

ELECTRIC RAILWAY JOURNAL

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ALTHOUGH we are urging the use of Steel Tie Track Construction we cannot tell you with a cost accountant's precision its exact cost.

You can, however, by careful estimates based on other's experience, very closely

approximate the cost of Steel Twin Tie Construction for your 1923 work.

The figures above are quoted from one of the detailed cost records kept by customers on 1922 work which, with other data, we will be pleased to send to any interested railway man.

THE INTERNATIONAL STEEL TIE CO.
Cleveland

Freight Haulage on Electric Railways

One of the first requisites, when inaugurating a general freight business, is to establish confidence in the minds of all shippers that your road is properly equipped to insure prompt and reliable service.

In order to establish this confidence, you must show your prospective customers that you have provided suitable electric equipment to meet their service requirements.

Baldwin-Westinghouse Electric Locomotives

are in daily use establishing confidence, and producing substantial freight revenue for many electric railways throughout the country.

"Express Service at Freight Rates", a slogan of interurban freight service, gives the electric railway precedence over its competitors.

Carload shipments and economical length of trains will assist to build up the freight business of the electric railway industry.

Special Publication No. 1634, "The Electric Railway and Freight Transportation", will help you analyze your freight haulage problems.

Address either company:

The Baldwin Locomotive Works
Philadelphia, Pa.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.



ELECTRIC RAILWAY JOURNAL

HENRY W. BLAKE, Editor

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Another Angle on the Educational Value of the "Journal"

I read the *Journal* from cover to cover every week and I find a great deal of real information in the advertising pages as well as in the text pages.

THIS was the comment proffered by a prominent Eastern railway executive to one of the editors of the *Journal* the other day. That interested us, you see, because it all comes back to this:

It costs real money, \$250,000 a year, to produce the *Electric Railway Journal* for the benefit of those engaged in the electric railway transportation business. The sources of revenue which make this much appreciated work feasible are the manufacturers who supply equipment to the railways. These manufacturers buy advertising space in the *Journal*, because it is the most effective and economical way of reaching the consumer with their sales messages. Their advertising copy is of such a constructive and helpful nature, that it forms a very important part of the whole educational service of the paper.

It might almost be said that these pages represent the work of a great additional corps of editors, for a good deal of thought and effort are put into the copy that appears in the advertising pages to drive home the economy or bettered service that the manufacturer is prepared to help you secure. While the editors of these advertising pages have an ax to grind, to be sure, it is evident that they could not keep on paying the cost of space in which to put their story before you, if their product did not have real merit.

It pays to read the advertisements, consistently, so that you may be constantly in touch with what the manufacturers are doing to help in improving your service or income. But the fellow who wins is the fellow who *does* something about it, when the advertiser offers an improvement.

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Cable Address: "Machinat, N. Y."

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Publishers of
Engineering News-Record
American Machinist
Power
Chemical and Metallurgical Engineering
Coal Age
Engineering and Mining Journal-Press
Ingeniería Internacional
Bus Transportation
Electric Railway Journal
Electrical World
Electrical Merchandising
Journal of Electricity and Western Industry
(Published in San Francisco)
Industrial Engineer
(Published in Chicago)
American Machinist—European Edition
(Published in London)





This high speed train is equipped with Imperial Luminous Arc Headlight. It throws a strong beam of light even on reduced voltage.



Every section of the country has safety cars equipped with Imperial Incandescents.

Imperial Headlights give you —
The type you need
The service you want

You'll find an Imperial Headlight which is exactly suited for your cars. There are several designs of Incandescents, of Luminous Arcs and Carbon Arcs in the complete Crouse - Hinds Imperial line. You can choose the type which pleases you most or you can outline your requirements and we will make a recommendation.

Here's the big idea to keep in mind—whatever the Imperial Headlight that goes on your cars, you're certain to get long and satisfactory service from it.



The **Ohio** **(B)** **Brass** Co.
 Mansfield, Ohio, U.S.A.

New York Philadelphia Pittsburgh Charleston, W.Va. Chicago Los Angeles San Francisco Paris, France
 Products: Trolley Material, Rail Bonds, Electric Railway Car Equipment, High Tension Porcelain Insulators, Third Rail Insulators

Insurance plus Marsh & McLennan Service

OTHER THINGS BEING EQUAL—Marsh & McLennan would not be carrying the insurance for a great number of the largest public utilities in America. The public is no more interested in where you buy your insurance than they are interested in where you buy your rails or cars or other equipment.

Marsh & McLennan solicit your insurance solely because they can render you a service that will decrease your insurance costs.

On one large Eastern Corporation, for example, we were able to reduce the insurance rate from \$17.50 per thousand to \$4.30 per thousand. Why not buy your insurance where you can buy the most for you money?

