or very nearly equal, the short method just illustrated should not be used for their solution.

Fourth—When the two cylinder levers on a car are divided in the same ratio, with respect to similar points, the forces delivered to each of the end pull rods connected to them will be equal.

As an illustration of this, consider the cylinder levers I and II in Fig. 10. These levers have already been shown to be divided in the same ratio with respect to similar points, consequently, by the fourth law just stated, if a force of 2,945 lb. is delivered to rod B, the same force (2,945 lb.) will also be delivered to the rod C; this method will therefore considerably simplify the work otherwise required to obtain the same results.



BRIDGE IN PLACE, WITH NORMAL STREAM FLOWING THROUGH AFTER REPAIRS WERE COMPLETED

Raising a 500-Ton Concrete Culvert

A Washout on the Lines of the Rochester & Syracuse Railroad Undermined the Entire Footing of a Culvert, Which Was Successfully Salvaged by Raising to Its Original Position

BY D. E. CROUSE

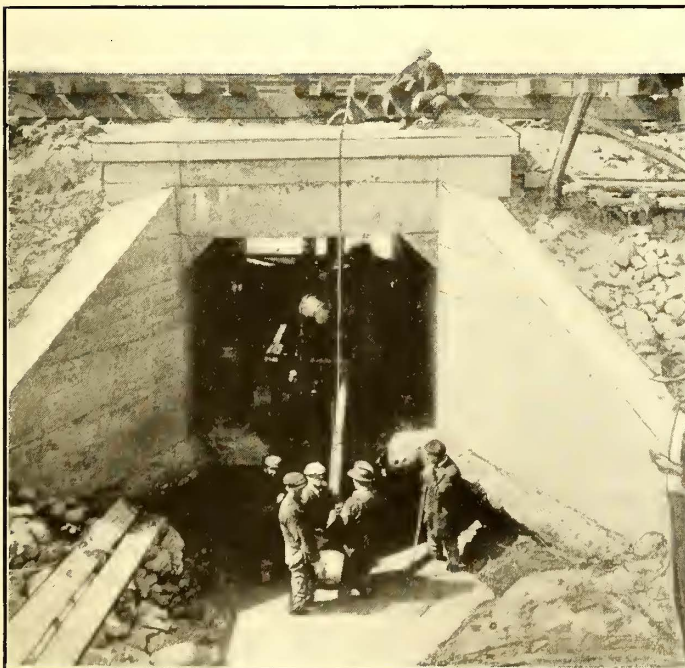
Chief Engineer Rochester (N. Y.) & Syracuse Railroad

THE accompanying illustrations show various stages of the work of salvaging a 500-ton concrete culvert which was washed out during the spring flood last year on the lines of the Rochester & Syracuse Railroad. The flood undermined the entire footing of the culvert shown and the south end of the culvert dropped about 4 ft. Before the high water subsided timbers were placed over the culvert to carry the railroad traffic, and as soon as the flood abated the normal stream was pumped out dry in order to make an inspection of the damage and ascertain how repairs could be made in an economical and satisfactory manner.

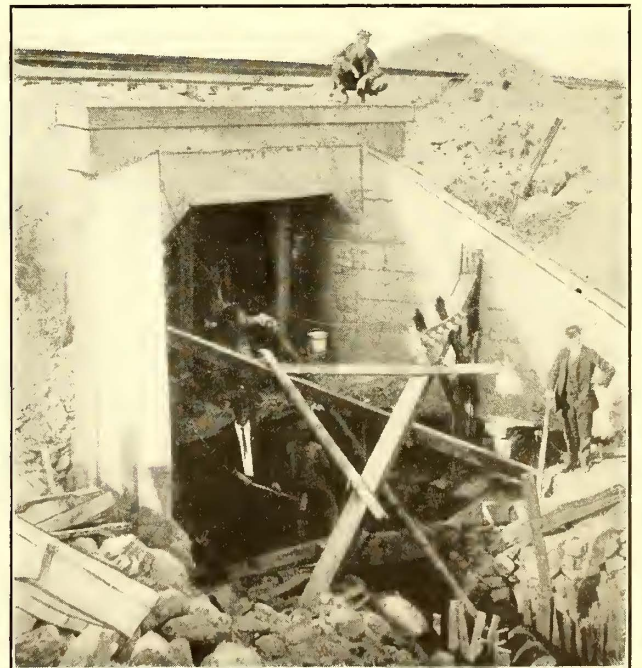
In order to keep the stream below the foundation level,

a 3-in. centrifugal pump was used on the south side and a 4-in. centrifugal pump was placed on the north side of the bridge. As shown in one of the accompanying illustrations it was found that the entire footing was undermined and that the culvert was practically resting on the tips of the wing walls. As there were no fractures in the concrete, it was determined to try and jack the culvert up to its original position and then replace the foundation. Earth was excavated from the sides of the culvert in order to free the batter and jacks were then placed under the entire footing course. Approximately 900 tons capacity in jacks was used and the culvert was successfully raised to its original position without a single fracture developing in the concrete.

With the culvert in place a new footing course was run in and the jacks were removed. The repairs as outlined cost \$650, and a replacement of the culvert which otherwise would have been necessary would have cost about \$4,000.



BRIDGE AFTER NORMAL STREAM HAD BEEN PUMPED OUT



WALLS EXPOSED AND JACKS PLACED READY FOR RAISING

Providence Engineers Discuss Electrification

At Joint Meeting of Providence Engineering Society and Providence Section A. I. E. E., C. C. Whittaker Outlines Electrification Status on a Number of Steam Railroad Properties

AN ILLUSTRATED lecture was given before the Providence Engineering Society, meeting in conjunction with the Providence Section of the American Institute of Electrical Engineers, on March 15, by C. C. Whittaker, railway engineering department Westinghouse Electric & Manufacturing Company. Among other things he said that studies on the substitution of the electric locomotive for steam motive power on a number of railroads have indicated that the resulting operating economies are sufficient not only to carry the charges on the capital investment but, in addition, the flexibility of the new type of motive power permits a greater volume of traffic to be handled over existing trackage and thereby obviates additional capital expenditure for increased trackage required with steam operation. In some cases it has been found that electrification will permit a road to care for a 75 per cent increase in tonnage with less capital expenditure than would be necessary for the expansion of steam facilities. In most cases the operating economies take care of the fixed charges on the increased capitalization.

In one case it was found that the gross investment for electric operation would be \$2,939,000 as compared with \$1,090,000 for steam, the net investment therefore being \$1,849,000. However, the relative operating expenditures were estimated at \$500,760 and \$925,165, a saving in operation of \$424,405. The return on the gross investment was 14.45 per cent and on the net investment 23.2 per cent. The costs of generated power were practically the same in this case under electric and steam operation, due to the fact that the location was in a coal mine district where coal was cheap.

A study made for a single-track Western railroad, where congestion was not involved and the general method of operation with electric power would be quite similar to that of steam, showed the following:

The section represented 133 route-miles of single track and provision was made for a 40 per cent increase in business. The gross investment for electric operation was \$12,561,000 and for steam \$3,599,260, or a net investment of \$8,961,740. The relative operating expenditures were \$3,826,381 and \$5,530,217. The annual saving in operation was \$1,703,836; the return on the gross investment, 13.6 per cent, and the return on the net investment, 19 per cent.

Mr. Whittaker then took up the various arguments in favor of electrification that have been advanced from time to time and briefly touched upon a number of typical installations. As to the matter of systems, he said that each system in use has reasons for its adoption, which fact is looked upon by broad-minded engineers as the one big factor that has caused the advancement of electric motive power to its present-day position. A decision as to system for a particular road or group of roads should be based upon engineering analysis from the standpoint of present and future requirements.

Among the interesting practical data which Mr. Whittaker gave were some relating to the Pennsylvania Tunnel and Terminal electrification in New York City.

Here thirty-three 166-ton electric locomotives, each equipped with two 2,000-hp. motors, have handled all the passenger trains into and out of the New York terminal for the past ten years. They have made a total mileage of more than 7,000,000, with 64,437 miles per locomotive detention and 11,456 miles per minute detention, including mechanical, electrical and man failures. The locomotives require tire turning on account of worn flanges every 50,000 miles on the average, the actual figure varying between 25,000 and 100,000 miles. One engine recorded 142,000 miles between tire turnings. Third-rail shoes require replacement in summer on a 15,000-mile basis and in winter on a 3,000-mile basis. The original commutator has not been turned since it went into service. Motor brushes have lasted for 150,000 miles and motor bearings are renewed on a 30,000-mile basis. The maintenance of these locomotives over an extended period has cost approximately one-sixth that of the equivalent steam locomotives.

Annual Report of the A. E. Standards Committee

This National Clearing House for Technical Information Is Now a "Going Concern"—Contributions from Industrial Associations and Companies Interested Will Be Required to Supplement Dues

ALTHOUGH the annual report of the American Engineering Standards Committee will not appear in final form for some time, from advance galley proofs it is possible to summarize a few of the facts of electric railway interest which it will contain. The committee now comprises the following member bodies: American Electric Railway Association, American Institute of Electrical Engineers, American Institute of Mining & Metallurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society for Testing Materials, Electrical Manufacturers' Council, Electric Light & Power Group, Fire Protection Group, Gas Group, National Safety Council, Society of Automotive Engineers, and the United States Departments of Agriculture, the Interior, the Navy and War.

In the report the functions of the committee are stated to be: To unify methods of arriving at engineering standards; to secure co-operation among various interested organizations in order to prevent duplication of work and promulgation of conflicting standards, but not itself formulate standards; to act as an authoritative channel of co-operation in international engineering standardization; to promote in foreign countries a knowledge of American engineering standards; to collect and classify data on standards, and to act as a bureau of information regarding standardization.

The committee has now been actively at work for more than a year, although much of the time and effort so far have necessarily been spent on laying a basis for work. Prior to Dec. 31, 1920, three standards were approved, these bearing respectively the numbers 1, 2 and 3. Specifications and tests for portland cement were approved as "tentative American standards"; specifications for fire tests of material and construction were similarly approved, and certain pipe threads were approved as "American standard."

Several standards were submitted for approval, but had not been acted upon prior to the above date, as follows: As "American standard," the National Electrical Code; as "tentative American standards," a

standard test for toughness of rock, a standard method for distillation of bituminous material suitable for road treatment; a standard method for sampling coal; specifications and tests for portland cement; and as "recommended American practice," safety code for head and eye protection. A large number of projects for which sponsorships have been arranged are under way, including such items as rating of electrical machinery, ball bearings, gears, machine tools, nuts and bolt heads, pipe flanges and fittings, screw threads, castings, various safety codes, etc.

The American Engineering Standards Committee, usually referred to as the main committee, composed of forty-seven members, is solely an administrative and policy-forming body and does not concern itself with technical details. Each industry, or branch of industry, is wholly autonomous in its standardization work, the function of the main committee being merely to assure that each body or group concerned in a standard shall have an opportunity to participate in its formulation, which is in the hands of a working committee, technically called a "sectional committee," made up of representatives designated by the various bodies interested, together with other specifically qualified individuals. The main committee must approve the personnel of each sectional committee as being authoritative and adequately representative of the various interests concerned.

Each sectional committee is organized by, and is under the leadership of, one or more of the principal bodies interested. Such bodies are known as "sponsors." The committee has decided that if it is the desire of any industry to have a general committee, representative of the industry as a whole, as a means of developing and correlating the standardization work of the industry that arrangement will be eminently satisfactory.

As to publication of the standards, individual standards are published by the sponsor bodies, but provision is made for the publication collectively of standards approved by the committee and also for the original publication of individual standards upon request or approval of the sponsor bodies. The committee acts as distributing agent for all standards approved by it, or which have been submitted to it for approval.

At present the work is supported by the dues of the member bodies, \$500 for each representative on the main committee. Exception is made in the case of government departments, pending the enactment by Congress of legislation which is necessary to enable the departments to contribute their share of the expenses of the committee. As the present dues are not sufficient to support and develop the work the committee will seek contributions from industrial associations and companies interested in standardization.

It is planned that the committee office shall serve as a bureau of information on engineering standardization, keeping in touch with what is going on in connection with this subject, both in America and abroad.

The American Society of Mechanical Engineers is engaged upon a revision and enlargement of its power test codes issued in 1915. Nineteen codes are being drafted to cover all classes of power plant machinery. Nineteen committees are engaged, supervised by a main committee of twenty-eight, of which Fred R. Low of New York, editor of *Power*, is chairman, and Prof. Clifford B. LePage of Stevens Institute of Technology, Hoboken, is secretary.

Why Alter the Standard Safety-Car Design?

Advantages and Disadvantages of Double-Door Type of Construction with Longer Platforms Are Discussed and Data Are Given Regarding Power Consumption and Passenger Interchange Time.

BY J. C. THIRLWALL

Railway and Traction Engineering Department, General Electric Company, Schenectady, N. Y.

A NUMBER of articles and letters have recently appeared in the *ELECTRIC RAILWAY JOURNAL* discussing at considerable length the desirability of changes in the design of the standard safety cars. Some operators seem to feel that double doors, permitting simultaneous entrance and exit, are necessary, and that a wider aisle is desirable. Apparently the thought behind these suggestions is that the use of a double-door car with bigger platform and aisle space will result in a better schedule through a shortening of the time of passenger interchange. Other operators vigorously dispute this claim, including one, at least, who has made the experiment, and who now uses but one of the two doors with which his one-man cars are equipped.

There is unquestionably a feeling of irritation produced in the minds of passengers waiting to board a car, if they are held up twenty or thirty seconds while fifteen or twenty people are leaving a single-door car, particularly in rainy weather, and actual complaints from such people or the fear that such complaints would occur have without doubt influenced those operators who have insisted on changes in the standard design and dimensions. For points of heavy interchange, particularly on streets where several lines operate in common and headways are extremely short, the theory of the simultaneous egress and entrance of passengers is alluring, and the temptation is strong to increase the standing space so as more comfortably to handle rush-hour crowds. But the actual effect of such changes, in spite of the Madison experience, is problematical, and they do involve penalties which are not at all problematical.

INCREASED WEIGHT WILL REQUIRE LARGER MOTORS

The essential features of the original Birney design were the dimensions of the body, the use of a low-wheel, long wheelbase truck, and the elimination of every pound of unnecessary weight. Some strengthening of structural parts was found desirable after the first cars had been tried out in service. Northern cities had to use more heaters than those in the South, and more interior sheathing, and required 26-in. wheels instead of 24-in. wheels to provide winter clearances. But minor changes such as these have not altered the fundamental design, although they have increased the weight considerably above what it was at first, and that thereby increased first costs and decreased the schedule possibilities. But the car builders can still build in quantity for stock and give the industry the benefit of the economies of production.

But if the car bodies are to be lengthened and widened to varying degrees, the trucks may have to be changed to conform and weights may easily increase to a point where larger-size motors will be required to meet heavy service in the larger cities. Under these conditions, standardization and quantity production will be impossible; prices will inevitably increase, and the sale of cars on car trust certificates will be impracticable.

So much for the general objections to fundamental changes; now for the specific ones. According to the article in the March 12, 1921, issue of the *ELECTRIC RAILWAY JOURNAL*, the double-door cars in Madison weigh 2,600 lb. more than the standard cars originally used there, and it costs real money to carry around this extra weight. Energy consumption goes up almost in direct proportion to the tons moved, maintenance of equipment and of track are both increased and where we used to say "5 cents per pound per year," we can today say that for many roads it costs 10 cents a year for every pound of weight in their regularly used cars.

Of these items, power is the largest and the one that can be figured the closest. Data recently compiled by the American Electric Railway Association giving statistics on power costs from representative railway power stations show that for ten large plants ranging from 15,000 to 87,000 kw. in capacity the average operating cost per kilowatt-hour is 1.08 cents. Twelve smaller stations of from 4,500 to 13,000-kw. capacity show an average cost of 1.62 cents. These figures do not include fixed charges.

Repeated tests of safety cars in frequent-stop city service indicate an average motive-power consumption of 140 watt-hours per ton mile (including passenger load) at the car, or about 200 watt-hours at the alternating-current switchboard in the power station. Figures compiled by the writer, and presented in an article published in the Oct. 2, 1920, issue of the *ELECTRIC RAILWAY JOURNAL*, covering 1,255 safety cars operated by thirty-eight railways, showed an average annual mileage per car owned of 42,500. The annual energy consumption, on this mileage figure, per ton of weight would be $0.2 \times 42,500$ or 8,500 kw.-hr., or 4.25 kw.-hr. per pound. At the lower cost in the above figures, each pound of weight in the cars costs 4.6 cents per year for power; at the higher rate, which is nearer the average, I believe, it costs 6.8 cents per pound per year.

The effect of weight on track and equipment maintenance is more difficult to determine. Obviously with light cars, the special trackwork, rails and joints will last longer and tie spacing can be increased, and, with any given truck and motors, the lighter the body the longer the life of wheels, axles, truck members, brake shoes and motor insulation. The longer and wider the body, the more it costs to repaint it and to make the ordinary running repairs.

OPERATING COSTS ANALYZED

We know fairly accurately the average operating costs of the standard safety cars. Twelve companies operating over 400 safety cars averaged in 1920 1.6 cents per car-mile on their safety-car lines for maintenance of way and structure, and for equipment maintenance, 1.7 cents. Of the first figure, probably at least one-fourth, or 0.4 cent, covers items that would be directly affected by car weights; of the latter, fully one-half, or 0.85 cent, would be affected by the weight and size of body. The total of these items, or 1.25 cents, is the weight factor per car-mile of the standard safety cars on these twelve properties. The weight of these cars with average load is about 17,000 lb., so that with an annual mileage of 42,500, as previously assumed, the cost per pound is $(1.25 \times 42,500) \div 17,000 = 3.1$ cents. This cost, of course, will vary, depending on many factors, but probably on few roads would it be less than 2 cents, while on many it would be 4 cents.

The total cost, therefore, for power and maintenance is at least 7 cents per pound per year, and may be 10 cents. A fair average would be about 8.5 cents; so the 2,600 lb. of additional weight will add about \$200 a year to the operating costs. Fixed charges on the \$600 extra first cost of the car will add another \$100 annually, making the total penalty \$300 on an average.

If a materially faster schedule could be made as a result of these changes, this extra cost might be justified, but the man who expects such a result is very apt to be disappointed. The following records have been published during the past four months by the American Electric Railway Association, comparing speed of passenger interchange on safety cars and on two-man prepayment types:

	Seconds per Passenger Interchange Two-man Cars	Safety Cars
Denver, Col.....	2.75
Baltimore, Md.....	2.31	2.64
San Antonio, Tex.....	2.93	3.14
Charleston, S. C.....	2.60	3.40
Portland, Ore.....	2.97	3.61
Trenton, N. J.....	1.70	1.84
Average	2.54	2.93

The records above were all taken by the operating companies, excepting those in Trenton, which were made by inspectors of the New Jersey Public Utilities Commission. They show an average difference per passenger of but 0.4 second in favor of the double-door, two-man cars, or a total of 0.8 second per passenger per trip. In other words, in handling seventy-five passengers per hour, the total duration of stops would be only one minute longer than on a two-door, two-man car. But certainly a part of this extra time is due to one-man operation rather than to interference between entering and leaving passengers. As a matter of fact, the Public Utilities Commission report on safety-car operation in Trenton indicates that only about 5 per cent of the total time of passenger stops was occasioned by passengers leaving when others were waiting to board the car. Every one familiar with traffic conditions knows that at most stops passengers board or passengers alight, but there is no interchange, or simultaneous boarding and alighting. So it is safe to say that of the one minute per hour excess time of the safety car, not more than 15 or 20 seconds could possibly be saved by a double door of wider aisle. And, further, the extra weight of these features slows down the free-running speed of the car and decreases the rate of acceleration to such an extent that the resulting schedule speed is much more apt to be reduced than increased. With the present size motors, a 15,000-lb. car with a fifty-passenger load can be safely accelerated at only about 1.5 m.p.h.p.s., the minimum rate for normal schedules. Cars weighing 17,200 to 17,500 lb., as do the Madison and Lancaster cars, or 19,000 lb. as do those in Logansport, must either accelerate more slowly than is desirable or must overload the motors, with consequent increase in maintenance cost and failures, and if still heavier passenger loads are permitted, as often occurs, this condition is still further aggravated. In other words, for general service and normal schedules in the larger cities, the standard safety car weight is about as great as the present 25-hp. motors are capable of handling; any further increase in body weights will, in many cases, call for larger motors with a material increase in first cost, and in total weight of car.

Therefore, in so far as expediting the handling of traffic is concerned, there would be no advantage in changing the present body dimensions or seating arrangement. There may be in some localities a prejudice against one-man operation, or against single-truck cars, that leads to criticisms of the loading arrangement and aisle width of the standard safety car, and which can be placated by the suggested changes. But it must be remembered that in the past five years there have been built and put into service some 4,000 one-man cars of the Birney design, and fewer than 100 that have had the changes previously discussed, and in only one case has a company previously using the standard car found it necessary to make the changes in subsequent purchases.

Economical Painting for Safety Cars

A Three-Coat System of Painting Has Been Worked Out for the Safety Cars in Trenton, N. J., Which Apparently Has a Satisfactory Life and at the Same Time a Low First Cost

BY H. E. KROUSE

Master Mechanic Trenton & Mercer County Traction Corporation, Trenton, N. J.

AFTER several experiments the officials of the Trenton & Mercer County Traction Corporation feel that they have solved their problems for refinishing twenty one-man safety cars which that company has in service. The system adopted reduces to a minimum the shopping time, as well as the necessary labor and material, and based on the results of an inspection of cars which have now been in service for the past six months it appears that a satisfactory life will be obtained at a very low first cost.

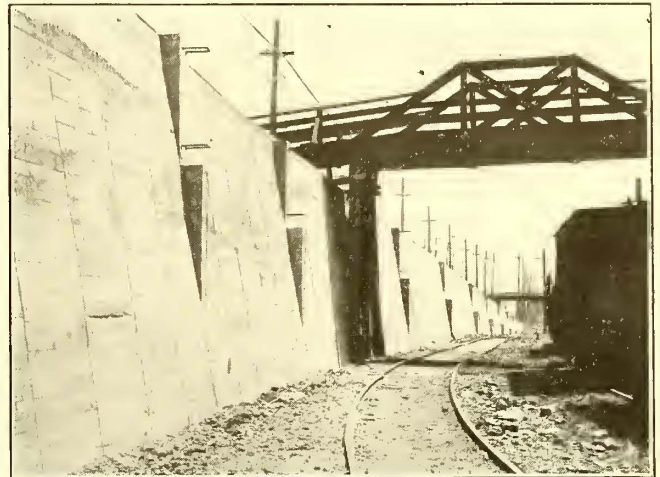
The painting system that is now being used consists of first scrubbing the car body with soft soap and water and then sanding it down. No extensive priming coat is used, but the spots of the car at points where the paint is entirely gone is covered with a metal primer. A coat of lead, tinted to correspond closely to the general car colors, is next applied. This actually constitutes the first coat and is the preparation coat for receiving the finishing enamel. Next a coat of long oil finishing enamel is applied and the numbering, striping and lettering are then completed. Striping has been almost entirely eliminated. The final coat consists of finishing varnish, which is applied over the enamel.

The application of this last coat of varnish over the oil enamel having a semi-gloss is somewhat of a departure from the established practice of this road, and is not considered a necessity. However, it has been found through a test covering ten months of service that by adding a coat of high-grade finishing varnish over the enamel where this short system of painting is used the general condition of the car is improved and a much longer service is obtained. By the use of this three-coat system the shopping time of cars has been reduced from one-third to one-half of that originally found necessary, and a substantial saving in both material and labor has been effected. Results thus far have been so satisfactory with this system that plans are being made to refinish forty more cars of the one-man type and ten 44-ft. steel cars of another type with this method in connection with the painting schedule for the coming year. Railways are practicing economies in all directions during these times of high prices and painting offers a fruitful field for economical methods.

Trolley Pole Support Built Into Retaining Wall

TO PROVIDE permanent and substantial supports for trolley poles along the Army Street retaining wall in San Francisco the city built into the wall at the time of its construction concrete steps and steel bar loops as shown in the accompanying illustration. The poles carry telephone wires, feeders and the trolley wire for tracks of the United Railroads in the street behind the retaining wall.

The steps built to support the poles are 2 ft. wide and 1 ft. 4 in. in length. The bars are 1½ in. in diameter, the first one located 1 ft. above the step and the second 6½ ft. above it, or 6 in. below the top of the



STEPS AND LOOPS FOR SUPPORTING TROLLEY POLES

riser or shoulder of concrete that extends vertically above the step. The 1½-in. bars extend almost through the retaining wall and hook into a grillage of reinforcing bars in a vertical plane. The loops are 13 in. square inside. When the pole has been placed it is wedged firmly against the concrete by shims driven in around the loops.

"Through Bolt" Housings

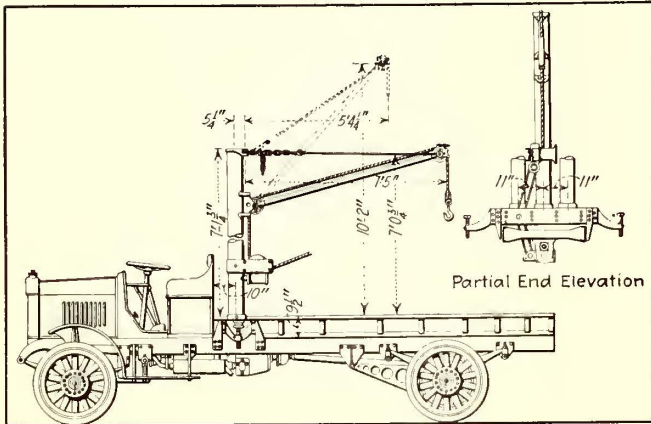
LOOSE housings have been the source of many of the troubles experienced with split frame railway motors. Early motors were built with housings held in the frame by tap bolts which screwed into tapped holes in the housing. Considerable trouble was experienced with these housings due primarily to the stretching of bolts holding the frame together. This caused the clamping action on the housings to be released and resulted in loose housings. The loose housings caused the tap bolts to work loose in the tapped holes. This condition was difficult to remedy and the repair could be only temporary.

Recently, the split frame motors of the Westinghouse Electric & Manufacturing Company have been so designed that the housing is fastened to the frame by through bolts, which are held tight by steel nuts. When the nuts wear loose, the remedy is simple and inexpensive: throw the nut away and use a new one. The old housing is known as the "tap bolt" type, while the new design is termed a "through bolt" housing. Through bolt housings have been supplied not only on the more recent designs of split-frame railway motors but also to replace the tap bolt housings on many of the older motors.

When the housing seat is badly worn, it has been found that the most satisfactory way to repair is to rebores the frame to a larger size and supply a housing to suit. The Westinghouse company has also developed an "oversize" housing in order to care for this method of repair.

Truck Crane to Reduce Loading Time

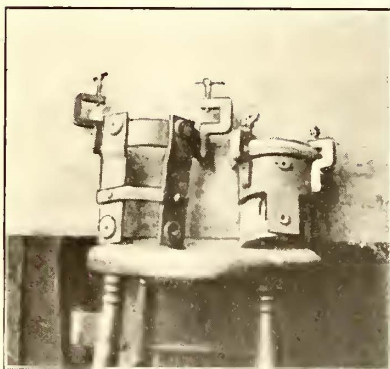
THE Meade-Morrison Manufacturing Company, East Boston, Mass., is marketing a truck crane of 1-ton capacity which may be applied readily to any standard truck. The equipment consists of an upright steel column, a boom with fastenings, a base with cross channels, outrigger leveling screws and a winch with brackets. When the chain has been unshackled, the boom end may be slipped out of the slot and the boom laid on the truck body to prevent slapping when the



REMOVABLE TRUCK CRANE

truck is in motion. If it is desired to use the truck on work not requiring a winch the mast or column may be unpinned and lifted out of the base castings and the entire base may be covered by temporary flooring. With the column and winch in the usual position, loads may be pulled up over the rear of the truck by direct pull from the winch, without the use of the boom.

Jig Facilitates Drilling of Bearings



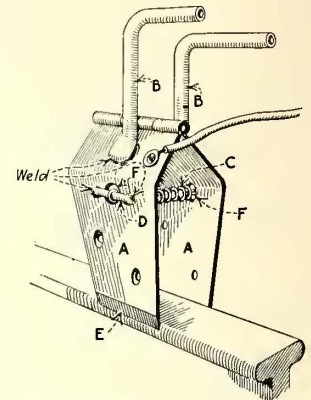
BEARING JIGS FOR LOCATING DOWEL PIN HOLES

THE accompanying picture shows a jig used in the shops of the Des Moines (Iowa) City Railway for locating the dowel pin holes in axle bearings. The bearing to be drilled is merely tightened up in the jig with the two screws shown and a drill run down through the holes provided in the jig. This scheme assures

the accurate location of the dowel pin holes and the jig may be placed in position and removed very quickly. It is necessary to have a different jig for each class of bearings, and care must be taken to see that the jigs are made to fit perfect bearings to start with, otherwise inaccuracies result.

Handy Ground Clamp for Electric Welding

THE accompanying illustration shows a form of ground clamp used by the Easton Transit Company for attaching ground wires to electric welders, grinders and other apparatus used on the lines. It has been found of great convenience and its simple construction makes it available for use by any railway.



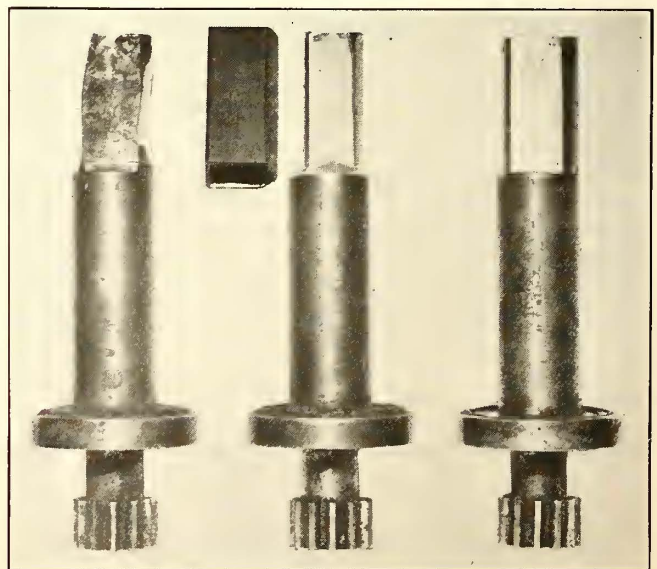
GROUND CLAMP MADE FROM HINGE

The clamp is made from an ordinary strap hinge bent as shown. Two 3/4-in. holes are drilled at F, and a K-10 controller spring is passed through these and is held in place by two 3/4-in. rods welded in place. The ends of the hinge are cut off and sharpened at E and suitable handles made of 3/4-in. iron pipe are shaped and welded to the upper portion of the hinge. If it is desired to insulate these handles a piece of rubber hose may be slipped over them. The wire which forms the electrical connection is attached to the hinge by a 1/4-in. stove bolt and washer.

This form of clamp can be quickly applied to and removed from almost any part of the track or special work, and it has been found especially valuable in paved streets, as its construction permits of its use in a very small crevice along the rail. When not in use the clamp is used to hold the coils of line or ground wire to some part of the machine and it thus helps to stow away the wire in good condition.

Steel Sleeves for Broached Shafts

THE use of drawn steel sleeves in repairing the handle fits of controller shafts and brake valve stems enables this work to be done at a very small percentage of the cost that new parts would cost. D. B. Flower, distributor of electric railway accessories, Philadelphia, is furnishing steel sleeves in any size necessary to fit the various broaches of controller handles and brake valve handles. The method of repairing



REPAIRING WORN BROACH FITS WITH STEEL TUBING

the worn fits is shown in the accompanying illustration. The illustration at the left shows a worn stem before repairs have been started. This is machined, as shown in the center illustration, to such a size that the steel tubing will form a tight fit when forced on to the stem. The illustration at the right shows the completed job.

Letter to the Editors

Labor Bureau Statistics Are Weighted

CITY OF PHILADELPHIA

DEPARTMENT OF CITY TRANSIT, VALUATION DIVISION
PHILADELPHIA, PA., April 5, 1921.

To the Editors:

I note on page 629 of your issue of April 2, a statement that the index price of the U. S. Bureau of Labor statistics is an unweighted average.

You will find by referring to the U. S. Monthly Labor Review or to Bulletin No. 226 or No. 269 of the Labor Department that this index price is weighted in accordance with the census statistics for each important commodity. The bureau states very clearly that the index number assigns "to each commodity an influence proportioned to its importance in the country's markets."

The best statisticians regard the Bureau of Labor index prices as the best weighted and most generally satisfactory of any available in this country, and in view of the widespread public interest today in index prices and index wages, the writer ventures to suggest that you publish this correction in an early issue.

E. E. GEORGE.

[EDITORS' NOTE.—Mr. George's letter was submitted to J. F. Layng, the author of the article referred to, who has explained that Mr. George is correct as to the weighted character of the data given in the reports of the Bureau of Labor Statistics. The reference made by Mr. Layng to non-weighting was due to the statement, included in earlier bulletins, to the effect that products were so selected as to be "self-weighting." Later reports have been based on weighted data.]

Association News

Building and Structures Committee Meets at Columbus

THE Engineering Association buildings and structures committee met at the Deschler Hotel, Columbus, Ohio, on April 2, 1921. Those present were D. E. Crouse, Rochester & Syracuse Railroad, chairman; N. E. Drexler, Newport News & Hampton Railway, Gas & Electric Company; J. R. McKay, Indiana Service Corporation, and S. J. Steiner, Aurora, Elgin & Chicago Railroad.

The subcommittee on the design of a typical shop building reported the results of its two meetings with the equipment committee's subcommittee on this sub-

ject, and the various details of shop equipment layout and building were thoroughly discussed. The chairman of this subcommittee will have a tentative shop layout and plan ready to present at the next equipment committee meeting, scheduled to be held early in May.

The subcommittee which is co-operating with the way committee on the subject of wood preservation discussed this subject as it relates to the treatment of structural timber and piling and also presented data and photographs of treated timber, indicating the value of preservative treatment. A joint questionnaire on this subject has been issued and the subcommittee will make a further report after studying and summarizing the replies.

In connection with the subject of prepayment and postpayment fare collection at terminals, many plans for both were studied. Plans were laid for an early subcommittee meeting to be held with the Transportation & Traffic Association, so that a form of letter may be drafted to obtain from member companies information regarding this form of fare collection.

More than 125 members are now on the roll of the Camden company section of the Public Service Railway, an increase of more than 100 since the organization meeting.

Milwaukee Locomotive in Fine Art



OIL PAINTING BY SCHENECTADY ARTIST RECENTLY FEATURED IN ART EXHIBITION IN NEW YORK CITY

AN OIL painting of a winter scene on the Cascade division of the Chicago, Milwaukee & St. Paul Railroad, featuring one of the new General Electric passenger locomotives, was shown at a recent exhibition of the National Art Club in New York City. The painting is by Walter L. Greene of Schenectady, N. Y., the artist who painted the picture of the United States battleship *New Mexico*, recently presented to the Navy Department by E. W. Rice, Jr., president of the General Electric Company.

Mr. Greene is an American by birth, but secured his advanced art training in France and has exhibited at French and Belgian salons, as well as in this country. He is a member of the Boston Art Club.

News of the Electric Railways

FINANCIAL AND CORPORATE • TRAFFIC AND TRANSPORTATION

PERSONAL MENTION

Blanket Franchise Urged

Railway at Richmond Regards This as Necessary to Carry Out New Financing

The Virginia Railway & Power Company announces the following result of the recent valuation of its Richmond lines made by Stone & Webster as a basis for discussion of a proposed new franchise:

Money put into Richmond Railway system, including interest, less actual return.....	\$20,249,400
Value of property, based on inventory, at average prices of 1914-1920	12,488,841
Difference	\$ 7,760,559

The company is asking a return only on the inventory value in the proposed new franchise now pending before the committee on streets of the City Council.

The above relates to railway property entirely and does not include property in Richmond operated under the company's light and power franchise.