We will be glad to outline this service to business executives who are interested in reducing insurance costs.

MARSH & MCLENNAN
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New York
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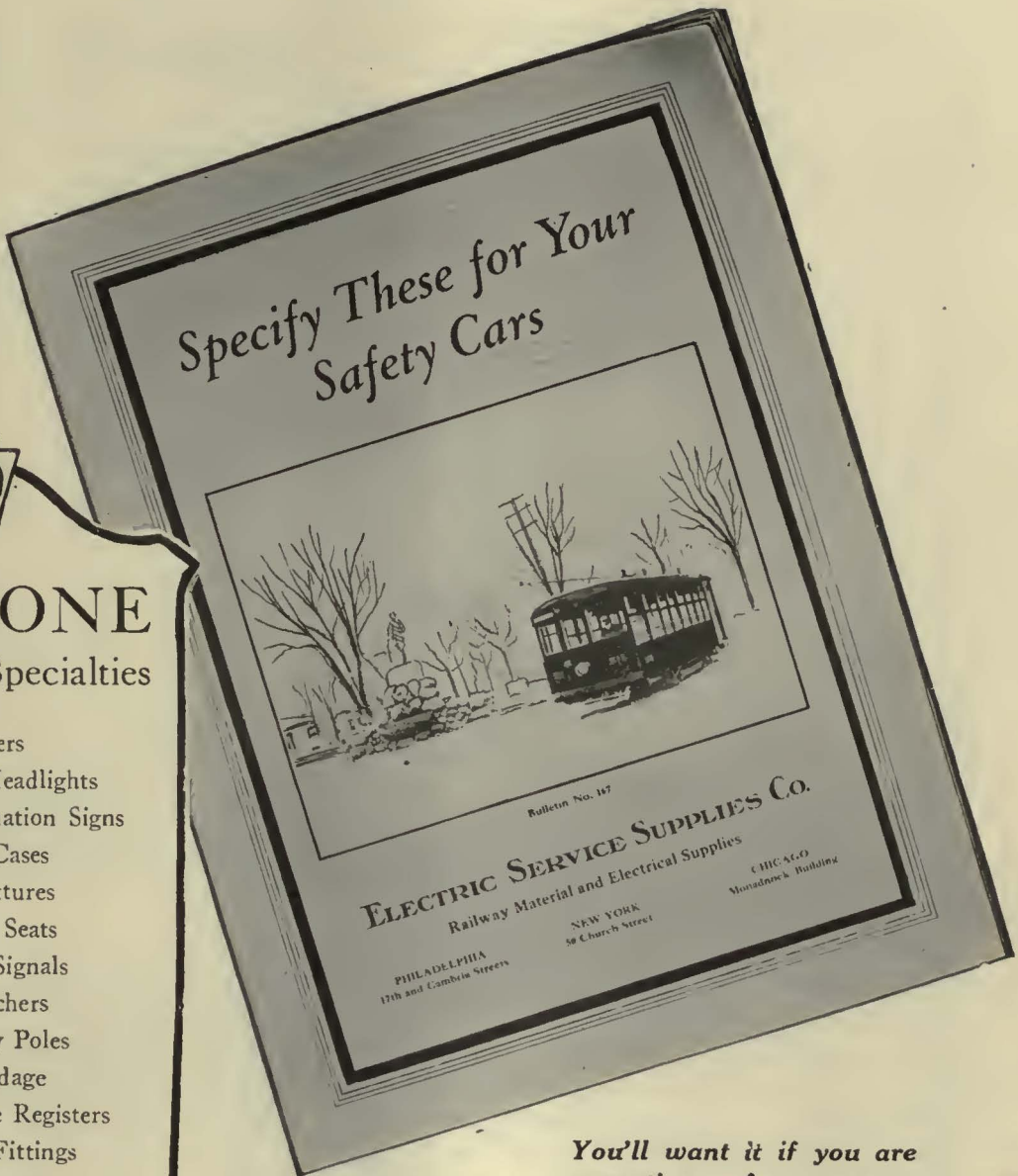
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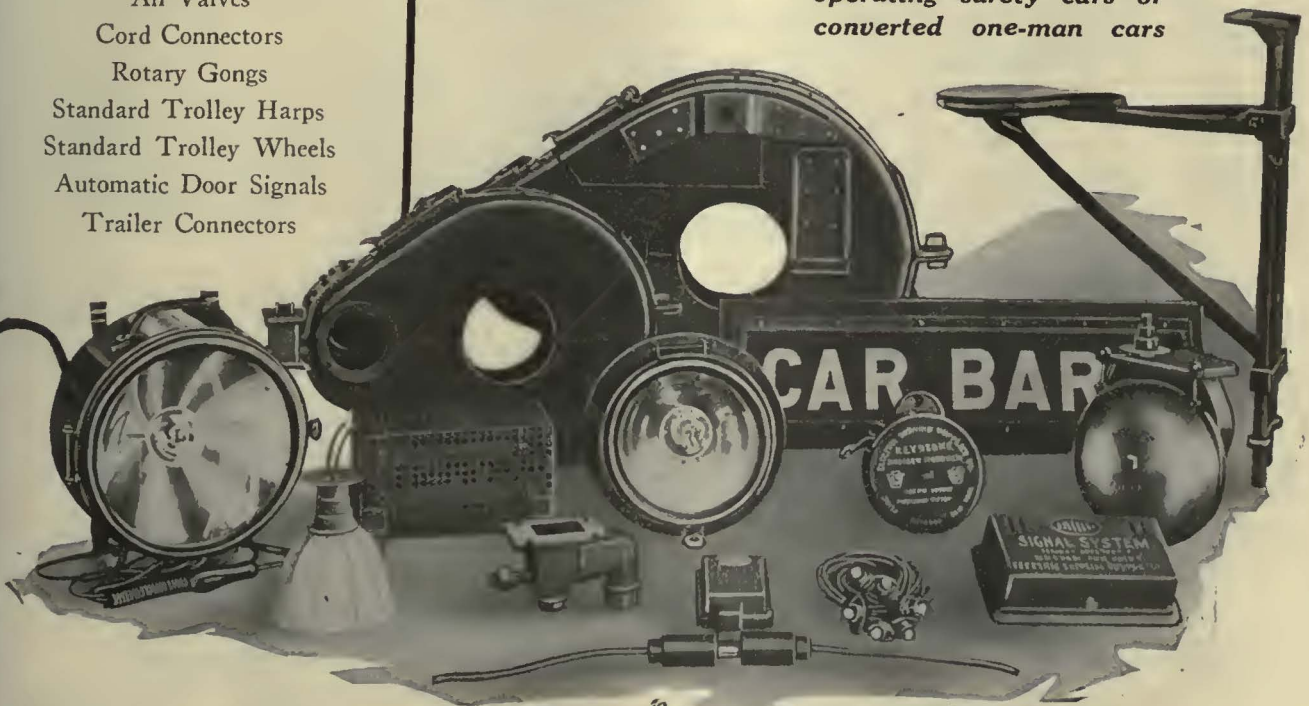
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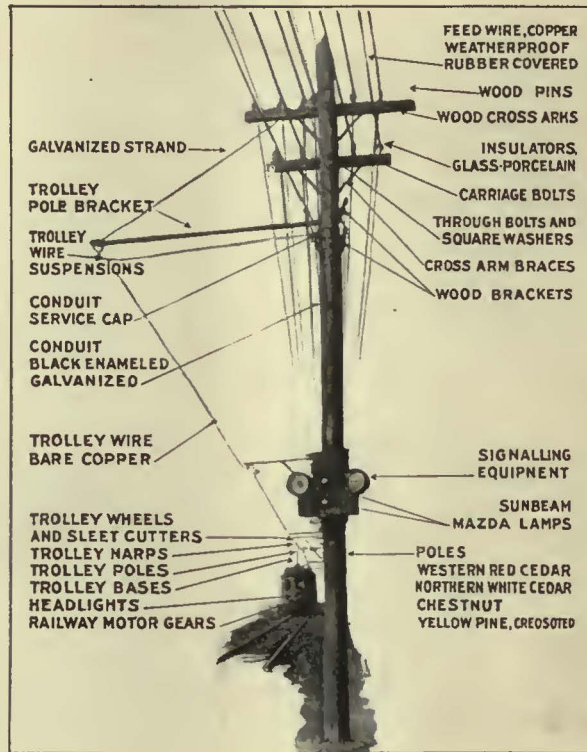
Safety Car Specialties