E. Randolph Williams, vice-president and general counsel, recently made public the total value of the property of the company as computed by Stone & Webster as of June, 1920. In an address before the Richmond Chapter of the American Association of Engineers Mr. Williams asserted that the entire Virginia holdings of the company were valued at \$49,000,000.

Thomas S. Wheelwright, president, has declined to give out for publication the text of the Stone & Webster report, though an abstract of that part relating to the railway lines in Richmond is being used before the committee on streets in connection with the discussions of a new franchise, and that part relating to the lines in Norfolk is similarly being used before the city manager and commission of that city in relation to discussion also pending there for a new franchise.

The company operates now under a number of franchises. Of the two base franchises in Richmond that granted to the Richmond Traction Company expires in 1926 and that granted to the old Richmond Railway & Electric Company expires in 1929. With one of its important base franchises now having less than five years to run, the company is finding it difficult to raise money for needed improvements and extensions and is pressing consideration of a new blanket franchise for Richmond.

Officials of the company have informed Mayor Ainslie that while the road is making some money at the present 6-cent fare, the lack of any credit makes it necessary to pay for

all improvements out of earnings, and for that reason track replacement where streets are to be paved can only proceed as the company can afford to pay for the work from its daily earnings.

Wage Cut Results in One-Day Strike

Employees of the Orange County Traction Company, Newburgh, N. Y., have accepted a reduction in wages, but not until the road had been tied up for a day by a strike. The company had a contract with its men expiring on May 1 at the following rates of pay: one-man operators, 53 cents an hour and two-man work, 48 cents an hour. In conferences with the men officers of the company advised that it was necessary for the next year that wages be lowered 10 per cent, and that the rates for one-man operators would be 48 cents an hour and two-man 43 cents an hour. The men were told that these rates would be effective from April 10. The men insisted on retaining the old rate of pay for the succeeding year, and refused to operate the cars on April 10 at the new rate. In consequence the company operated no cars on that day. Through the intervention of Major McKay, City Manager, several conferences were held between officials of the company and its employees and settlement was made at the following rate: 43 cents an hour for two-man work and 50 cents an hour for one-man work. A straight decrease of 10 per cent was made on all other departments. Service was suspended only one day.

Present Columbus Wages Continued

No reduction will be made in the wages of employees of the Columbus Railway, Power & Light Company, Columbus, Ohio, although the agreement expired on March 31 that was reached through the board of arbitration after the strike of 1919.

The announcement that no cut in wages is contemplated was made by Norman McD. Crawford, vice-president of the company. The statement issued by Mr. Crawford shows that the payroll for the year 1920 exceeded \$4,500,000. The statement declares:

Facing as we are a nation-wide business depression and the knowledge that, without exception, all business interests are either reducing wages or reducing forces, or both, it must be evident to you that this company cannot continue to be the exception unless we are able to face the prevailing condition with each individual achieving maximum efficiency, not only in production but also in loyalty united with watchfulness in the interest of the company, and undivided determination to achieve 100 per cent efficiency.

Utility Bill Protested

Ohio Companies Contend Governor's Proposal Would Make Figure-heads of Commissioners

Public utilities corporations of Ohio are up in arms over the administrative reorganization bill, sponsored and submitted by Governor Davis and now pending in the General Assembly. They object to the reorganization scheme as it applies to the State Public Utilities Commission and its proposed future status. The House passed the bill and messaged it to the Senate.

PROGRAM PROTECTED

Spokesmen for the steam and electric railways and the power and light companies appeared before the Senate reorganization committee during the week ended April 2, and made emphatic protest against the provision transferring the executive work of the State Public Utilities Commission from it to the director of the proposed department of commerce. They told the committee that this change will make the utilities commissioners mere figure-heads and will center too much power in the hands of the Governor, who is to name the director of this and other proposed departments.

A strong plea was made that the bill be amended to allow the commission to retain the power and authority to name all its experts and other officials. As the bill was prepared by the Governor's experts all control over the executive department of the commission is taken away and the commissioners are merely retained to exercise quasi-judicial powers, and to pass on rate cases.

As the result of the protests lodged with the committee by the representatives of the utilities the committee has incorporated amendments which make concessions, but do not accede to the wish of the corporations that the utilities commission be left in its present status and with its present powers.

AMENDMENT TO BILL URGED

The amendments, instead of taking away all the administrative powers of the commission and its right to name its subordinates, provide that the director of commerce shall serve as secretary to the commission. It is hoped that this change will meet with the approval of the public utilities companies.

It was expected that the reorganization bill would come up for passage during the week ended April 9, after which, in the event the Senate passes the measure it must be sent back to the House for concurrence by that body.

New Orleans Conference

City Insisted on \$35,000,000 Valuation for Railway—Bankers Dismayed at Prospects

A very important executive conference attended by J. D. O'Keefe, receiver of the New Orleans Railway & Light Company, Judge Rufus E. Foster of the United States District Court, and visiting Eastern Bankers was held at New Orleans on April 6 in order to map out a definite plan for the solution of the traction troubles of New Orleans.

The Mayor appears to be inflexible in his determination to adhere to the plan of the City Council setting forth fourteen points which it regards as essential for acceptance by the company if the matter is to be settled. One of these fixes the valuation of the property at not more than \$35,000,000, with a yearly return of \$2,150,000, and allowing a further increase in the valuation of \$5,000,000 for new money. On this new money a return of 7½ per cent would be allowed, whereas the return on the valuation the city is willing to allow would be 6.14 per cent.

Other conditions covered are that the Commission Council shall approve all undivided profits and securities issued, and that salaries shall be limited, track standardized, etc.

Mr. Dahl, one of the visiting financiers, had consented to accept the property valuation of \$44,700,000 placed upon it by the citizens' advisory committee and a rate of return of 7 per cent. He announced on behalf of himself and the visiting bankers, when the proposed plan was submitted by the acting Mayor, that further negotiations were useless. The conference thereupon came to an abrupt end. This valuation of \$44,700,000 had been approved by Receiver O'Keefe and Judge Foster.

Harold W. Newman, president of the New Orleans Stock Exchange, a member of the committee, in speaking of the decision reached by the City Commissioners, declared that the "fourteen" points are so inconceivable as to destroy the banking credit of the company.

If the Council passes the 7½-cent ticket ordinance, Receiver O'Keefe said he would refuse to accept that fare and warned the public that if the rate of fare was made to revert to 5 cents the street cars would not be taken out.

Service-at-Cost Legislation Approved

Upon recommendation of its legislative committee the Milwaukee City Council at its meeting on April 4 approved a bill to be introduced in the State Legislature authorizing the city to enter into a service-at-cost agreement with the Milwaukee Electric Railway & Light Company. The legislation has been asked by the public-utilities acquisition committee, appointed to investigate the feasibility and desirability of municipal ownership of the electric railway and electric light and power facilities of Milwaukee.

The bill is intended to give the city of Milwaukee power to carry out the recommendations which the public utilities acquisition committee is expected to make in a report to be submitted in the very near future. The bill provides for the usual service-at-cost agreement plus a feature which will make it possible for the city gradually to become the owner of the utility property. The company, under the proposed service-at-cost agreement, would be removed from the jurisdiction of the State Railroad Commission except in certain minor matters. Under the plan the city will also extend its credit to the company to finance extensions and improvements at a lower rate of interest than the company now has to pay.

Operating Proposal Transmitted to Council

Mayor Moore of Philadelphia, Pa., has transmitted to City Council the proposed form of agreement providing for the leasing of the city-owned Frankford Elevated Railway and Bustleton lines to the Philadelphia Rapid Transit Company for operation. Accompanying the draft of the proposed agreement was a message from the Mayor to Council, giving an outline of its provisions. It was referred without debate to the committee on transportation. Among the more important terms of the lease are these:

The Rapid Transit Company is to operate the lines and pay the city annually a return of 5 per cent on the amount invested in the property, which now amounts to about \$15,000,000.

The lease is to expire July 1, 1957. There is, however, also a provision that the lease "shall absolutely cease and determine without further notice six months after the date of the final adjudication of the valuation of the properties operated by the company, including the lines leased hereunder now pending before the Public Service Commission."

The city also reserves the right at any time after five years from the date of the agreement, during the term of the agreement, to terminate it after giving the company six months' notice.

The company is to supply two of the three power stations and to equip and operate the Bustleton surface line.

The company is required to furnish "safe and reasonably adequate accommodations to the public."

The city is to supply a maximum of 100 cars (50 of these have already been ordered). It shall also supply a sub-station of about 4,000 kw. capacity, located at Front Street and Fairmount Avenue.

The company is to be liable for any damage claims, excepting such as result from any defect in the property that may exist prior to May 1.

The payment of rentals to the city is to have precedence over the payment of dividends on Philadelphia Rapid Transit stock.

Buffalo Cuts Wages

All Unskilled Labor Included in Retrenchment—One-Man Car Operators Only Trainmen Included

Reductions in basic wages affecting all classes of unskilled employees except platform men are announced by the International Railway, Buffalo, N. Y., effective on May 1. The pay of unskilled laborers, boosted during the war by the War Labor Board to an abnormal sum as compared with wages of skilled employees, will be equalized by the new scale announced by President Herbert G. Tulley.

In a statement to employees explaining the new scale, President Tulley says that for the year 1920 the company fell short by more than \$1,000,000 of earning a fair return upon the value of its property devoted to public service, according to the formula adopted by the Public Service Commission when the 7-cent fare, with four tickets for a quarter was granted.

The situation as far as 1921 is concerned is even worse, Mr. Tulley says, with the result that for the months of January and February the company failed by \$300,000 to earn the amount required. This is occasioned by the industrial depression, which has been so acute that at the present time the gross receipts show a falling off of 17 per cent. Mr. Tulley said:

At this time the management does not intend to change the basic rate of its motormen and conductors, or of its skilled employees. The abnormal rates of wage paid some classes of unskilled employees must be adjusted and certain costly working conditions must be corrected. The maximum rate of trainmen has been increased 75 per cent since May 31, 1918, while wages of certain classes of unskilled employees, such as curve cleaners, watchmen, bridgemen, helpers, car cleaners, etc., have been increased an average of 100 per cent and in some cases as high as 200 per cent.

\$100,000 PAID FOR UNPRODUCTIVE TIME

President Tulley points out that last year the International paid to trainmen more than \$100,000 for time during which no work was performed, exclusive of layover time. He says that "payments for which no service is rendered cannot be justified and cannot be continued, consequently a new set of working conditions eliminating such payments will become effective on May 1, 1921. Compensation for loss of time when taking the nine hours' rest period will be discontinued under the new rules and only such guarantees, allowances or special compensations as are provided in the new working conditions will be paid after May 1."

The local lines of the International in the city of Lockport last year did not earn operating expenses. Under these circumstances President Tulley explains that the company is not justified in continuing payment of the 5 cents extra compensation for the operation of one-man cars in that city. Effective May 1, trainmen in Lockport will be paid the same scale as those in Buffalo, 55, 58 and 60 cents an hour.

"The rates of pay of all other em-

ployees except those listed will for the present be continued unchanged," the statement says.

The International Railway says it makes no guarantee of the continuance of these rates for unskilled workers and that its ability to maintain them is dependent upon an improvement in the revenue of the company and the extent to which the employees co-operate with the management in its efforts to operate the property efficiently and economically.

The changes in rates per hour effective May 1 are as follows:

Auto washers, 40 cents an hour.
 Bridge agents, 45 cents an hour.
 Car cleaners, 40 cents an hour.
 Car cleaners foreman, 45 cents an hour.
 Curve cleaners, 40 cents an hour.
 Drillhands, 50 cents an hour.
 Firemen shops and carhouses, 40 cents an hour.
 Freight truckers, 45 cents an hour.
 Helpers, mechanical department (all classes), 45 cents an hour.
 Janitors, 40 cents an hour.
 Laborers, 40 cents an hour.
 Sandmen, 40 cents an hour.
 Scrubbers (paint shop), 50 cents an hour.
 Scrubbers (foreman), 54½ cents an hour.
 Shifters, 45 cents an hour.
 Stove-man, 40 cents an hour.
 Storeroom laborers, 40 cents an hour.
 Sweepers, 40 cents an hour.
 Watchmen, 40 cents an hour.
 Trainmen employed on trolley express, flat and work cars will be paid the same rate as trainmen in the passenger service, viz: 55, 58 and 60 cents an hour.
 Trainmen operating "one-man" cars in Lockport, 55, 58 and 60 cents an hour.

City of Chicago Still Obdurate

Checks for a total of \$3,590,616 were refused by the city of Chicago on April 9. Tender of this amount was made by the Chicago Surface Lines in payment of the city's share of transportation revenue for the two years preceding Jan. 31, 1921. This is what is known as the city's 55 per cent of net revenue. The city contends that the ordinances under which these payments are made have been abrogated by the companies in allowing rates of fare to be increased. Last year the "55 per cent" amounted to \$1,448,848, while this year it totaled \$2,138,383. There was also an amount due from the companies in the matter of the adjustment of certain claims.

Mayor Thompson evidently has been forced by public sentiment to accept certain amendments to the transportation measures which are awaiting action by the State Legislature. Radical changes were made in the proposed bill at the last minute, and it will be called up for action in the near future. Originally the Mayor saw insurmountable obstacles in a suggestion that the elevated roads be included in the plan for a "transportation district." It is now intended to make it possible for the city to acquire these properties as part of the general plan.

A more important change is in a provision that the trustees under the act may raise fares above 5 cents in order to cover costs of operation. Other proposed amendments would put all employees of the district except the highest executives under civil service and would call for a referendum on bond issues.

New Wage Draft Presented

Important Changes, Including Wage Reduction, Are Outlined by Eastern Massachusetts Street Railway

The joint conference board of the union of employees of the Eastern Massachusetts Street Railway has been handed a draft of a proposed agreement prepared by the public trustees of the company and has been asked to submit the agreement to the local unions throughout the Bay State System for approval. The company announced on Feb. 25, that it would reduce wages 20 per cent effective May 2, 1921.

The new agreement is to be made for one year beginning May 2, 1921. In it the trustees state that the company will do nothing to prevent any employee from becoming or continuing to be a member of the union and will not in any way discriminate against a member thereof because of such membership.

A new provision of the proposed agreement submitted by the trustees is that all regular employees shall be provided without expense or medical examination, with group life insurance similar to that now enjoyed by the supervisory force. The amounts of this group insurance range from \$500 for employees in the service one year to \$2,000 for employees in the service for ten years or more. These policies are to be issued to the employees without cost to them.

OLD WAGE SCALE TO BE RESTORED

Wages will be restored to the scale in effect prior to May 1, 1920, namely 46, 48 and 51 cents an hour. Operators of one-man cars will receive 56 cents an hour. Instructors will continue to receive 4 cents an hour in addition to their regular pay. The working day of conductors and motormen and so-called miscellaneous employees will be nine hours. The company will no longer dismiss an employee solely upon complaint of the union that he has violated union rules.

Extra men called for work will continue to receive a guarantee of six hours' wages. The Saturday half-holiday with pay for shop employees is abolished. Time and a half for Sunday and holiday work and overtime to mechanical and miscellaneous employees will be discontinued. Free transportation to employees, whether or not they are in uniform, will be continued.

Seniority rating of regular conductors and motormen will remain unchanged, but work for men on the spare list will be assigned instead of being selected by seniority. Seniority rating of mechanical and miscellaneous employees will be eliminated.

Local discipline cases will be taken up by the manager and labor representatives as in the past and appeal can be made to the public trustees, who will meet one day each month for the purpose of hearing such cases as may be referred to them.

The trustees claim that changes in

working conditions and wages provided for in the new agreement are proposed solely to increase efficiency and to help reduce fares.

Arbitration Unavailing in Davenport

State arbitration, tried in Iowa for the first time, has failed to settle the dispute between the trainmen's union and the Tri-City Railway over the discharge of the president of the union for criticising company discipline in a public address.

Following a hearing at Davenport the board, appointed by Governor N. E. Kendall, found "the defendant company was in error, in denying the arbitration of this controversy, under the terms of its contract."

The board, however, did not recommend the reinstatement of the discharged union official, stating this was not within its province. This leaves the controversy just where it was before resort was made to State arbitration.

While the trainmen's union voted to back up its discharged official with a strike, none has been called and the men appear to have let the matter drop.

In the meantime the trainmen are drawing a 70-cent maximum wage held in force by an injunction secured by the Socialist City Attorney of Davenport. There has so far been no disposition on the part of the company to go into court and fight this injunction, probably because the wage scale expires with the old contract on June 1. The Socialist party took sides with the trainmen, when the company notified the latter their wages would be cut from 70 to 40 cents an hour on April 1 and secured an injunction to prevent this cut. Since then an injunction has been employed to prevent the shortening of the bridge line loop, a measure of economy resorted to by the railway.

Future Policy of Detroit United Not Announced

No announcement has been made by the Detroit (Mich.) United Railway as to what action it will take next with respect to the future, in view of the recent defeat of its service-at-cost plan. An early meeting of the directors of the company is scheduled and some action will probably be announced soon after this meeting. Announcement was made by the company prior to the election, however, that no matter what was the outcome of the referendum it would continue to give such service as it was enabled to.

The final count of the ballots cast on April 4 on the two ordinances pertaining to railway matters in Detroit, showed results about as indicated by the preliminary reports based upon counts from a few precincts. The Detroit United Railway's proposed service-at-cost ordinance was voted down, while the city's purchase-plan ordinance was carried with about the same percentage of votes as were cast last year in favor of the bond issue to pro-

vide for a municipal system of street railways for the city.

The company's proposition required a 60 per cent affirmative vote, but received only about 36½ per cent. The city's ordinance providing for the purchase of several sections of Detroit United Railway lines received about 65 per cent majority.

Reports from the sections of the city now being served by the new Detroit Municipal Railway lines, which have been in operation since Feb. 1, indicate that municipal ownership was highly indorsed. In some instances in the St. Jean and Charlevoix district, a vote of approximately four to one was reported in favor of the purchase plan ordinance.

Wage Conference Proposed in Salt Lake City

New contracts between the Utah Light & Traction Company, Salt Lake City, Utah, and the Amalgamated Association are being sought by company officials. The present contract, which has to do with hours of work, wages and working conditions, will expire on May 1.

A proposal to reduce the present pay of platform men and carhouse mechanics is anticipated by the union officials, but nothing of this nature was mentioned at the preliminary conference between General Manager Dicke of the company and President Baker of the union. It was said recently, however, that if a wage reduction were sought it might, in some instances, be as much as 20 per cent. Company officials would not discuss the matter other than to say that a request for a conference had been made by it.

The time for holding the conference was designated as April 11.

City Seeks Crossing Rights

Legislation effecting the crossing of privately owned lines by municipally owned railways in Detroit has been introduced in the State Legislature. One bill, the Pitkin bill, is reported as an amendment of the general railroad law which makes no provision for crossings by municipally owned lines. The Pitkin bill provides for the handling of such crossings by the State Public Utilities Commission.

The Copley bill, introduced about a week prior to the Pitkin bill, would give the City Council power to decide questions relative to such crossings.

In discussing the Pitkin bill, David H. Crowley, special counsel for the city of Detroit in street railway matters, who drafted the Copley bill, stated that the former would endanger the success of municipal ownership in Detroit. It would transfer jurisdiction over municipal street railway crossings to an outside body such as the Public Utilities Commission, while such crossings primarily concern the city.

The Copley bill, Mr. Crowley states, gives the commission a limited authority to pass on safety devices for crossings in which a street railway is

involved, while the Pitkin bill, if it delegates control of such crossings entirely to the commission, is dangerous to municipal ownership.

Carhouse Changes at Boston

On account of the destruction of two large surface carhouses by recent disastrous fires the Boston (Mass.) Elevated Railway has undertaken extensive repairs and enlargements of two other carhouses to provide the necessary facilities. On Feb. 21 the carhouse at Neponset was burned to the ground, followed by the partial destruction of the Amory Street carhouse on March 4.

To provide for the loss of the Neponset station the so-called Park Street carhouse at Fields corner is being entirely remodeled. The old wooden structures are being demolished and a new brick building is to be constructed in the center of the area with a lobby and office building at one side. The track layout is being revised to accommodate a total of 122 of the largest type cars.

The plan is to establish an up-to-date carhouse of good exterior appearance for the storage inspection and minor repairs of surface cars. The area on the public street sides is to be surrounded by a neat masonry wall, and it is expected that property in the neighborhood will be considerably improved by the removal of the unsightly wooden structures and the construction of the new carhouse and office building. The layout has been worked out on lines similar to those in use in Cleveland and other Middle West cities and will be thoroughly fireproof and modern in every respect.

To take the place of the Amory Street house the old surface car station at Forest Hills, which for some time has been out of use except as a dead storage plant, will be repaired and put into shape for about 100 of the largest cars. It will be put into service as a full operating rating station, with inspection and repair facilities, pits, etc.

Practically all this repair and reconstruction work will be done by the engineers and working forces of the company.

Although a considerable number of old cars were destroyed by the two fires the trustees are not planning any immediate additions to rolling stock except ten one-man cars, on which bids have been asked.

Trainmen Agree to Wage Cut

Motormen and conductors of the North Alabama Traction Company at Albany and Decatur voluntarily agreed to accept a cut of about 5 per cent. in their wage scale in a hearing before the Public Service Commission on April 4 of the petition of the receiver of the company for permission to operate one-man cars on all lines. The proposal was made by Melvin Hutson, attorney for the men, who opposed the receiver's petition. Witnesses for the company

testified that the monthly deficit of the company now is about \$800. The proposed cut of the employees would save about \$250 a month. If the company is permitted to operate one-man cars the services of eight employees will be dispensed with, which will save the company a little more than \$900 a month, and will give an earning of about \$100 a month, provided other expenses do not increase.

Cleveland Men Voting

Officials of the union representing the 3,400 motormen and conductors in the employ of the Cleveland (Ohio) Railway Company have offered to accept the 20 per cent reduction in pay effective on May 1 if the company's closed shop agreement with the men is allowed to remain in force. John J. Stanley, president of the railway, has consented to this providing the closed shop agreement is changed sufficiently to permit union members to resign from the union without being forced to quit the company's service. All new men must join the union within sixty days after entering the employ of the company.

The 20 per cent wage reduction will make the wages of the Cleveland men 55 cents an hour for the first three months, 58 cents an hour for the next nine months, and 60 cents an hour thereafter instead of 70-72 and 75 cents an hour.

At mass meetings of the union members on April 13 propositions made by Mr. Stanley were discussed. It was planned to conduct a referendum vote on the propositions among the members on April 15. The proposals upon which the men were to vote are:

1. To accept a 20 per cent wage reduction and the closed shop agreement to remain in effect as at present.

2. To accept a reduction in pay to make the scale 55c. an hour for the first year and 62c. an hour thereafter, the closed shop agreement remaining in effect except for an amendment that will permit members of the Union to resign without being forced to quit the company's service.

3. To arbitrate all points in dispute including the closed shop, questions to be as follows:

Shall the company continue the present closed shop in effect?

Shall compensation for the trainmen be continued as provided by the War Labor Board for night runs, spread runs and Sunday runs?

What shall the new rate of pay be?

In case the men elect to have all points in dispute arbitrated, James H. Vahey, Boston, attorney for the International Union, is to represent the men, while C. Loomis Allen, Syracuse, is to act for the company.

Mr. Stanley and officials of the union have come to a practical agreement regarding other demands of Mr. Stanley for changes in the present clauses inserted by the War Labor Board. This understanding between the union officials and Mr. Stanley calls for the elimination of all extra pay for the spread time runs, continuation of ten hours pay for eight hours night car runs and payment of time and a quarter for work in excess of regular runs instead of time and one-half.

Irregularities Alleged in Connection with Railway Legislation in Massachusetts

A formal investigation has been started by the Massachusetts Legislature of charges of irregularities in connection with the passage of legislation in 1918 and 1919 affecting the Boston (Mass.) Elevated Railway and the Eastern Massachusetts Street Railway. Although there has been constant criticisms of members of the Legislature ever since the passage of the acts establishing the public trustee method of control of these two traction properties, it was not until recently that open charges were made.

During the course of a debate on a bill to have the trustees report on the feasibility of instituting more 5-cent fare lines in Boston, Representatives Hays and Lomasney both openly charged that members of the 1918 Legislature borrowed money from certain Boston trust companies and speculated in railway stock just prior to the passage of the legislation, the inference being that they were thus influenced to vote for the bill which would presumably increase the market value of the railway securities. These charges aroused a great deal of discussion in the press and in the present Legislature with the result that an order was passed for an investigation.

A committee has been appointed consisting of Senators Lyman A. Griswold, chairman, and Walter A. Hardy, Representatives Henry L. Shattuck, James B. Brown and John W. McCormack, none of whom was a member of the 1918 Legislature. It was decided at the start to have no one on the investigating committee who was a member of the Legislature at the time the bills were passed. Subsequently it was decided to investigate the 1919 Legislature, which passed the bill authorizing the Commonwealth to purchase the Cambridge subway from the Boston Elevated Railway.

The State Bank Commissioner has been directed to furnish to the committee the names of all Senators or Representatives in 1918 who had loans in any of the trust companies in Massachusetts which have been closed as a result of financial difficulties. It is also proposed to broaden the scope of the inquiry to require the Boston Elevated Railway to furnish its transfer books and records, and to call upon Boston brokerage firms for a record of their transactions at the time of this particular legislation.

Eight-Hour Bill Defeated.—Senate bill No. 313, in the California Legislature, known as Harris eight-hour bill for electric railway man, was passed out favorably by the labor and capital committee of that body, but was defeated in the Senate on March 31. The first vote was twenty-two to sixteen. The measure was then set over for reconsideration and was defeated on April 9 by vote of twenty-one to eighteen.

News Notes

Attempt to Repeal Utilities Law Fails.—Attempts to abolish the Utility Commission of Tennessee have failed in the present Legislature which has only less than one week to run now before final adjournment.

Electrical Industry Advertised.—A page advertisement appears in *Collier's* for April 9 entitled "Will Your Town Stop or Move Ahead?" It is inserted by the *Electrical World* and points out that during the next four years the electric light and power industry, if it is to keep up with the demands, needs an additional investment of approximately \$4,000,000,000. The interest which the public has in the adequate development of the electric light and power companies is pointed out. The advertisement is signed by James H. McGraw, president of the McGraw-Hill Company, Inc.

Municipality to Install Trackless Trolley.—The Board of Estimate of New York City has appropriated \$383,200 for extensions, improvements, and operation of municipal trolleys. Of this sum, \$83,200 was given to the Staten Island lines to extend service on the Meyers Corners line to Linoleumville and to put into operation a trackless trolley between Schmidt's lane and Seaview Hospital. Of the amount set aside \$150,000 will go to purchase sixty used cars to take care of the summer traffic in Staten Island. A similar amount was appropriated for the purchase of one-man cars for the Williamsburg Bridge.

Interurban Reduces Wages.—A reduction in the wages of its trainmen of 17½ per cent and those of linemen trackmen, shopmen and power house men of from 15 to 20 per cent was made on April 1 by the Indianapolis & Cincinnati Traction Company, Indianapolis, Ind. This, it is explained, makes a reduction that amounts to approximately one-half of the increases granted since 1918. The wages of the trainmen were reduced from 47 cents to 40 cents an hour, while the wages of the linemen, shopmen, trackmen and power house men, which varied from 35 to 60 cents an hour, were reduced to from 30 cents to 50 cents an hour.

Wage Reduction Talk in Cincinnati.—The Cincinnati (Ohio) Traction Company has notified its stationary firemen it desires to reduce their wages. This is in accordance with the existing contract between the company and the Union. The firemen's contract year ends May 1, that of the engineer's June 1 and of the motormen, conductors and other employees July 1. All would run on from year to year unless modified. It has not been announced how much

the company wants the wages of the firemen reduced, but there is a report that it is around 20 per cent. Stationary firemen get 90 cents an hour and regular motormen and conductors 59 cents an hour.

Trainmen Accept Wage Cut.—Employees of the Albany Southern Railroad, Hudson, N. Y., have agreed to accept a 10 per cent reduction in wages. General Manager Hewes in a circular letter to the employees issued on April 2 asked them, in view of the reduced earnings of the company, to accept a cut of 10 per cent in their pay. The employees asked for a conference with the general manager. The request was granted and after a discussion of the subject of the company's condition the employees agreed to accept the reduction. The reduction affects motormen, conductors, freight crews, freight handlers and some others. The motormen and conductors were receiving 55 cents an hour.

Programs of Meetings

National Electric Light Association

The National Electric Light Association will hold its forty-fourth annual convention in Chicago from May 31 to June 3, 1921. The business session and meetings of the convention will be held at Hotel Drake.

Mechanical Division of A. R. A.

The general committee of the Mechanical Division of the American Railway Association, at a meeting in New York on March 30, decided to hold a business session at the Hotel Drake, Chicago, on June 15 and 16, instead of the convention that was to have occurred at Atlantic City. The program has been modified and reports will be presented only by the committees on the following subjects: Prices for Labor and Material, Car Construction, Loading Rules, Brake Shoe and Brake Beam Equipment, Train Brake and Signal Equipment, Specifications and Tests for Materials, Tank Cars and Standing Methods of Packing Journal Boxes. Both morning and afternoon sessions will be held.

Chamber of Commerce

The ninth annual meeting of the Chamber of Commerce of the United States will be held at Atlantic City, N. J., April 26 to 29, 1921. The session will begin with a meeting of the national councillors on the afternoon of April 26. Thereafter there will be general sessions in the morning of each day and the afternoon of April 29, with group meetings on the afternoons of April 27 and 28. The groups this year are (1) civic development, (2) domestic distribution, (3) fabricated production, (4) finance, (5) foreign commerce, (6) insurance, (7) national resources production and (8) transportation and communication, including (a) shipping and (b) railroads. The two sections of the transportation group meet separately on Wednesday afternoon but jointly on Thursday afternoon.

Financial and Corporate

Direct Offering Successful

\$1,000,000 of Notes Sold in Twelve Days to Employees, Customers and Public

The Portland Railway, Light & Power Company, Portland, Ore., has sold to its employees, customers and to the public an issue of \$1,000,000 of 8 per cent five-year gold notes, the entire offering being disposed of in twelve days, with a considerable over-subscription. This is the first attempt the company has made to dispose of securities since the original preferred and common stock of the company was sold.

The campaign was conducted by the company itself through its employees, but met with whole-hearted co-operation from the many banking institutions located in the Portland territory. These banks disposed of nearly \$100,000 of the gold notes purely as an accommodation without a cent of commission for this service.

The selling organization of the company was under the direction of A. C.

Toledo Deficit Increasing

Economies Sought From Wage Readjustment, Revised Power Rates and Car Rerouting

The operating deficit of the Community Traction Company, Toledo, Ohio, for March is expected to be larger than that for February, when it amounted to \$58,000. The payments made on April 11 showed a balance of about \$37,000 accumulated in the maintenance, depreciation and claims and damage funds to offset the deficit in the stabilizing fund, which has fallen below the \$300,000 mark now. Maintenance has been set at 10 cents a car-mile in order to create a surplus for summer work. In the depreciation fund, which may be used for extensions and betterments, there is now a surplus of \$14,000.

The wage conference held for the purpose of working out a contract between the Community Traction Company and the carmen's union has dragged along and will probably end in a deadlock. The men have been offered a cut in wages from 60 cents to 58 cents an hour. A vacation of two weeks with pay has also been withdrawn. Electrical workers are also debating the terms of a new agreement and in the meantime the old contract is being extended.

It is thought that action on contracts is being postponed in order to await the decisions of conferences due on May 1 between the men and the railways at Detroit and Cleveland. The Toledo contract has always been one month in advance of the contracts of these two cities, and on a down-scale revision of wages is put in an important position in the bargaining. What step the city might take to protect its equity in the property in event of a strike is problematical. The commissioner and board of control may have something to say about wages to be paid before the matter is definitely settled.

The refusal of Henry L. Doherty to allow city experts to view the books of the Acme Power Company, one of his subsidiary power companies in Toledo, in an effort to fix a reasonable rate for power supplied by the Toledo Railways & Light Company to the Community Traction Company has brought forth a friendly effort from the city officials to bargain with the company. The conferences on power will be taken up soon by Henry Riggs, Ann Arbor; V. B. Phillips, Cleveland, and David Friday, Ann Arbor, who have been secured to determine the rate for the contract. The Acme Power Company has set a rate at 2.35 cents a kilowatt, which the commissioner has disapproved as excessive.

A portion of a rerouting plan suggested to the Council by Commissioner

Wilfred E. Cann has passed the Council committee and will without doubt be put into effect in a few weeks. It is a plan to eliminate a portion of one by combining two lines into a one-way belt. The elimination of the Indiana Avenue line as proposed has not had the sanction of the Council as yet. The changing of the Huron and Erie lines and the making of a separate line of Western Avenue will effect a saving estimated at \$97,000 a year in the operation of the system here.

Suspension of Service Suggested

Threats to abandon the City Railway line and perhaps the Wheeling & Elm Grove Line, both owned by the Wheeling (W. Va.) Public Service

Let's Keep Our Money at Home

\$1,000,000
8 Per Cent Five-Year Gold Notes
Portland Railway, Light and Power Company
Dated March 1, 1921—Due March 1, 1926
TITLE & TRUST COMPANY, PORTLAND, OREGON, Trustee

There is more urgent need now than ever for our own people to patronize home industry and keep our money working for the progress and development of our own home community. There is no better way for the thrifty wage earner to help home industry than to become the owner of one or more of the 8% Gold Notes now offered to the public by this Company. Investment in these attractive securities is of great importance to you, to the community and to this Company.

- 1—The purchase of these notes by our home people will serve to strengthen the financial position of this Company.
- 2—The proceeds from these notes will enable this company to materially improve its public service to you.
- 3—You know that the business affairs of this Company are efficiently managed and that those who are directing it will safeguard your investment.
- 4—Ownership of a few of these notes will increase your own personal earning power.
- 5—The territory served by this Company is capable of large and growing development.
- 6—This Company supplies an absolutely essential public service permanent in character and steadily growing in demand.

Notes in Denominations of \$100, \$500 and \$1000

*They may be purchased in limited amounts on ten cent payments, the Company paying interest on amounts paid in.

POINTS TO REMEMBER.

These notes are one of the most attractive investments ever put on the local market.
The investment is safe.
The interest rate is unusually high.
It is a home investment for home people.
The interest is paid regular and promptly every six months.
You may buy the notes for cash or on easy payments.

ASK YOUR BANKER.

Come in and talk the matter over with our Securities Department or get the facts by clipping and sending in the attached coupon.

<p>SECURITIES DEPARTMENT Portland Railway, Light and Power Company First Floor, Electric Bldg., Portland, Or., Mar. 1921 DIVISION OFFICES Salem, Or.; Oregon City, Or.; Vancouver, Wash.</p>	<p>INQUIRY COUPON</p> <p>Portland Railway, Light and Power Co. First Floor, Electric Bldg., Portland, Or., Mar. 1921</p> <p>Name _____ Address _____ City _____ State _____</p>
---	--

Home Industry Has Scored a Triumph

The Portland Railway, Light and Power Company wishes to express a word of appreciation to its employees, patrons and the public as a whole for the liberal manner in which they have received our offering of \$1,000,000 of 8% five-year Gold Notes.

This offering was taken and considerably over-subscribed in the brief period of 12 working days.

What is particularly gratifying is the fact that the public has demonstrated a hearty and impressive spirit of loyalty and support of a home industry devoted to a public service which is necessary and permanent and steadily increasing in demand.

The success of this undertaking further demonstrates that the people of this district are a thrifty and prudent people; that they recognize the material benefits that will accrue to the community as a whole from their support of those local enterprises that are substantially concerned in the continued development and upbuilding of the community.

This Company will undertake to merit in the highest degree this measure of public confidence and will exert its best energies and skill always toward the one end, namely: To meet, so far as it can, the needs of the public and to continue to play its substantial part in the further growth and prosperity of all the people and all the territory served by it.