- Air Sanders
- Golden Glow Headlights
- Illuminated Destination Signs
- Steel Gear Cases
- Lighting Fixtures
- Motormen's Seats
- Faraday Car Signals
- Trolley Catchers
- Shelby Trolley Poles
- Samson Cordage
- International Fare Registers
- Fare Register Fittings
- Air Valves
- Cord Connectors
- Rotary Gongs
- Standard Trolley Harps
- Standard Trolley Wheels
- Automatic Door Signals
- Trailer Connectors



*You'll want it if you are
operating safety cars or
converted one-man cars*





Everything Electrical is as Near You As, our Nearest House

Both the goodwill of a community toward its street railway and the company's own profits depend on continuity of operation.

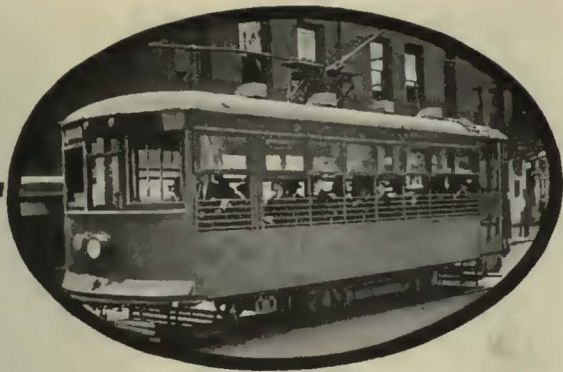
Continuity necessitates an organization to bring quickly to the railway everything electrical it needs.

The Western Electric Company provides this service through 48 Distributing Houses particularly well located and organized to supply every street railway with the materials upon which its continuity of operation depends.

A
NATIONAL
ELECTRICAL
SERVICE

Western Electric Company

OFFICES IN ALL PRINCIPAL CITIES



Standard Type of
NATIONAL PNEUMATIC
 Door Engines



Speed and Safety

National Pneumatic Door and Step Operating Mechanisms, Motorman's Signal Lights and other devices are being used by hundreds of the leading electric railway companies here and abroad.

Let us study your particular operating and equipment problems. We will make recommendations, and refer you to other roads where problems like yours have been solved with resultant increase in speed and safety by means of National Pneumatic Equipment.

Write today

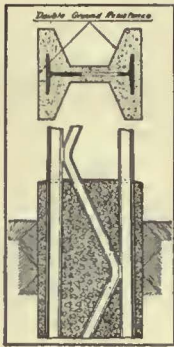
National Pneumatic Co.
 Incorporated
 50 Church St., New York
 McCormick Bldg., Chicago
 Works: Rahway, N. J.

Manufactured in Canada by
 Dominion Wheel & Foundries, Ltd.
 Toronto, Ont.





Secure Against the Ravages of Time



The concrete base of a Bates Steel Pole is easily set, either pre-cast or in the field, and besides holding the pole firmly with an interlocking foundation of steel and concrete, is an effective protection against rust or corrosion below ground.

Overhead construction on Bates One-Piece Poles is least effected by the destructive action of time and the elements. Their life is based on the endurance of steel, and this material is protected from rust by the Bates Concrete butt below ground and very simple and inexpensive maintenance above ground.

The taper form and the distinctive truss lacing of Bates Poles gives the greatest strength with light weight because every ounce of the material is used. There is no excess of material or labor put into Bates Pole manufacture.

Comparison with any other comparable type of pole, on any consideration of first cost, effective life, or maintenance and depreciation, shows that Bates Steel Poles give most in service in return for the investment. Bates Poles have always cost less per mile of line and given a uniform life far greater than any other type of pole. Today the first cost of Bates Poles is less than any comparable poles of any other type.

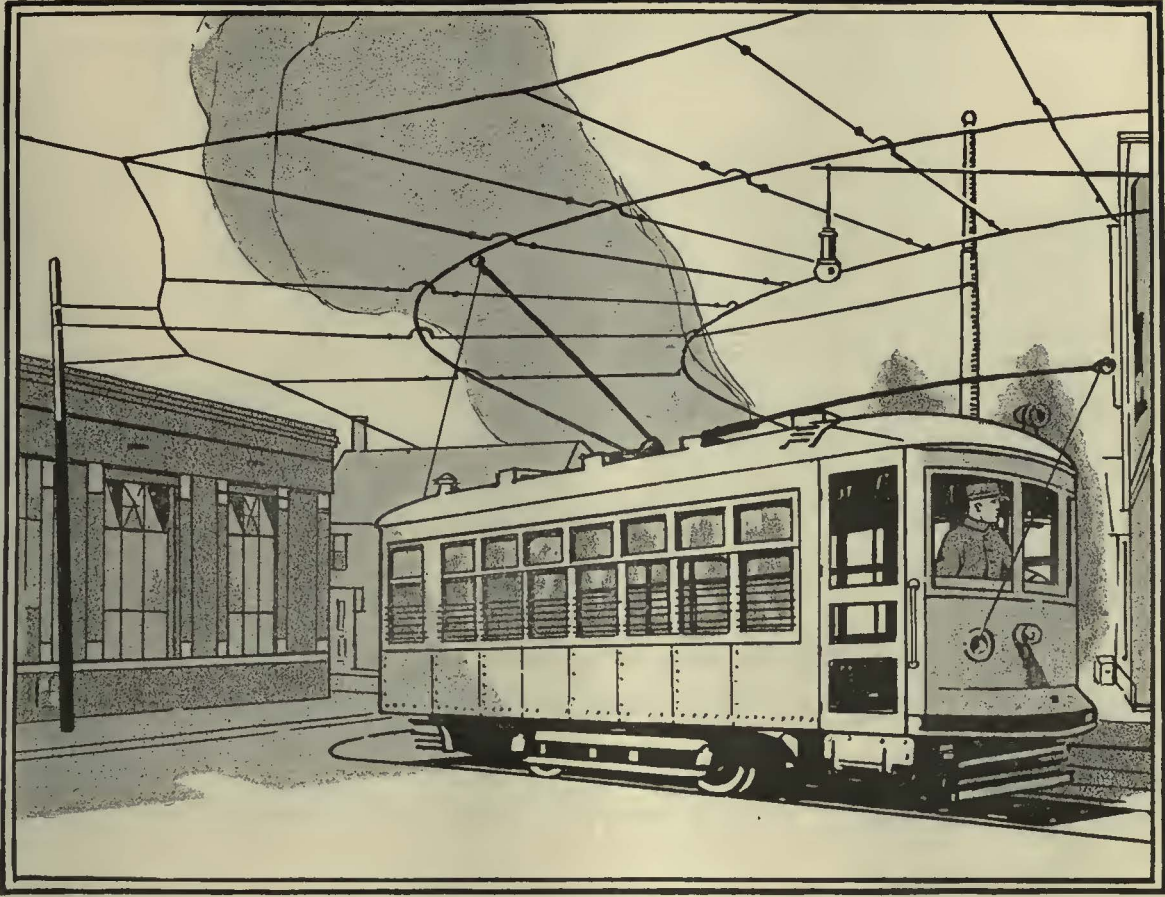
The overhead shown here, on the New York, New Haven, and Hartford R. R. is proving that Bates Pole construction gives the greatest security and a distinct advantage in cost. Our nearest office will gladly supply data and prices.

Bates Expanded Steel Truss Co.

208 So. La Salle St., Chicago, Ill.

District Offices in All Principal Cities.

BATES ONE PIECE POLES
EXPANDED
STEEL POLES



Uninterrupted Service

ANACONDA Trolley Wire is made from Anaconda Copper 99.95% pure. A single organization is responsible for the whole process of mining, smelting, rolling and drawing, thereby insuring the utmost in quality at every stage of production from Mine to Consumer.

To insure uninterrupted service specify Anaconda Trolley Wire.

ANACONDA COPPER MINING CO.

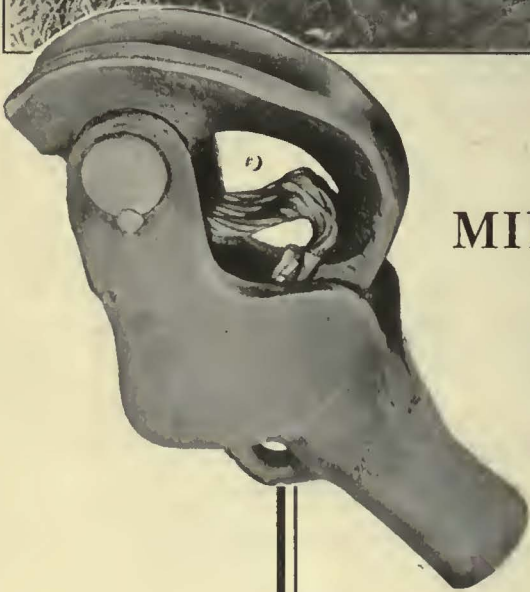
Rolling Mills Department
CHICAGO, ILL.

THE AMERICAN BRASS COMPANY

General Offices
WATERBURY, CONN.

ANACONDA

TROLLEY WIRE



—on these big fast cars!

MILLER TROLLEY SHOES

Patented

Give Service Equivalent to Pantagraphs

So writes an official of the Pacific Northwest Traction Company, who operates these Bellingham—Seattle electric fliers. "The service given is very much the same as the ordinary pantagraph of the slide type," he says. And below are some other points mentioned in the same letter.

What They Say After Three Years Experience

1. Miller Trolley Shoes "give much better and more constant contact."
2. Are "much easier on motors."
3. "More satisfactory so far as the headlight is concerned."
4. Answering the question—are they more economical than trolley wheels—"yes."

Try Them on Your Own Cars

MILLER TROLLEY SHOE CO.

Boston-21, Mass.

Western Representative:

Economy Electric Devices Co., 1590 Old Colony Bldg., Chicago, Ill.



Defeating Depreciation with **AJAX** Electric Arc Welder

With this inexpensive portable equipment old, battered joints and worn and broken special-work can be restored for further years of useful service. It makes a strong, penetrated weld and is easily understood and operated by any track-man of reasonably average intelligence.

Specifications

Weight—only 155 lbs.

Dimensions—18 in. x 28 in. x 36 in.

Capacity—333 amps. at 600 volts.
—200 amps. at 300 volts.

Control—Switchboard attached.

Equipment—Electrode Holders.
—Trolley Pole.
—Cables.
—Face Shield.
—Canvas Cover.