Portland Railway, Light and Power Company
By FRANKLIN T. GREFFITH, President

SPECIMENS OF THE APPEAL AND THE APPRECIATION

Corporation, were made at a meeting of the City Council by J. D. Whittemore, general manager, following orders from the city to pave between the tracks. Mr. Whittemore said:

Notwithstanding the revision of the fares effective during December, 1920, the City Railway continues to operate at a deficit, and inasmuch as there appears to be little prospect of relief in sight the directors of the company have voted to call a meeting of its stockholders and to recommend that they take such steps as may be necessary to discontinue the operation of the road and liquidate whatever assets may remain. It is expected that the stockholders of the company will follow this recommendation and that immediate steps will be taken to wind up the affairs of the corporation.

In view of these facts and conditions, I regret to state that it will not be possible for the City Railway to undertake any of the work outlined in your letters.

Buses compete with lines of the Wheeling & Elm Grove Company.

McMicken, commercial manager of the company. The sales force consisted of about fifteen officials and department heads who acted as "key men." These chairmen recruited their individual committees for selling the notes to the other employees and to the company's patrons. The publicity and advertising in connection with the offering were directed by W. P. Strandborg of the company.

The success of the campaign is indicated by the fact that nearly 1,900 out of 2,800 employees of the company subscribed for the notes. The balance of the offering was taken by the public, the total number of individual subscribers being approximately 33,000.

A remarkable feature of the campaign was the fact that approximately

70 per cent of the subscriptions were paid for in actual cash, although the company offered two forms of partial payment subscriptions—one 10 per cent down and 10 per cent a month, and the other 10 per cent down and the balance before April 15. As indicating the wide-spread distribution of the company's notes the largest individual sale was \$7,500.

In conjunction with the selling campaign an intensive advertising drive was conducted in which both the educational and selling features of the undertaking were emphasized. The company sent to its 54,000 customers a four-page circular containing a great deal of detailed information about the company's affairs and also about the notes themselves. With this circular went a letter signed by Franklin T. Griffith, president of the company, and an information card with details of the method of applying for the notes.

An "Inquiry Coupon" was attached to the circular and as the requests for further information came in they were tabulated and indexed and followed up by sending out an illustrated folder of eight pages with additional information about the note issue and the service which the company is rendering to the many communities in its territory. In addition to this a series of fifteen display advertisements, quarter page in size, were used in the local daily papers and selected advertisements were used in practically all the publications in the territory that is served by the company.

These display advertisements were supported by two special issues of *Watts Watt*, the official publication of the company distributed on the cars every Friday morning. Attractive car cards were also used as dash signs on all the company's passenger cars for a period of two weeks and window newspapers pointing out attractive investment features of the gold notes were displayed, two in each car.

An important feature of the campaign was the method used in securing the names of prospects. Each of

the 2,800 employees of the company was pledged to turn in to the campaign organization a list of three names each day for a period of ten days. This gave the selling force a list of 84,000 persons and these were carefully sifted by removing duplications and eliminating those that were not regarded as favorable prospects, and the balance of the list was turned over to teams of two employees each and personal solicitation was made.

The entire cost of the campaign was substantially less than if the notes had been offered to the public through the regular banking and investment channels. The exact cost of the campaign

is not available at this time, but as evidence of the very nominal cost it can be said that the expense for advertising, which was the major part of the cost, was under 0.7 of 1 per cent. The balance of the cost was limited virtually to printing of the forms, blanks and stationery and the necessary postage.

Quebec Company Negotiating Sale.—The Quebec Railway, Light, Heat & Power Company, Quebec, Que., is negotiating for the sale of the Quebec & Montgomery Railway. With the sale of this railway the company will become solely a public utility concern.

Railway Credit Growing Steadily

Notwithstanding Increased Operating Ratio City and Interurban Company's Credit Indicator Increases 10 per Cent

According to an analysis of operations covering 127 electric railway companies made by E. J. Murphy, statistician of the bureau of information and service of the American Electric Railway Association, the gross income for seventy-two urban companies increased 4.3 per cent, while for fifty-five interurban companies it increased 4.9 per cent over the previous year. Deductions by interurban companies increased 7.9 per cent against 0.15 by urban companies.

EVEN with these increased fixed charges the net income of city companies applicable to dividends increased 42.5 per cent, interurban companies decreased 1.6 per cent, while if combined the weighted average shows a 24.5 per cent gain.

The credit index, that is, the ratio of gross earnings to gross income, also shows improvement. In the case of the urban companies it increased from 4.74 to 5.24, the interurban companies 3.65 to 3.98 while if the totals are combined the index is 4.54 and 5.02 for 1919 and 1920 respectively, a gain of slightly more than 10 per cent.

Deductions from gross income, for fixed charges, are still greater than it should be for a sound financial basis. Improvement has been made by the urban companies. In 1920 this percentage was 87.8, as against 90.3 the previous year. For the interurban

companies the opposite is true. In 1920, 70.8 per cent of gross income went to fixed charges while in 1919 the percentage was 68.8.

On a combined basis the operating revenue increased 16.3 per cent and operating expenses 18.9 per cent. The operating ratio increased from 76.8 in 1919 to 78.4 in 1920: The increase in operating expenses seems to have been consistent. For all companies it was 18.9 per cent, for the city companies 18.8 per cent and for interurbans 19.2.

An analysis of the operating accounts shows that notwithstanding this increase the amount spent for each item follows practically the same percentage for the two years, the greatest variation, however, being in the cost of power, with the cost of conducting transportation next. Both of these variations were in the neighborhood of 1 per cent.

TABLE I—COMBINED INCOME STATEMENT OF SEVENTY-TWO CITY AND FIFTY-FIVE INTERURBAN ELECTRIC RAILWAYS FOR THE CALENDAR YEARS 1919 AND 1920

	72 City Companies			55 Interurban Companies			127 City and Interurban Companies		
	1920	1919	Per Cent Increase	1920	1919	Per Cent Increase	1920	1919	Per Cent Increase
Railway operating revenue.....	\$229,629,280	\$196,999,477	16.6	\$37,724,460	\$32,75,494	15.2	\$267,353,740	\$229,751,971	16.3
Operating expenses:									
Way and structures.....	\$22,625,964	\$19,166,412	18.0	\$4,818,027	\$4,113,560	17.1	\$27,443,991	\$23,279,972	17.9
Equipment.....	23,742,679	20,480,766	15.9	3,431,323	3,041,514	12.8	27,174,002	23,522,280	15.5
Power.....	28,940,898	22,978,675	25.9	5,753,790	4,566,871	25.8	34,694,688	27,545,546	25.9
Conducting transportation.....	81,972,242	68,629,920	13.8	9,200,254	7,872,619	16.7	91,172,496	76,502,539	18.1
Traffic.....	688,120	664,679	3.5	9,200,254	228,596	9.6	91,172,496	893,275	5.1
General and miscellaneous.....	23,475,899	20,796,833	12.8	4,912,135	3,969,733	23.7	28,388,034	24,766,566	14
Transportation for Investment Cr.....	113,036	131,085	13.8	2,927	1,078	171.5	115,963	132,163	12.2
Railway operating expenses.....	\$181,332,766	\$152,586,200	18.8	\$28,365,448 (a)	\$23,799,021	19.2	\$209,698,214	\$176,385,221	18.9
Net operating revenue.....	48,296,514	44,413,277	8.7	9,359,012	8,953,473	4.5	57,655,526	53,366,750	8.0
Operating ratio.....	79.2	77.5	2.2	75.2	72.6	3.6	78.4	76.8	2.1
Net revenue: Auxiliary operations.....	\$9,821,719	\$10,145,846	3.2	\$1,513,818	\$1,634,812	7.4	\$11,335,537	\$11,780,658	3.8
Taxes.....	15,672,984	13,448,647	16.5	1,965,564	1,731,456	13.5	17,638,548	15,180,103	16.2
Operating income.....	42,445,249	41,110,476	3.3	8,907,266	8,856,829	0.57	51,352,515	49,967,305	2.8
Non-operating income.....	3,969,075	3,389,232	17.1	1,241,669	816,228	52.2	5,210,744	4,205,460	23.9
Gross income.....	46,414,324	44,499,708	4.3	10,148,935	9,673,057	4.9	56,563,259	54,172,765	4.4
Deductions.....	40,198,081	40,136,210	0.15	7,187,695	6,663,743	7.9	47,385,776	46,799,953	1.3
Net income.....	6,216,243	4,363,498	42.5	2,961,240	3,009,314	1.6	9,177,483	7,372,812	24.5
Per Cent: Gross income to fixed charges.....	115.5	110.9	4.1	141.2	145.2	2.8	119.4	115.8	3.1
Ratio: Net income to operating revenue.....	2.7	2.2	2.3	7.9	9.2	14.6	3.4	3.2	5.7
Car-miles operated.....	530,238,431	518,507,394	2.2	74,609,893	73,306,782	1.8	604,848,324	591,814,176	2.2

Figures in italics denote decrease.

(a) Includes \$7,206 undistributed expenses.

(b) Includes \$2,392 undistributed expenses.

TABLE III—OPERATING STATISTICS AND DERIVED RATIOS FOR THE CALENDAR YEARS 1919 AND 1920

	City			Interurban			Total City and Interurban					
	No. of Companies	1920	1919	Per Cent Increase	No. of Companies	1920	1919	Per Cent Increase	No. of Companies	1920	1919	Per Cent Increase
Operating revenue.....	72	\$229,629,280	\$196,999,475	16.6	55	\$37,724,460	\$32,752,494	15.2	127	\$267,353,740	\$229,751,971	16.4
Per mile of line.....	53	44,336	38,662	14.7	44	11,636	10,354	12.5	97	32,067	27,927	14.8
Passenger revenue.....	72	\$219,950,509	\$191,975,086	14.5	55	\$31,729,735	\$27,649,905	14.8	127	\$251,680,244	\$219,624,991	14.5
Per revenue passenger.....	68	0.069	0.063	7.9	43	0.12	0.11	9.1	111	0.072	0.066	9.1
Per car-mile.....	72	41.5	37.0	12.1	55	42.4	37.7	17.4	127	41.6	37.1	12.1
Per mile of revenue track.....	60	\$25,508	\$22,755	12.1	45	\$8,010	\$7,177	11.2	105	\$20,325	\$18,243	11.4
Per car-hour.....	68	3.72	3.81	2.3	46	4.64	4.09	13.4	114	3.82	3.42	11.6
Per maximum revenue car operated daily.....	59	\$15,598	\$13,729	13.6	39	\$17,049	\$15,410	10.5	98	\$15,739	\$13,894	13.2
Total passengers.....	71	3,903,547,828	3,755,907,509	3.9	48	274,064,071	255,575,776	7.2	119	4,177,611,899	4,011,483,285	4.1
Revenue passengers.....	68	2,933,559,233	2,807,339,035	4.5	42	241,660,531	226,021,569	6.9	110	3,175,219,764	3,033,360,604	4.6
Per car-mile.....	68	6.2	6.1	1.8	42	3.7	3.6	2.7	110	5.9	5.8	1.7
Per car-hour.....	66	57.4	56.4	1.7	39	46.8	45.2	3.5	105	56.4	55.3	1.9
Per mile of revenue track.....	58	375,540	356,788	5.3	37	74,642	69,638	5.7	95	300,169	284,316	5.6
Per maximum revenue cars operated daily.....	57	211,121	242,451	12.9	31	124,276	115,971	7.2	88	204,826	228,903	10.5
Transfer passengers.....	61	735,758,394	707,087,306	4.1	21	23,492,729	21,974,451	6.9	82	759,251,123	729,061,757	4.1
Ratio: Transfer passengers to revenue passengers.....	61	25.3	27.6	8.3	18	11.6	11.7	.8	79	24.4	26.3	7.2
Car-miles operated.....	72	530,238,431	518,507,394	2.3	55	74,609,893	73,306,782	1.8	127	604,848,324	591,814,176	2.2
Per car-hour.....	68	9.1	9.1	.46	46	11.0	10.9	.9	114	9.3	9.3	.1
Per mile of revenue track.....	60	59,723	59,147	1.0	45	18,974	18,843	.6	104	43,750	36,028	21.4
Per maximum revenue car operated	59	39,547	40,042	1.2	39	40,673	40,943	.6	98	39,656	40,130	1.1
Car-hours.....	68	45,516,538	44,425,174	2.5	46	5,495,175	5,370,832	2.3	114	51,011,713	49,796,006	2.4
Miles of line.....	53	4,233.4	4,137.6	2.3	44	2,545.0	2,527.8	.7	97	6,778.4	6,665.4	1.7
Miles of revenue single track.....	60	7,665.4	7,546.2	1.6	45	3,094.9	3,074.8	.7	105	10,760.3	10,621.0	1.3
Average maximum number of cars operated daily.....	59	10,591	10,258	3.2	39	1,141	1,112	2.6	98	11,732	11,370	3.1

Italics indicate decrease

The amount of service rendered by the city companies increased 2.2 per cent, while for the interurban companies it increased but 1.8 per cent. The traffic index, car-miles per revenue passenger for sixty-eight city companies, shows a slight decrease. In 1920 the ratio was 0.1615, as compared with 0.164 in 1919. For forty-two interurban companies the index was 0.2705 in 1920, as against 0.278 in 1919.

Inquiry Into Ending of Trusteeship.—Termination of the trusteeship of the Connecticut Company, New Haven, Conn., was discussed at an executive session of the committee of railroads of the General Assembly at Hartford on April 5, with the result that two of its members were delegated to ask the Attorney General for advice as to the course to be taken in turning the company over to the stockholders.

Public Service Railway Valuation Announced

\$125,000,000 Fixed for Rate Making Purposes as Value of Property and Business Employed for Public Convenience

The value of the property and business of the Public Service Railway, Newark, N. J., as of Jan. 1, 1921, employed for the public convenience is \$125,000,000 with an operating efficiency of the physical property and organization of 86 per cent. This is the judgment of Ford, Bacon & Davis, engineers, New York, who were employed by the street railway valuation commission of New Jersey, Aug. 30, 1920. "Value of Service" is the test applied.

THE engineers were instructed to ascertain and determine the value of all the property, including every proper and lawful element thereof, of the Public Service Railway, in accordance with Chapter 351, Laws of 1920, State of New Jersey. The members of the valuation commission are Edward E. Edwards, governor, William T. Read, State Treasurer, and Newton A. K. Bugbee, Comptroller.

On April 11, 1921, Ford, Bacon & Davis transmitted their complete and detailed report covering the valuation for use in fixing rates under existing laws, an abstract of which follows: In arriving at the final figure representing the value of the railway property they have been guided by the decision of the Supreme Court of the United States in Smyth vs. Ames "what the company is entitled to ask is a fair return upon the value of that which it employs for the public convenience"; in other words, the valuation submitted includes only so much of the business and property of the Public Service Railway as it employs for the public convenience and excludes any so-called element of franchise value. The valuation also excludes the property of the Public Service Railroad.

The unamortized cost of the superseded property, which has been discarded due to obsolescence or inadequacy was found to be \$4,701,943 and the reproduction cost of the property not used in operation based on Sept. 1, 1920 prices for labor and material was \$645,593. Both of these figures are given in order to comply with the law, which calls for a determination of the value of all of the property.

The cost of the property as a going concern built up from actual expenditures of the company as revealed by its records, in other words the historical cost, was \$119,150,163.

TABLE II—COMPARATIVE SUMMARIZED INCOME STATEMENT (ON A CAR MILE BASIS) OF 127 ELECTRIC RAILWAYS FOR THE CALENDAR YEARS 1919 AND 1920

	Seventy-Two City Companies			Fifty-Five Interurban Companies			127 City and Interurban Companies		
	1920	1919	Per Cent Increase	1920	1919	Per Cent Increase	1920	1919	Per Cent Increase
Railway operating revenue..	43.3	38.0	13.9	50.6	44.7	13.2	44.2	38.8	13.9
Operating expenses:									
Way and structures.....	4.3	3.7	16.2	6.5	5.6	16.1	4.5	3.9	15.4
Equipment.....	4.5	3.9	15.4	4.6	4.1	12.2	4.5	4.0	12.5
Power.....	5.5	4.4	25.0	7.7	6.2	24.1	5.7	4.7	21.3
Conducting transportation	15.5	13.2	17.4	12.3	10.7	15.0	15.1	12.9	17.6
Traffic.....	0.1	0.1	..	0.3	0.3	..	0.2	0.2	..
General and Miscellaneous...	4.4	4.0	10.0	6.6	5.4	22.2	4.7	4.2	11.9
Transportation for Investment Cr.....	0.02	0.03	33.3	0.04	.001	300.0	0.02	0.02	..
Total operating expenses...	34.3	29.3	17.1	38.0	32.3	17.6	34.7	29.8	16.4
Net operating revenue.....	9.1	8.6	5.8	12.6	12.2	3.3	9.5	9.0	5.6
Operating ratio: (per cent)...	79.2	77.5	2.2	75.2	72.6	3.6	78.4	76.8	2.1
Net revenue: auxiliary operations.....	1.9	1.9	5.0	2.0	2.2	9.1	1.9	2.0	5.0
Taxes.....	3.0	2.6	15.4	2.6	2.2	9.1	1.9	2.0	5.0
Operating income.....	8.0	7.9	1.3	12.0	12.0	..	8.5	8.4	1.2
Non-operating income.....	0.7	0.7	..	1.6	1.1	45.5	0.9	0.7	28.6
Gross income.....	8.7	8.6	1.2	13.6	13.01	3.8	9.4	9.1	3.3
Deductions from gross income.....	7.6	7.7	1.3	9.6	9.1	5.5	7.8	7.9	1.3
Net income.....	1.1	0.9	22.2	4.0	4.0	..	1.6	1.2	33.3
Per cent: Gross income to fixed charges.....	115.5	110.9	4.1	141.2	145.2	2.8	119.4	115.8	3.1
Ratio: Net income to operating revenue.....	2.7	2.2	2.3	7.9	9.2	14.6	3.6	3.1	16.1

The report says that it seems to have been the practice in the past to attempt to determine the value of a public utility without regard to the value of the service rendered to the public, placing "as it were, the cart before the horse, and resulting in there being no real foundation for the values thus attempted to be established." If the value of the service rendered is once established, the value of the property devoted to the public use is readily determined by ordinary economic considerations. The value of service consists of the normal cost of rendering such service plus the profit necessary to induce capital to flow into the business.

The cost of service as defined includes operating expenses, plus depreciation, allowance for obsolescence where changes in the art are taking place or where the industry is growing at a rapid rate, taxes and interest on an amount sufficient to produce a modern plant and facilities for furnishing the equivalent service in an efficient and economical manner; such amount not being limited to simply the cost of the physical structure but including all costs incident to organization before and after the physical structure is functioning, and in addition thereto, generally, losses incurred during early operation which are more or less in-

The value of an ordinary freely competitive commercial or industrial enterprise is dependent upon the value of its product or service. The engineers make a distinction between a freely competitive industry and a monopolistic organization, in which latter class public utilities were said to belong.

These more or less monopolistic enterprises, such as public utilities, instead of being regulated by the economic law of supply and demand, are kept in check by artificial restraints of the law. If the regulation proceeds to a point where the return permitted the property devoted to public use is less than that available for money invested in a competitive and unregulated industry (safety of investment being equal), value is impaired and property is taken without just compensation and the public service is itself injured as the extension of facilities is curtailed.

There is not much probability, at least in the near future, that prices for labor and material will revert to anywhere near the pre-war basis and consequently due consideration was given to existing prices in computing the value of the property. Taking cognizance of the present prices was in line with recent New Jersey decisions.

In conclusion the report stated that while an estimate of the amount of

New Jersey Valuation Act Amended

The valuation act of New Jersey under which the preceding report was made provided that the valuation so found should be accepted as final for rate-making purpose, no means for review being included in the act. Mainly because of the lack of any review provision Governor Edwards vetoed the measure. It was promptly repassed over his dissent. Agitation was kept up for the inclusion of some means of review in the measure and at the present session of the Legislature the act of 1920 was amended so as to provide "that such valuation shall be subject to review on certiorari." Provision is further included now for cross-examination by representatives of the municipalities and others before the Board of Public Utility Commissioners of the authors of any such valuation. Hearings on applications for rate increases for electric railways are also to be given preference in their consideration over matters of routine pending before the commission. The amendments have been approved by the Governor.

Governor Urges Valuation Based on Earning Power

Governor Miller of New York has discovered that the transit relief legislation passed at his behest does not guard the public interest sufficiently in the provision which it makes for transit valuations. In consequence he rushed to the Legislature on April 13 a special message on this matter urging haste in the enactment of the amendment to the so-called Knight-Adler law now suggested as the law-making body is to adjourn within a few days.

The emergency message was one of more than 1,000 words. The Governor said in part:

The ordinary standards of physical valuation, either original or reproduction cost, less depreciation, do not meet the emergency with which we have to deal, and physical valuations, according to any standard that could be prescribed, will in most cases under existing conditions be grossly unfair to the public.

It is very difficult to prescribe by statute a standard of principle of valuation that will be fair and not too inflexible. I fear in the absence of any other prescribed standard the statute as it now stands will be construed as contemplating a valuation based on physical values which, as I have said, may prove to be grossly unfair to the public.

Applied to the matter in hand the valuation should be based on the estimated prospective earnings at the fare in each case which the company is permitted to charge under its franchise or contract with the city, the valuation in no case to exceed the original cost or the fair reproduction cost less depreciation of the utility property which is necessarily employed in the public service.

Of course, I construe fair reproduction cost to mean such cost under normal, not abnormal, conditions.

The Senate on Wednesday passed, unanimously, a bill which provides, in part, that:

Such valuation shall be made with due regard to the estimated prospective earning capacity of the property necessarily used in the public service at the rate or rates of fare that the company prior to the taking effect of this act was entitled to charge.

Elements as of Jan. 1, 1921	Labor and Material	
	Average Pre-war Prices	Sept 1, 1920 Prices
Reproduction cost new of the property as a going concern.....	\$88,815,887	\$189,489,560
Accrued depreciation of the physical property.....	14,922,144	33,646,737
Minimum value of power lease.....	11,194,000	19,149,000
Reproduction cost of property not used in operation.....	645,593

herent in every form of business activity and are characteristic of public utilities. To this cost should be added a profit in sufficient amount to induce capital to flow into the industry.

In the findings of fact as to value no investigation was made of whether the property had in any measure been built up from past earnings or from money furnished from other sources, such as the sale of securities. This follows the ruling of the Board of Public Utility Commissioners in the Passaic Gas Case, approved by the Court of Errors and Appeals of New Jersey, which states that "deferred regulation is no excuse for refusing at present to allow a fair return upon what is the lawful property of the company."

Value is defined as the desirability or worth of a thing as compared with the desirability of something else; often confused with the qualities and circumstances on which, taken together, such desirability depends. The economic concept of value is definite and can have but one meaning, whether it is value for condemnation purposes, value in a confiscation case, value for rate making purposes or value for barter and exchange. This conception of value was recognized by the Supreme Court of the United States in 1894 in a decision rendered by Justice Brewer in *Regan vs. Farmers Loan & Trust Company*.

superseded property and non-operative property had been made, such allowance was not included in the final figure. Superseded property should be given consideration in the fixing of future rates if investigation proves that past rates fixed by regulation had been inadequate to give a fair return over reasonable allowances for obsolescence caused by the growth of business or changes in the art.

The property of the Railway Company was found to be on the whole well maintained except in a few instances where the physical property was not in the best operating condition, but where the condition can be remedied by the expenditure of a comparatively small sum. It was the opinion of the engineers that it would be impossible to produce a theoretical modern plant at very much less than the cost of reproducing the existing plant of the Railway Company. An analysis of the operating statements submitted by the company and a comparison with those of other street railways indicated an efficient operating organization. The report drew attention to certain economies which might be effected in several departments of the company, which would somewhat reduce operating expenses. These economies, it was added, were all given due weight in the engineers' conclusions as to the operating efficiency.

Traffic and Transportation

Winnipeg Fare Upheld

Appeal Court Unanimous in Its Finding Upholding Rights of Public Utilities Commissioner

The right of the Winnipeg (Man.) Electric Railway to charge higher fares as ordered by the Public Utilities Commissioner was sustained by the Appeal Court of Manitoba on April 4. The decision of the Appeal Court was unanimously in favor of the company on all points. Because of its sweeping and definite nature the ruling practically ends litigation arising out of the higher fares which has been pending for more than two years. The judgment is also of far-reaching effect because in several of the provinces in the Dominion of Canada there are public utility commissions.

Immediately after the judgment had been rendered the Winnipeg City Council discussed the situation and passed a resolution favoring a plan to enter into immediate negotiations with the Winnipeg Electric Railway, while at the same time authorizing the city solicitor to carry the appeal against the judgment of the Appeal Court to the Privy Council.

It is interesting to note that for some months past A. W. McLimont, vice-president of the Winnipeg Electric Railway, has been endeavoring to negotiate with the City Council with a view to settling the transportation problem in Winnipeg permanently. Alternative suggestions proposed by the company to the City Council will now form the basis of negotiations. They follow:

1. The city taking the street railway at the present time.
2. Agreeing upon the terms under which the company shall operate for the remaining period of the franchise.
3. Making an entirely new agreement, based upon service-at-cost or some similar arrangement, in which the profits of the company shall be limited and the fares to go up or down as the cost of operation increases or decreases. The control of this form of operation might be by a commission composed of representatives of the city and the company with an independent chairman.

Briefly reviewing the situation in Winnipeg it might be stated that in the fall of 1918 the company was faced with a serious financial situation on account of increased operating costs and then applied to the City Council for leave to increase fares over those stipulated in the franchise under which the company was operating.

The City Council referred the company to the Public Utilities Commission, and two interim orders were issued by the commission which also made exhaustive valuation of the company's property. This investigation extended over two years and included a complete valuation of the company's physical assets, while the company's

financial history also came under review. At the end of the investigation the commissioner made a final order raising the fares as follows:

Cash fares 7 cents.
Four tickets for 25 cents.
School children seven for 25 cents.

The city appealed against this order to the Court of Appeal.

By the terms of the order allowing the appeal to be taken the point submitted to the Court of Appeal was limited to the following question, viz.: Had the Public Utilities Commissioner the necessary authority to make the order raising the fares in so far as it affects the city of Winnipeg? Provided, that on the said appeal no question should be raised or argued as to the constitutional validity of the public utilities act, or as to the validity of the appointment of the said commissioner to his office.

The controversy between the city and the company as to the public utilities act involved two questions:

1. As to whether it was within the powers of the province to enact such legislation.
2. Whether upon the construction of the act as passed, assuming it to be within the powers of the province to pass it, the commissioner had power to change the fares fixed under the franchise agreement between the city and the company. The question before the Court of Appeal in the present instance was limited to the second of these two questions, the question as to the constitutionality of the act being eliminated.

The Court of Appeal has now unanimously decided the second question by upholding the powers of the Public Utilities Commissioner to change the fares fixed by the franchise agreement.

Boston Elevated Permitted to Run Buses

The Massachusetts Department of Public Utilities has granted its approval to the petition of the Boston (Mass.) Elevated Railway for the right to own and operate auto buses for the transportation of passengers and freight. Under the Massachusetts laws, any company desiring to operate motor buses for passenger transportation must first obtain the general approval of the Department of Public Utilities and is then obliged to secure a license from the city or town in which it proposes to operate.

The Boston Elevated desires to substitute the buses for street cars on Market Street, Brighton, a part of the city of Boston, and it will therefore proceed to petition the Boston City Council for the necessary license. The company, faced with the necessity of reconstructing its track for about 1½ miles on Market Street, where the traffic is comparatively light, decided to seek permission to abandon the track and operate the buses.

Fare Extension Accepted

Company at Columbus Hopes to Be Able to Meet \$3,000,000 Improvement Program

The Columbus Railway, Power & Light Company, Columbus, Ohio, has accepted the ordinance recently passed by the City Council which assures it of a continuance of the present rate of fare, authorized more than a year ago, of 6 cents cash, or five tickets for a quarter. This action was taken by the board of directors of the company on April 7 following a period of several weeks' consideration of the Council's ordinance authorizing extension of the present tariff.

Under this ordinance the company may charge the present rate of fare during the remainder of the life of the blanket franchise under which it is now operating. This terminates April 3, 1926. Under the temporary increase granted more than a year ago the company was authorized to increase the then existing fare of 3½ cents, with eight tickets for a quarter, to 6 cents, with five tickets for a quarter, for a period ending April 3, 1922. The new legislation accepted by the company, therefore, extends the higher rate four years.

The extension was granted on the company's showing that to return to the old rate would not only compel operation at a loss, but would preclude all possibility of restoring the financial credit of the company and prevent the carrying out of improvements and extensions demanded of it under the existing franchise.

Demands of the Council for improvements during the remainder of the franchise period, in exchange for the continued high rate contemplate a program of betterments and extensions involving a cost of \$3,000,000. The directors are still somewhat dubious as to their ability to make good on this consideration, but it was decided to accept the ordinance and make the best of the situation, with the hope that conditions will get better and allow the company to make a sufficient profit to permit it to meet the demands and at the same time assure itself of an adequate credit.

Company officials have assured the men that there will be no reduction in present wages, fixed by a board of arbitration about a year ago.

Seven-Cent Injunction Upheld

Judge Evans of the United States District Court, Louisville, Ky., has refused to hear that city in the matter of dissolving the temporary restraining order preventing interference with the Louisville Railway's 7-cent fare, stating that he would entertain no motions until the United States Court of Appeals decides the case.

The city will not seek to enforce penalties for collection of 7-cent fares as provided for in the Statutes of 1869 and will not take any action against the Louisville Railway other

than to file a suit in the state court to enforce the contract of the company with the city.

This announcement was the one City Attorney Lawton and his assistant, W. T. Baskett, planned to make had they been allowed by Judge Evans to make a motion to dissolve the 7-cent injunction.

The city contends that the injunction hangs on the ground that the city might enforce the penalties against the company. Claim was made that the question of contract should be tried out in a state court, it having no place in a federal court.

Fares Reduced 50 per Cent

The Boston (Mass.) Elevated Railway on March 26 established a 5-cent local fare in Everett and Malden on the seven surface routes feeding the terminal of

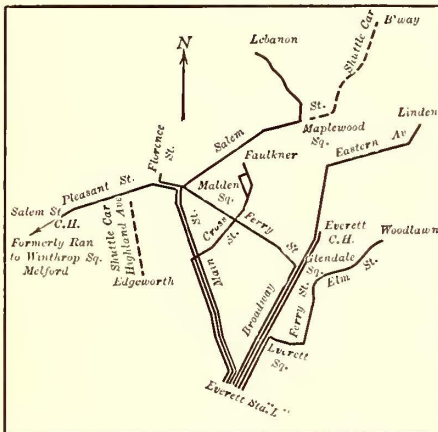
SERVICE ON BOSTON ELEVATED RAILWAY FROM EVERETT STATION

Surface Route	Length of Route (One-Way Distance) Miles	Week-Day Schedule				Sunday Schedule	
		Cars		Headway		Cars	Headway
		Nor.	Rush	Nor.	Rush		
Lebanon St.....	4.099	5	11	10	5	5	10
Salem St., C. H.....	3.405	5	15	10	3	5	10
Florence St.....	3.348	5	5	10	10	5	10
Faulkner.....	2.665	3	7	15	6	3	15
Everett, C. H.....	1.948	2	11	20	3		
Linden.....	3.535	2	6	20	7½	5	10
Woodlawn.....	2.519	3	7	12	6	3	15

the elevated line at Everett, shown in the accompanying map.

Some idea of the service rendered and the length of the rides possible for the 5-cent fare are given in the accompanying table.

The Highland Avenue and Salem Street routes are changed to stub and



EVERETT AND MALDEN 5-CENT FARE DISTRICT

shuttle routes instead of running to the terminal as heretofore. On these routes Brill single-truck safety cars are operated on a thirty-minute headway during normal hours, and on a 20-25 minute headway during rush hours.

Freight Delays Penalized.—The Public Service Commission of Indiana has authorized all interurban companies operating in Indiana to increase freight storage rates 1 cent a pound for every twenty-four hours. The increase was made as a penalty to cause shippers to move goods promptly.

Five-Cent Fare Denied in San Antonio

United States Supreme Court Holds that a Confiscatory Rate There Will Not Stand as City Did Not Have Franchise Power

In the case of the city of San Antonio vs. the San Antonio Public Service Company, the Supreme Court of the United States on April 11 affirmed the action of the lower court in enjoining the city of San Antonio from enforcing a 5-cent fare against the San Antonio Public Service Company. The decision is regarded as far-reaching in its consequence in Texas at least.

THE lower court contended and the Supreme Court concurs that the right to enforce such a rate was not secured by the city by contract and such enforcement was beyond the power of the city because it would mean the confiscation of the property of the railway which would result in violation of the fourteenth amendment of the Constitution of the United States.

controllable grant of special privileges or immunities shall be made."

The final decree just rendered enjoins the city from interfering with the complainant in substituting a 7-cent fare and besides enjoins the city from enforcing the various ordinances complained of in the bill prohibiting and punishing the charging of a higher rate than 5 cents. The decree, however, reserves the right to the city to ask relief whenever, because of a change in conditions, the 5-cent fare should cease to be confiscatory. In addition the enforcement of the city ordinance imposing the half-fare rate for school children was enjoined, although the continued enforcement of the state half-fare law, which had been upheld, was expressly declared by the Supreme Court not to be restrained.

Continuing the opinion says:

That in view of the admitted fact of confiscation the court had power to deal with the subject is too clear for anything but the statement. And we think it is equally clear that the right to regulate gives no power whatever to violate the constitution by enforcing a confiscatory rate, a result which could only be sustained as a consequence of a duty to pay such rate arising from the obligations of a contract, it follows that the solitary question to be considered is whether a contract existed empowering the city to enforce the confiscatory rate.

Primarily the answer to that question must depend upon whether the ordinance of 1899 fixing the 5-cent rate was a contract. That it was not and could not be, we are of opinion, is the necessary result of the provision * * * of the state constitution, which existed in 1899, prohibiting "any irrevocable or uncontrollable grant of special privileges," when considered in the light of the irrevocable and uncontrollable elements which must necessarily inhere in the ordinance of 1899 to give it the contract consequence relied upon. * * *

The fact is that all contentions of the city as to obligation of contract as to the 1899 rates illustrate the plainly erroneous theory upon which the entire argument of the city proceeds; that is, that limitations by contract upon the power of government to regulate the rates to be charged by a public service corporation are to be implied for the purpose of sustaining the confiscation of private property.

Increase Asked in Workingmen's Fare

An increase of 80 cents a month in the fare for Rock Island arsenal workingmen has been asked by the Tri-City Railway, Davenport, Ia. The men have been buying tickets for \$2.80 per month, good to and from the arsenal as many times a month as their work there requires.

Figured on the basis of twenty-six working days a month, the average number, and two rides a day, the new fare schedule petitioned for would be approximately 7 cents a ride. This increase is proportionate to the raise from 7 to 9 cents on city lines in Davenport, Rock Island and Moline.

In March, 1899, the City of San Antonio by ordinance extended to July 1, 1940, the franchise of the San Antonio Gas Company, the Mutual Electric Light Company, the San Antonio Street Railway and the San Antonio Edison Company. The ordinance provided, among other things, that the two last-named companies which operated railways in the city were to charge a 5-cent fare for one continuous ride over any one of their lines with one transfer to or from either line to the other.

In April, 1900, all the property of the two railway companies was sold under a decree of a state court to the San Antonio Traction Company, and that company with the approval of the city thereafter controlled and carried on both lines.

In 1903 the state enacted a half-fare law making it the duty of the traction company to carry school children and students for half fare and subsequently an ordinance was passed by the city in furtherance of this law. The company refused to carry out this legislation on the ground that it impaired the obligation of its contract as to the rate of fare resulting from the city ordinance of San Antonio of 1899 in violation of the state and Federal constitutions.