Grinding Equipment

**ATLAS
Rail Grinder**

**UNIVERSAL
Rotary Track Grinder**

**RECIPROCATING
Track Grinder**

**DIAMOND BRAND
Grinding Wheels**

Write for circular and prices

RAILWAY TRACK-WORK CO.
3132-48 E. Thompson St.
Philadelphia, Pa.

AGENTS:

Chas. N. Wood Co. Boston	Atlas Railway Supply Co. Chicago
Electrical Engineering & Mfg. Co. Pittsburgh	P. W. Wood New Orleans
Equipment & Engineering Co. London, England	

“The Resiliency We Obtain



DAYTON

From These Ties Will More Than Pay For Their Cost"

This enthusiastic statement was made by L. L. Allbritton, Gen. Mgr., Wichita Falls (Texas) Traction Company in a short article in the August 26th, 1922 issue of Electric Railway Journal, regarding 3700 feet of track installed last spring.

The track was laid in a street formerly paved with solid concrete. A strip 6 ft. 10 in. wide and 14 in. deep was cut out of the center and Dayton Resilient Ties were placed on 3-ft. centers with 75-lb. standard A.S.C.E. T-Rail. All joints

were electrically seam welded, using joint bars and a resistance type welder.

Mr. Allbritton said further: "Churches and residents along this route have complimented us very highly on the seeming smoothness and *quiet* running of the cars over the track."



Save!

From \$2,000 to \$6,000 a Mile

Let us show you how to build a permanent, quiet track at a saving of \$2000 a mile over track laid on wood ties in gravel ballast, and \$6000 a mile over track laid on wood ties in concrete.

THE DAYTON MECHANICAL TIE CO.

707 Commercial Building, Dayton, Ohio

Canadian Representative:

Lyman Tube and Supply Co., Ltd., Montreal, Quebec

**Resilient
TIE**



The Thermit reaction



Thermit Insert Weld after grinding

Recent Thermit Insert Welding, Milwaukee, where the oldest welds are still in excellent condition after having been in service ten years

Seeing is Believing—Never Truer Than in the Case of

Thermit Insert Rail Weld

One of the many instances wherein long experience with Thermit joints has instilled indelible satisfaction was voiced in the following remark of a street railway engineer the other day, who hails both temperamentally and actually from Missouri: "We're going to stick to Thermit until H—1 freezes over!"

Experience has shown time and time again that even the most skeptically-minded street railway engineers when once given the opportunity to witness an actual demonstration of making a Thermit Insert Weld have become unshakably convinced with—

1. The simplicity of the method
2. It's speed of operation
3. The strength of the weld obtained
4. The continuous, jointless track thereby obtained
5. Its superiority for reducing joint maintenance costs to an absolute zero, thus greatly adding to the life of the rail.

Let us show you by sending you a demonstrator free of charge to instruct your man how to eliminate rail joints.

"The First Cost Is The Last Cost"