A suit by mandamus to compel it to do so was begun by an individual, and from a ruling adverse to the company's contention, the case was taken to the Court of Civil Appeals. That court held that it was unnecessary to consider whether the rate requirement was a contract because it was adopted long after the provision of the state constitution that "no irrevocable or un-

Franchise Rate Valid

The Iowa Supreme Court Decision Affects Both the Des Moines and Ottumwa Railways

The railway question at Des Moines, Iowa, has been thrown wide open again with the dismissal last week on motion of the Ottumwa Railway & Light Company of its appeal to the Iowa Supreme Court on the fare case at Ottumwa. The Ottumwa case is expected to have a direct bearing upon the rate in Des Moines by reason of the fact that Judge Martin J. Wade, of the Federal court, in granting the receivers for the Des Moines City Railway the 8-cent fare ruled as follows:

If the Supreme Court of this State changes its former decision and holds a franchise rate valid this fare will be changed. The court will bow to the highest court of this State as it did in the 6-cent fare decision.

By its dismissal of the appeal the Iowa Supreme Court wiped out its previous decisions, and the legal battle is restored to the District Court, which previously upheld the city of Ottumwa in its contention that a 5-cent fare should be charged.

ALLOWED TO INCREASE RATES AS A WAR MEASURE

The Ottumwa case has dragged along in the courts for several years. The Ottumwa franchise provided for a 5-cent fare, but as a war measure the City Council allowed the company to charge 6 cents. With the coming of peace the city sought to restore the 5-cent fare, which was objected to by the Ottumwa Railway & Light Company on the ground of increased costs. When the case was appealed to the Supreme Court that tribunal sustained the ruling of the lower court, but on a rehearing the higher court reversed itself. The city then asked a new hearing and the dismissal of its case was asked by the Ottumwa Railway & Light Company.

Attorneys for the city of Des Moines state that as soon as possible they will make formal application to Judge Wade for an order restoring the 5-cent fare in Des Moines.

The Des Moines City Railway, through A. W. Harris, of the Harris Trust Company, which controls the company, has announced that unless the bus competition is eliminated the company will soon have to suspend operation. Mr. Harris made the above statement to the Greater Des Moines committee in proposing a service-at-cost feature of a new franchise proposal. The Greater Des Moines committee agreed to sponsor the movement and efforts were made to bring about a meeting of the City Council and attorneys and officials of the company. However, Mayor Barton declined to accept the invitation of the Greater Des Moines committee unless the meetings were in the City Council chamber and were open to the public. To date not progress has been made.

The battle between the buses and the electric railway is going on merrily in

the meantime and each side is using newspaper advertising in an effort to place its story before the people.

Ten-Cent Fare Plea Heard

The hearing on the application of the Trenton & Mercer County Traction Corporation, Trenton, N. J., to increase its fares from 7 cents to 10 cents was begun before the Board of Public Utility Commissioners on April 5. Rankin Johnson, president, stated that interest on bonds was defaulted on April 1 and that there are no funds with which to pay interest falling due on May 1. He said that in consequence there was a possibility that ninety cars serving as security for the bonds would be seized by the trustees under the mortgagee, leaving only thirty cars with which to maintain schedules. Mr. Johnson insisted that unless assistance is forthcoming immediately the system will have to pass into the hands of a receiver.

Even with an increased rate, Mr. Johnson said, the receipts of the corporation would fall approximately \$50,000 short of the sum required to meet expenses for the first year. He thought a higher fare would result in a falling off of not more than 5 per cent in the number of passengers, and that this would be but temporary.

Although the system is not confronted by jitney competition, Mr. Johnson declared that the receipts were undoubtedly affected by what he characterized as "private automobile competition." He testified that the corporation enjoys the advantage of a wage agreement slightly lower than that under which the Public Service Railway is working and also less than that prevailing in other cities similar in size to Trenton.

Transportation News Notes

Special Mid-day Fares Help Traffic.—It is announced that the cheap mid-day fares on the London County Council Tramways have so stimulated traffic as to produce substantial financial benefit.

Seeks Higher Fare.—The Wisconsin Traction, Light, Heat & Power Company, Appleton, Wis., has applied to the State Railroad Commission for permission to increase its lighting, power and street car rates.

City Proud of Its Five-Cent Fare.—Cars of the Lincoln (Ill.) Municipal Railway are to carry placards announcing a 5-cent fare, primarily for the edification of the visitor to that city as an advertisement of economical management of a municipal enterprise.

Railway and Jitney Schedules Articulated.—The Board of Aldermen of

Dover, N. J., has passed an ordinance compelling jitney operators to pay a license fee of \$100 a year and to arrange schedules so they interpolate those of the Morris County Traction Company.

Ferry-Railway Transfers Urged.—David W. Henderson, superintendent of the Seattle (Wash.) Municipal Railway, has refused to commit himself as to what the attitude of his office would be regarding the matter of entering into an agreement with the operators of the Elliott Bay ferry to West Seattle for the exchange of transfers from the cars to the ferry and from the ferry to the cars. A petition signed by several hundred citizens of West Seattle urges that the city take action to secure a transfer arrangement in order that the ferry, which is now losing money, may continue to operate.

Denver Tramways Seeks Fare Increase.—Application for a 20 per cent increase in interurban fares has been made by Ernest Stenger, receiver of the Denver (Col.) Tramway, to the Colorado Public Utilities Commission. The increased fares would affect traffic on the Denver-Golden and Denver-Lyden lines. In his petition to the commission Receiver Stenger points out that the increase would make the tramway fare to Golden the same as is now charged on the Denver & Intermountain line. Since Aug. 6, 1918, when the commission granted the city tramway a 7-cent fare, it has been charging 7 cents on its interurban lines.

P. R. T. Asks Continuation of Present Fare.—The Philadelphia (Pa.) Rapid Transit Company has filed at Harrisburg an application with the Public Service Commission for a continuance of the four-ticket-for-a-quarter tariff now in effect. If the request is granted, the present rates of fare would be continued after May 1, fixed as the time limit for the present tariff granted by the commission on Nov. 1. Valuation proceedings now under way will, it is expected, be completed within three months. The value fixed will determine the amount of returns to which the company is entitled and in that manner, will also fix the permanent rate of fare to be charged by the company.

Injunction Against Jitney Ordinance Denied.—Judge Hall at Kansas City, Mo., has refused to grant a permanent injunction restraining the enforcement of the ordinance prohibiting jitneys from operating on streets where electric railway cars are run. Jitneys began operating on April 7 over new routes away from rail lines. These routes took the jitneys through Eleventh Street, known as Petticoat Lane, the chief east and west shopping street. Merchants protested against congestion on this thoroughfare and Mayor Cowgill immediately ordered the jitney inspector to change this routing, and by noon jitneys were eliminated from that street. The Kansas City Railway had extra cars in service and speeded up schedules in response to the new conditions.

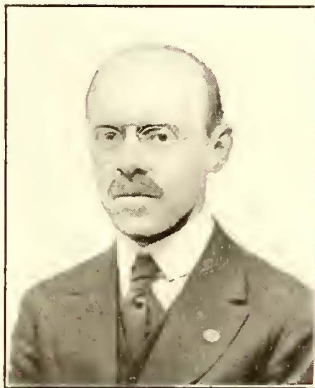
Personal Mention

Joins Consulting Firm

Mr. Litchfield, Formerly Engineer of the American Car & Foundry Company, Joins Gibbs & Hill

Norman Litchfield, who for the last three years has been mechanical engineer of the American Car & Foundry Company, New York, has resigned to join the staff of Gibbs & Hill, consulting engineers. He will devote special attention to electric locomotive and car equipment work. This will not be Mr. Litchfield's first experience in consulting work, for at one time he worked under L. B. Stillwell in the preparation of plans for the equipment of the New York subways.

During the period that experimental work was being carried on by Mr. Still-



NORMAN LITCHFIELD

well with the cars that had been designed for the subway Mr. Litchfield had charge of the tests. When the operation of the subway began he joined the engineering staff of the Interborough Rapid Transit Company, with which he was connected for a good many years. Previous to his association with Mr. Stillwell he served his apprenticeship in electric railroading in the shops of the Brooklyn Rapid Transit Company. He was graduated from Stevens Institute of Technology in 1901 with the degree of mechanical engineer.

Mr. Litchfield has been a very valuable contributor to the JOURNAL. He has written a great many articles on technical subjects dealing particularly with the fundamentals and details of car bodies and truck construction. In 1920 the JOURNAL began the publication of a series of articles by Mr. Litchfield on railway car materials. These were written with the idea that the ordinary mechanical man of a railway is confused when seeking specific information by the vast amount of material confronting him. It was also felt that a better understanding of the

characteristics of various materials used in car construction would result in simpler and more uniform specifications being drawn up for car builders, and in this way cause a step toward standardization to be taken to effect greater economies in materials and cost.

Mr. Litchfield has been actively interested in the work of the American Electric Railway Engineering Association and served as its secretary for a number of years. He is also a member of the executive and standards committees of the association.

Los Angeles Railway Has an Official Question Target

George E. Ferguson has been made special representative of R. B. Hill, superintendent of operation of the Los Angeles (Cal.) Railway. This is a new position which has been created so that there might be some one to help the trainmen in their work.

Mr. Ferguson will go from one division to another unannounced and at different times of the day to talk over with the trainmen in an informal way any of the points about which they may wish to question him. In this capacity he will also meet the men around the assembly room and discuss service with them on their own ground instead of over a desk top. This method, it is hoped, will give a personal touch under which everyone will feel free to discuss matters for the betterment of service.

Mr. Ferguson has been with the Los Angeles Railway since 1905, and has served in practically every section of the operating department. This experience makes him well able to give correct information on questions pertaining to any phase of a trainman's work. At the time of his appointment Mr. Ferguson was in the schedule department.

Mr. Trazzare, Publicity Manager of Georgia Railways, Resigns

J. F. Trazzare, manager of publicity department of the Georgia Railway & Light Company, Atlanta, Ga., severed his connection with the company on April 1. This was occasioned by the reorganization of some of the work of the company along the lines of publicity, safety and employment, all of which had been under Mr. Trazzare's direction. In the interests of economy the company has discontinued these as separate departments. The safety work of the company has been placed under the direction of F. L. Butler, the new general manager of railways.

Up to the present time no definite publicity organization has been ef-

fectured. Meanwhile the publicity work of the company will be handled by Mr. Atkinson, chairman of the board of directors, and Mr. Arkwright, president of the company.

W. R. Dunham, Jr., Resigns

Former Connecticut Company Engineer Joins Construction Firm of Engel & Hevenor

William R. Dunham, Jr., resigned as engineer of maintenance-of-way of the Connecticut Company, New Haven, Conn., on April 15 to become chief engineer for the firm of Engel & Hevenor, contracting engineers, New York City, and for H. P. Hevenor, a member of the firm, in his private engineering practice.

Mr. Dunham is rounding out thirty years of engineering work in the electric railway field, which he entered as a student in an engineering office in Providence, R. I., where work was done for the Union Railroad, a horse railway of that city. When the railway organ-



W. R. DUNHAM, JR.

ized its own engineering department Mr. Dunham joined it, and as the system developed he was rapidly promoted. When, in 1893, the Union Railroad was merged in the United Traction & Electric Company he became principal assistant in track matters.

In 1902, when the United Gas Improvement Company took over the Providence property and formed the Rhode Island Company, Mr. Dunham's duties were radically changed for a time. Due to his familiarity with the layout of the property he was assigned to develop a system of transfers, for which purpose a new department was formed. However, two years later he went back with the engineering department in charge of all civil engineering matters.

In 1906 Mr. Dunham went to New Haven to become assistant engineer in the maintenance-of-way department of the Consolidated Railway (now the Connecticut Company), becoming engineer of maintenance-of-way in July, 1914, which position he has held ever since. In this position he did most valuable construction, maintenance and

valuation work. Recently he was an appraiser of the property of the Shore Line Electric Railway, Norwich, Conn., and also assisted the Public Utilities Commission of Connecticut in valuation work.

During his engineering career Mr. Dunham has taken an active part in the affairs of engineering and other associations. He has been a member of the American Electric Railway Association since 1915, and was president of the Connecticut Company local section of that association. He has been a member of the A. S. C. E. since 1906, and was chairman of the committee which formed a local section of that body. He is a past-president of the Connecticut Society of Civil Engineers. He is also an active member of the American Association of Engineers, of the New Haven Railroad Club, and of the New England Street Railway Club. In leaving the operating railway field Mr. Dunham will have occasion to keep up his affiliation with most of these organizations, for the firm of Engel & Hevenor does much electric railway construction work.

No successor to Mr. Dunham will be named for it is intended to leave his former position vacant indefinitely. The three division engineers who formerly were required to report to him as engineer of maintenance-of-way will now be responsible to General Manager J. K. Punderford.

R. S. Moore has resigned as vice-president in charge of the New England investment business of the Byllesby Engineering & Management Corporation.

J. W. Ellingson, traffic manager of the Utah-Idaho Central Railroad, Ogden, Utah, resigned March 1, to become traffic manager of the Amalgamated Sugar Company.

J. M. Martin has been appointed auditor for the Piedmont & Northern Railway, Charlotte, N. C., to succeed Bond Anderson, who resigned April 1 to engage in private business. Mr. Martin has been head bookkeeper in the office of the Piedmont & Northern for the past several years, and will have charge of the general auditing of the company.

Edward M. Moore has been appointed by Director Twining as private secretary to the director of the City Transit Department of Philadelphia, Pa. The former private secretary to the director was John Egan. He resigned many months ago and no appointment was made to the vacancy until the choice of Mr. Moore, who is a son of Mayor Moore of Philadelphia.

C. W. Loughry will succeed Frank P. Litschert as secretary of the Public Service Commission of Indiana on May 1. The new secretary is a graduate of Indiana University and the Indiana University Law School. Mr. Litschert, who will retire as secretary of the commission, was private secretary of ex-Governor Goodrich and his appointment

to the service body place was a temporary one following the resignation of Carl Mote at the end of the Goodrich administration.

Hilding Angstrom, chief engineer of traction lines of Malmoe, Sweden, a city of 150,000, was in Terre Haute, Ind., recently inspecting the Terre Haute traction plant and system, and giving special attention to the little green cars. He said to E. M. Walker, general manager: "I came to Terre Haute for the reason that I was told that progressive traction methods are being worked out here. Your shops and plants show efficiency, even by a casual visit. I believe the small cars are the traction solution for short hauls and for lines which do not encounter trying topographic and other hard conditions."

A. P. Patterson, appointed acting general superintendent of the railway department of the New Orleans Railway & Light Company, New Orleans, La., to fill the vacancy caused by the resignation of N. H. Brown, entered utility work in 1905 as general manager of the street railway, electric and gas properties in Meridian, Miss. He remained there until December, 1917. From 1910, when Henry L. Doherty & Company purchased these properties, until he left the Doherty interests, he was called upon to make examinations and valuations of a number of other properties. During 1918 and 1919 Mr. Patterson was engaged in a private engineering business which, on Jan. 1, 1920, he sold to accept a position with J. K. Newman, New Orleans, La., chairman of the bondholders' committee of the American City Company, New York. Through that connection he was assigned certain duties with the New Orleans Railway & Light Company and upon the resignation of N. H. Brown, was appointed acting general superintendent of the railway department.

Obituary

Warren G. Bristol, Manager

Warren G. Bristol, manager of the Hartford lines of the Connecticut Company, is dead. His body was found in Keney Park, Hartford, Conn., with his temple pierced by a revolver bullet. His death came as a great shock to the community and to his many friends, for Mr. Bristol was highly appreciated both as a man and for his ability as a railway manager. His associates had the highest regard for him. He was extremely popular among the employees and knew hundreds of trolley crews personally.

Not long ago, before a public gathering, he expressed great faith in the future of the electric railway. At that time he said:

I have devoted my life to the trolley business, and it might appear to some as if in the later years of my life I might be discouraged at the outlook, but I look for

a re-establishment of the trolley companies in the public favor, and do not believe the time has come or will come in the near future when jitneys and motor buses will take the place of the trolley systems. There is such an urgent need for trolleys to obtain the development of outlying district that I think within a few years there will be a great expansion of the trolley lines.

Mr. Bristol's first affiliation with street railways dates from October, 1893, when he was engineer of the construction crew which was engaged in building the trolley line between Meriden, Conn., and Wallingford. At that time he was under Norman McD. Crawford, who is now vice-president and treasurer of the Columbus Railway, Power & Light Company, Columbus, Ohio. When the line was completed he remained at Meriden as assistant to the superintendent and a year later, when the road was purchased by the New York, New Haven & Hartford Railroad Company, he himself became superintendent.

For about ten years Mr. Bristol was superintendent of the lines in the vicinity of Meriden. His career there was marked with success and when the opportunity offered itself in February, 1906, his superiors transferred him to Hartford as manager of the local lines covering a territory of 164 miles. It was this position that he held at the time of his death to the mutual satisfaction of city and company officials and the traveling public.

Some years ago he showed himself possessed of inventive genius and, in the interests of his company, developed and perfected the four-section stone and dump car, which is known as the Bristol multiple-body dump car. This type of car is used extensively on the Connecticut Company's system for the quick transportation and disposition of crushed stone, gravel and earth. Because of the compartments and mechanical devices for dumping, it makes possible the discharging of loads along the trolley routes where construction or repair work is in progress without delaying passenger traffic.

Mr. Bristol was born in Cheshire, Conn., on April 21, 1873. He received his early education in that town and was afterward graduated from the Yale Business College in New Haven, Conn. He was popular in railway circles, having served as vice-president of the New England Street Railway Club for one year and, in November, 1917, was elected president of the Connecticut Company Section No. 7, A. E. R. A.

Ferdinand O. Reed, chief ticket clerk of the Portland Railway, Light & Power Company, Portland, Ore., for the last eight years, died suddenly in that city on Feb. 18.

J. J. Swan, who had held the position as chief of the appointment bureau in the transportation department of the New York (N. Y.) Railways, died recently while on his way to his office. Mr. Swan was well known in and about New York City because of his long service with that company, which extended over a period of thirty-nine years.

Manufactures and the Markets

DISCUSSIONS OF MARKET AND TRADE CONDITIONS FOR THE MANUFACTURER,
SALESMAN AND PURCHASING AGENT

ROLLING STOCK PURCHASES

BUSINESS ANNOUNCEMENTS

Brake Shoe Prices About \$12 Less per Ton Since Jan. 1

Market Is Quiet with Producers Making Prompt Deliveries and Curtailing Present Good Stocks

The market for brake shoes presents much the same features as other railway equipment lines at this time. Stocks of finished material are large—too much so for a declining market, and producers are therefore following a retrenchment policy on production. Deliveries are, of course, immediate.