Metal & Thermit Corporation

120 Broadway, New York

PITTSBURGH

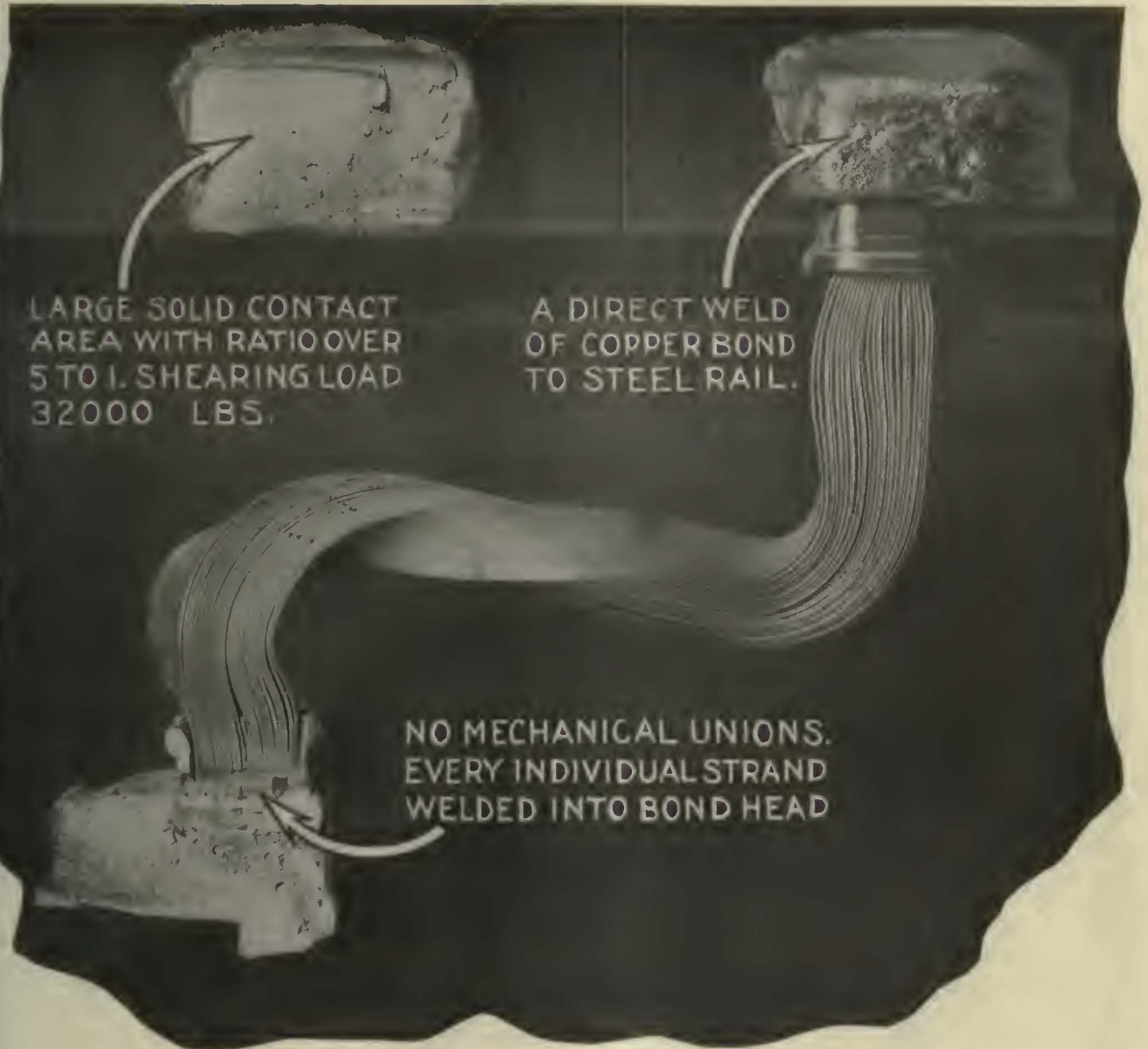
CHICAGO

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S. SAN FRANCISCO

TORONTO





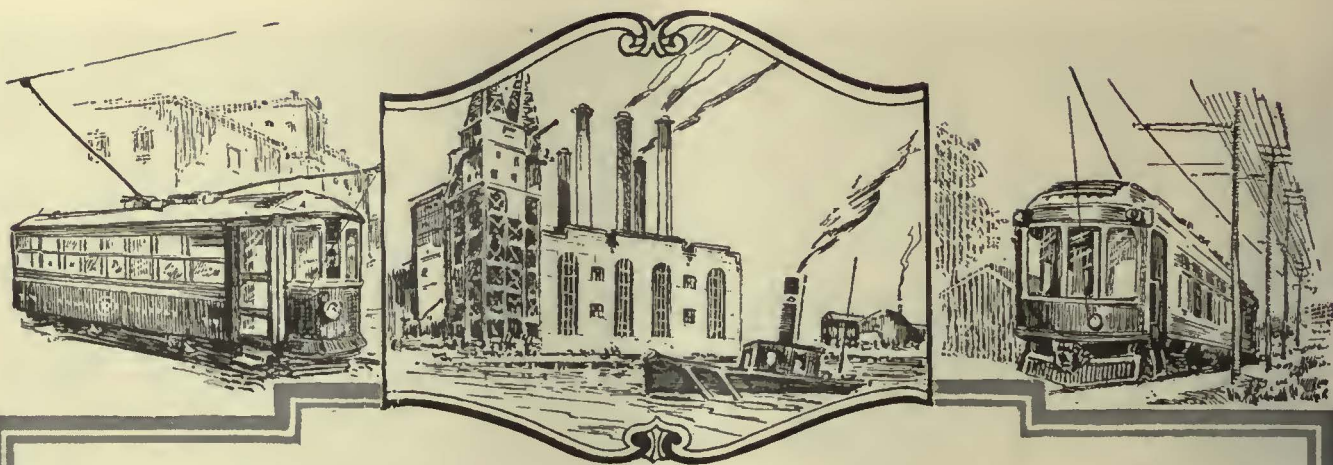
“That’s The Bond”

THIS was the expression of approval made by many engineers who witnessed the application of UNA Bonds at the Chicago Convention. Some of the features which so thoroughly appealed to these engineers are as follows:

1. Requires about one minute to install a 4/0 bond
2. Ease of application
3. Direct weld of copper bond to steel rails
4. Great strength of weld of copper bond to rails
5. Individual strand connections
6. Copper is path for current from rail to rail
7. Maximum power savings
8. Low cost

Send for new Bulletin No. 103

Rail Welding and Bonding Company, Cleveland, Ohio



Burning the Midnight Oil

Literally, and figuratively speaking, too, our engineers have burned the midnight oil to determine the burning oils best suited to street railway operations.