Buying for the most part is for immediate needs only and though the outlook seems to be that the brake shoe market has passed its lowest point and hence is somewhat optimistic in tone, there does not seem much chance that sales will equal those of last year. It is quite possible that a good demand will develop this fall, however. The replacement of wornout brake shoes, which is undoubtedly the chief factor in buying, has been one of the points upon which railways, especially steam, have economized. Many of the large number of idle freight cars on steam roads have been stripped of brake shoes, it is reported, to care for the rolling stock in actual operation. In the electric railway field this condition is of course not true and there the buying is said to be proportionately greater, some traction companies carrying from a two to three months' supply.

The second reduction this year in brake shoe prices was recently announced by one of the leading interests. The cut, which was effective April 1, was in the same amount as the previous decrease of Jan. 1, or about 8½ per cent. This is equivalent to a drop of \$6 per ton. The further price trend is largely dependent on malleable iron and labor costs, though it should be remembered that brake shoes have been advanced in price since before the war less than almost any other item of railway equipment.

Electrical Exports for February Hold Up Well

February's electrical exports, although they were \$2,000,000 under those of January, a record month, amounted to \$13,632,478. Last October the exports took a decided jump of more than two million and in November went over the ten million mark. December was over thirteen millions, January was over fifteen millions and February is holding up well.

Total exports of January and February amount to \$28,965,433. It took four months of last year to approach this

figure. The year 1916 was the first year to bring in total exports higher than those of the first two months of 1921, which were nearly thirty millions. Last year's total was \$102,618,508, and if 1921 continues at its present rate the total will yield over \$170,000,000. With all the slump in the general exporting market it appears that the electrical industry is holding up its end of the game in a very encouraging way. American electric railway products have always held an important place in supplying South American markets especially.

Corporation Reduces Prices on Many Steel Products

Effective Immediately, Prices Are from \$1.50 to \$15 a Ton Lower Than Former Schedule, a Decrease of from 3.8 to 17 per Cent

Effective at once a reduction in prices of many steel products ranging from \$1.50 to \$15 a ton was announced on Tuesday by Judge E. H. Gary, chairman of the Board, for the United States Steel Corporation. This supersedes the schedule to which the corporation has been adhering since its approval by the Industrial Board in March, 1919. Reductions on tubular goods and on sheets, it is stated, have not been completed and will probably be announced within the next few weeks. Steel rails and wire nails are unchanged.

In comparison with the former schedule the new prices effect a reduction of \$9 a ton in plates, \$5 a ton in structural steel, \$5 in bars, \$9 in wire rods, \$7 for plain wire, \$8 for sheet bars and small billets, \$4 for slabs, \$1.50 for 4 x 4 and heavier billets and \$15 a ton for tin plates.

Independent mills have until last winter been holding to a schedule higher than that of the corporation, but last November a downward trend commenced in hope of stimulating business. Although this finally brought independent prices below those of the corporation it also brought little new business. It has been a common expression among the trade that a reduction in price by the leading interest would prove a stimulant not only to the steel industry but also to all industry, and particularly to building. It remains to be seen now what effect this cut of late last Tuesday will have.

No statement was made that wages in the corporation mills would be reduced in line with the prices of steel but it is believed in many quarters that this action will be taken in the near future.

Ten per Cent Reduction on Line Hardware

Manufacturer's Decrease of 7½ per Cent Passed on at Higher Figure by Jobbers

Pole-line hardware prices have again taken a drop. The reduction as announced by a leading manufacturer, effective April 11, amounts to about 7½ per cent, but this cut has been passed on by jobbers and distributors on an average of about 10 per cent. Other manufacturers are expected to follow suit in reducing quotations.

Prices quoted to electric railways and central stations by jobbers on representative material, f.o.b. Chicago, are as follows: Carriage bolts, ⅜ in. x 4½ in., \$2.25 per 100, compared with \$2.45 previously; cross-arm braces, 1½ in. x ⅜ in. x 28 in., \$13.25 per 100 as compared with \$15; machine bolts, ⅝ in. x 12 in., \$9.95 per 100 as against \$11.15. Lag screws, 1½ in. x 4 in., are now priced at \$4.25. General price reductions of from 5 to 7½ per cent were made on line hardware the middle of last February, and previous to that decreases of 5 to 15 per cent had been made during December and early January, so this is the third decided reduction in hardware prices that producers have made.

In general consumers have not entered the market very actively this spring, although demand from power companies is said to be increasing recently. As a result of the quiet market producers are only operating at from 50 to 75 per cent of capacity. Reserve stocks are sufficient to care for all immediate needs with prompt shipments.

Crossarms Drop Ten per Cent in Price

The Third Reduction Which Has Been Made This Year Should Provide Stimulus to Buying

Following the price reduction of 9 to 15 per cent on Rainier fir and long-leaf yellow pine crossarms that was made on March 1, as announced in the March 12 number of the ELECTRIC RAILWAY JOURNAL, prices have again been reduced. The decrease, which is effective April 11, amounts to about 10 per cent and applies to the representative prices that were quoted in the March 12 issue. This is the third general price reduction inside of two months and a half, the first, on Feb. 1, amounting to 15 per cent.

It is hoped that this latest price decrease will serve as a stimulus to de-

mand, especially as it comes at a time when kindred lines, such as poles and line hardware, are also reduced. Up to the present time the market has remained very quiet, and although stocks are good and deliveries prompt consumers have not followed up their inquiries by ordering but have preferred to hold off buying, presumably, until they think prices have reached a level low enough to represent a good buy.

Sweeping Price Reduction on Western Cedar Poles

Freight Rate Also Declines Slightly—Demand Seems on the Increase, with Good Stocks and Prompt Shipments

In order to do their share in bringing general prices to a level which will command public confidence and stimulate new activity in the industry, producers of Western red-cedar poles have announced decided price reductions. The extent of the cut, which was effective April 6, ranges in general from about 15 to 22 per cent. The new prices as compared with the old quotations on representative sizes are as follows: F.o.b. Chicago, 30-ft., 7-in. top, \$8.50, \$10.90; 35-ft., 8-in. top, \$14.30, \$16.25; 40-ft., 8-in. top, \$16.80, \$19.80. The same poles f.o.b. New York show the following new prices compared with the old: 30-ft., 7-in. top, \$9.55, \$12.20; 35-ft., 8-in. top, \$16.10, \$18.30; 40-ft., 8-in. top, \$19.15, \$22.40.

**ALTHOUGH PRICES ARE REDUCED,
COSTS ARE STILL HIGH**

In addition to this decrease there is a further reduction of 6 cents per hundredweight based on the weight of poles at time of shipment, allowable as the result of lower freight rates which went into effect on Western red cedar poles April 1. On a 35-ft., 7-in. top pole this is said to amount to about 30 to 35 cents. The action of producers in dropping their prices, it is stated, is not entirely justified by lower costs, but in view of the tendency of consumers to hold off buying it is taken in the hope that business will be stimulated thereby. Northern white-cedar poles as yet remain unchanged in price but the Southern white-cedar product was reduced about 15 per cent more than a month ago.

Demand at present is not large but seems to be on the increase, central-station companies especially showing considerable interest in the market. Electric railways are not placing many orders but producers are quite generally optimistic that before the year is out sales will have mounted to good proportions. Stocks of poles in the West are quite large, and as a result immediate shipments can be made to Eastern points. Sales west of the Mississippi are said to be in greater volume than nearer the Atlantic coast, for in the latter territory demand has in large part been supplied by local chestnut poles, which are somewhat cheaper in first cost.

Germans Again Undersell Electric Export Market

Word comes from the ELECTRIC RAILWAY JOURNAL'S correspondent in Sweden that all German business seems to be in one great muddle with no one very much concerned. Even so and with the high export fees, Germany continues to outsell everybody, thanks to the rate of exchange. The Swiss railroads, for instance, are offered Brown-Boveri electric locomotives for 1,000,000 francs apiece, while the A. E. G. offers the same thing, f.o.b. Switzerland, for 600,000 francs.

In one thing only does this correspondent find that the Germans are high and that is insulators. One very large order for the Swedish Board of Waterfalls went to an American company at a price laid down in Sweden that was lower than the Germans could meet.

Canadian Equipment Manufacturers Undersell This Country

As an instance of the difficulties which beset American manufacturers of electric railway equipment who would sell their product outside this country, the experience of a large Canadian electric railway in buying some new cars is significant. This company required twenty new street cars and called for bids in the United States and Canada. The most inviting bid was received from a well-known car manufacturer in this country and on the face of things this concern should have received the order. But when the traction company came to figure approximately 15 per cent increase in cost on the difference in exchange rates, not to mention the customs duty and the expense of a long freight haul, it found it necessary to revise its plans. Accordingly the number of cars ordered was reduced from twenty to ten, and these were equally divided between two Canadian manufacturers. The inference here is that the Canadian bids were so high that the size of the order had to be cut in half, yet the bids as accepted still represented a lower price than car manufacturers in this country could meet under the burden of exchange rates, duty cost and freight charges. According to the same source of information Canadian electric railways, which in the past have purchased much material in the United States, have now been obliged to break away almost entirely from this custom, due principally to prevailing exchange rates. The Canadian dollar is now 88½ cents.

Rolling Stock

Indianapolis (Ind.) Street Railway Company has recently had a number of open cars rebuilt by the Barney & Smith Car Company, Dayton, Ohio. The cars, which were originally built by J. G. Brill Company and which have been in use for twenty years, were inclosed and refitted for prepayment fare operation.

Franchises

Glendale & Montrose Railway, Glendale, Cal.—The Board of Trustees of the City of Glendale has given notice of the sale of the franchise of the Glendale & Montrose Railway. The franchise calls for the operation and maintaining of a street railway along certain streets of the City of Glendale for a period terminating Nov. 4, 1963.

Track and Roadway

Tidewater Southern Railway, Modesto, Cal.—Work has been started at Modesto, Cal., grading for the new route of the Tidewater Southern Railway into this city. The new road will come along the west bank of lateral four as far as Nellie Street and there cross the canal and come along Nellie, thence over P Street to Ninth and join the present tracks at the corner of Ninth and N Streets.

Columbus Railway, Power & Light Company, Columbus, Ohio.—Much of the program calling for the expenditure of \$3,000,000 facing the company is extension of present lines. One project contemplates extension of service 1¼ miles north of Columbus, a short distance beyond Clintonville. The company is now negotiating with the Columbus, Delaware & Marion Railway for the use of that company's tracks north of the city. Another extension is that to the suburb of Shepard, contemplating a mile of new track, while the company is also asked to extend its service on the Leonard Avenue line to Fifth Avenue, a distance of about a mile. These, in addition to much repaving work, delayed by the city because of the company's inability to do its share of the improvement, constitute the major part of the program.

San Francisco - Oakland Terminal Railways, Oakland, Cal.—The San Francisco-Oakland Terminal Railways has asked permission of the City Council of Oakland to double-track its line on Lake Shore Avenue between Prince Street and Walla Vista Avenue.

Montgomery Transit Company, Norristown, Pa.—The Montgomery Transit Company will reconstruct about 6 miles of track.

Charleston (W. Va.) Interurban Company.—The Charleston Interurban Company has been awarded a franchise by the City Council for the construction of a loop through Ruffner Avenue and the establishment of a one-man car line in this section. With the construction of the Ruffner Avenue loop one-man cars will also be placed on the Duffy Street loop.

Spokane & Eastern Railway & Power Company, Spokane, Wash.—The Spokane & Eastern Railway & Power Company and the Spokane Traction Company will spend \$151,000 in improvements and replacements during 1921, according to the year's budget made by Vice-president F. E. Connors. Part

of the money will be used for rehabilitation of eighteen of the traction cars to be made into one-man cars. Renewal of electric equipment will cost \$20,000, maintenance of traction lines will cost \$35,000, mechanical improvements \$30,000, and the remainder will be spent for engineering improvements.

Seattle, Wash. — The utilities committee of the Council has voted to recommend the extension of a street railway line from the Duthie Loop on West Spokane Street north of Harbor Island, a distance of one mile, to the Todd Ship Building Company's plant at the north end of Harbor Island. The action was taken after petitions had been submitted by various firms on the island, and it was agreed that the cost of the railway, \$19,000, will be advanced by the properties and firms benefited. It was agreed that eventually \$9,500 of this cost will be refunded by the street railway department. During the peak hours of travel service will be taken care of by several service cars, with 45-minute trips during the rest of the day.

Windsor, Ont.—A direct car line to link up the southern sections of Windsor, Walkerville and Ford with main service is suggested.

Windsor, Ont.—Construction of street railway extension is contemplated by Hydro Electric Power Commission, Essex Division, Sandwich Street.

Montreal (Que.) Tramways. — Construction of the Mount Royal Tramway will be started this spring according to a definite announcement made by city authorities. This project has been under consideration for some time. Judge Saint Cyr, chairman of the Montreal Tramways Commission, has received a letter from E. R. Decary, chairman of the Administrative Commission, which gives definite instructions. The route will be along Shakespeare Road.

Power Houses, Shops and Buildings

Fort Wayne & Bluffton Traction Company, Fort Wayne, Ind.—Fire destroyed a substation and interlocker at the intersection of the Fort Wayne & Bluffton Traction Company's line and the Clover Leaf Railroad late April 6 with a loss of \$10,000. The flames started from a short circuit in the substation.

Mesaba Railway, Virginia, Minn.—The Mesaba Railway will build one small carhouse, one substation and freight house. The railway will also purchase automatic control equipment for three substations.

Wilkes-Barre & Hazelton Railway, Hazelton, Pa. — The Wilkes-Barre & Hazelton Railway has purchased from the General Electric Company two 750-kw. 60-cycle rotaries with two three-phase transformers and a complete switchboard for automatic operation. This power equipment will not be delivered until July.

Professional Notes

G. E. Engineering Company, Inc., New York City, under date of April 1 announces the removal of its offices to 449 West Forty-second Street, a change that is made in line with the company's expansion of business.

William S. Turner & Company, Portland, Ore., announces the formation of an organization under the above name to act as manufacturers' agent for electric railway, power station, pumping and industrial plant equipment; to make reports appraisals etc.; and to design and construct public utility, municipal and manufacturing works. Mr. Turner will continue his business as consulting engineer in which he has been engaged for the past ten years. He has associated with himself among others, his son, Edmond S. Turner, a graduate of Stanford University, who will specialize in commercial engineering along electrical and mechanical lines. Among others the company is at present the representative of Heine Safety Boiler Company, De Laval Steam Turbine Company, Sanford Riley Stoker Company, C. H. Wheeler Mfg. Company and the James Leffel Company.

Trade Notes

Track Specialties Company, 29 Broadway, N. Y. City, announces the appointment of the Busch Corporation, 13 North Seventh Street, St. Louis, Mo., as its agent in that territory.

The American Engineering Company, Philadelphia, maker of the Taylor stoker, has established a Mid-Western service station at 1772 West Lafayette Boulevard, Detroit. A complete stock of parts for all sizes and types of these stokers is carried and immediate shipments will be made, it is announced.

The Canton Culvert & Silo Company, Canton, Ohio, reports two recent orders of more than usual size. A ten-carload order of "Acme" (nestable) Toncan metal culverts was shipped to a railroad in Cuba and the Pennsylvania State Highway Department, at Harrisburg, Pa., has awarded its annual contract to the company. The latter order totals approximately 52,000 lineal feet of corrugated metal culverts in various diameters, the equivalent of about thirty carloads.

Trackless Transportation Corporation announces the opening of general offices at 300 Madison Ave., N. Y. City. This newly organized firm of engineers and manufacturers of "The Imperial Omnibus" designed for twenty and thirty passengers with single-deck, and 50 passengers with double-deck, is prepared to plan, install, and supervise motorbus transportation systems and to furnish specially designed buses and equipment.

Electric Power Equipment Corporation, Philadelphia, Pa., announces the opening of a district office and ware-

house at 215 Tenth Street, Huntington, West Va., under the direction of L. T. Hall, who has been superintendent of construction for the company, formerly Lewis & Roth, for several years. Formerly he was with the Brooklyn Rapid Transit Company, the Norfolk & Western Railway Company and other concerns in both operating and construction work.

New Advertising Literature

Refractories.—"Clinker Proof Furnace Walls" is the title of a folder issued by the Bernitz Furnace Appliance Company, 15 State Street, Boston.

Valves.—The Rensselaer Valve Company, Troy, N. Y., is distributing book No. 12, describing its "Rensselaer" throttle and control valves.

Trademarks.—"The Work of the Trade-Mark Bureau" is the title of a booklet distributed by Mida's Trade-Mark Bureau, Ellsworth Building, Chicago.

Shop Tools.—Buffalo (N. Y.) Forge Company is distributing a catalog on its various types of forges, drills, and machines for cutting, punching and slitting metal.

High-Tension Switches.—The Royal Electric Manufacturing Company, Chicago, is issuing bulletins Nos. 20 and 25 inclusive, describing a new line of high-tension air-break switch equipment and outdoor bus supports.

Wire.—Copper Clad Steel Company, Rankin, Pa., has issued a sheet on "Copperweld Wire," comparing it with weatherproof, strand, and bare copper wire as to weight, breaking load, resistance etc.

Blowers.—The "Coppus" turbo blowers for undergrate draft and other industrial service is described in a recent publication of the Coppus Engineering & Equipment Company, Worcester, Mass.

Heater Temperature Control.—Consolidated Car-Heating Company, Albany, N. Y., has issued a new bulletin No. 13-B, illustrating and describing its system of thermostatic control for electric heaters.

Acceptances.—"Acceptances, Trade and Bankers'" is the title of a new book just published by D. Appleton & Company, New York City, written by Park Mathewson, vice-president of the Business Bourse, New York.

Overhead Expenses.—Chamber of Commerce of the United States of America, Mills Building, Washington, D. C., has just issued a pamphlet on "Overhead Expenses: How to Distribute Them in Good and Bad Times."

Combustion.—"The Burning Question" is the title of a new book issued by the Green Engineering Company, East Chicago, Ind., dealing with the question of proper combustion. "The Green Cast Iron Hopper Book," recently issued by the company, describes the cast-iron and structural-steel hopper.