We have conducted long-time burning tests. We have checked the performance of various oils under particular operating conditions. We have studied the various factors of different types of burners, different shapes and kind of wicks, different uses, and the different charac-

teristics of the oils which these uses require.

This background of study, experiment and test is behind the TEXACO Engineer when he recommends any of our burning oils for your hand-lanterns, switch lights, tail-lights, or whenever you use oil for illumination.

He knows burning oils from experience, just as he knows lubrication from the experience gathered in the hundreds of millions of car miles made with TEXACO Lubricants.

Some of Our Burning Oils are:

TEXACO Signal Oil for Hand Lanterns

A compounded oil of excellent quality especially noted for its long burning and its ability to remain lit to swing and handling.

TEXACO 300 Burning Oil for Hand Lanterns, Stationary Lamps, and Tail Lights

A clean oil which burns with a clean, clear glow, especially for its safety factor—high flash.

TEXACO Kerosene

This is the kerosene which is in demand as an illuminant in all parts of the world.

Texaco Petroleum Products cover the whole field:

TEXACO LUBRICATING OILS and GREASES

For Rolling Stock, Power Plant and Substations

TEXACO CRATER COMPOUND

For Gears and Pinions

TEXACO BURNING OILS

For Every Purpose

TEXACO GASOLINE

For Busses, Trucks and Automobiles



THE TEXAS COMPANY

DEPT. R-J · 17 BATTERY PLACE · NEW YORK CITY
HOUSTON · CHICAGO · NEW YORK
OFFICES IN PRINCIPAL CITIES



OF A SERIES OF ARTICLES PICTURING THE INFLUENCE OF THE ENGINEER IN THE AFFAIRS OF THE WORLD. PRESENTED BY THE MCGRAW-HILL COMPANY, INC., WHOSE PUBLICATIONS HAVE SERVED THE ENGINEER THROUGH HALF A CENTURY OF INDUSTRIAL PROGRESS

Coal Age

Power

THE GROWTH OF INDUSTRY

*Electrical
World*

*Engineering
News-Record*

BEHIND the work of the world's millions is the fabric of the world's industrial equipment. Into this fabric is woven the design of modern life.

*Electrical
Merchandising*

*Bus
Transportation*

¶ Vast, powerful and interdependent is this living industrial age. In little more than half a century science has transformed our globe of land and water into one gigantic institution.

*American
Machinist*

*Electric
Railway
Journal*

¶ This colossal ball whirling through space, which geographers once separated into hemispheres, and which governments and languages divided into nations, industry has united through service to meet human needs.

*Industrial
Engineer*
(Published in Chicago)

*Ingenieria
Internacional*
(Printed in Spanish)

¶ Where the discoverer once carried a flag and for the first time left an imprint of the foot of man, industry now delivers its wares for the preservation, comfort and refinement of life.

¶ Commerce knows no nationality and industry speaks all languages. Where man is, there is a market.

¶ While population has multiplied, sending overflowing peoples to cover trackless reaches of wilderness, the genius of the engineer has developed transportation, communication and production, so that all men may claim the right to live and progress.

¶ From the day of the isolated craftsman to this day of massed industry, the engineer has made possible an advance which cannot be reckoned because there has been no similar advance comparable with it.

¶ Of all the divisions of human effort there is none which may challenge the supremacy of the engineer, or show growth of like importance to human life.

¶ In the development of physical property, in capital investment, in labor employment, in scientific improvement of working conditions and equipment, in the advancement of product, in the accuracy of executive control, and in the service of the whole world of consumption, throughout the course of man's activities there has been manifest the trained mind of the engineer.

¶ The growth of industry is proof of the service of the engineer.

*Engineering
and Mining
Journal-Press*

*Chemical and
Metallurgical
Engineering*

*American
Machinist
European Edition*
(London)

*Journal of
Electricity and
Western Industry*
(San Francisco)

MCGRAW-HILL COMPANY · INC ·

NEW YORK

▶ PORTRAIT OF J. DALTON



BY JOHN LONSDALE

The Quaker *who made* Chemistry a Science

CAVENDISH had shown that two volumes of hydrogen and one of oxygen always combine completely to form water and nothing else. Proust, a Frenchman, had proved that natural and artificial carbonates of copper are always constant in composition.

"There must be some law in this," reasoned Dalton (1766-1844), the Quaker mathematician and school teacher. That law he proceeded to discover by weighing and measuring. He found that each element has a combining weight of its own. To explain this, he evolved his atomic theory—the atoms of each element are all alike in size and weight; hence a combination can occur only in definite proportions.

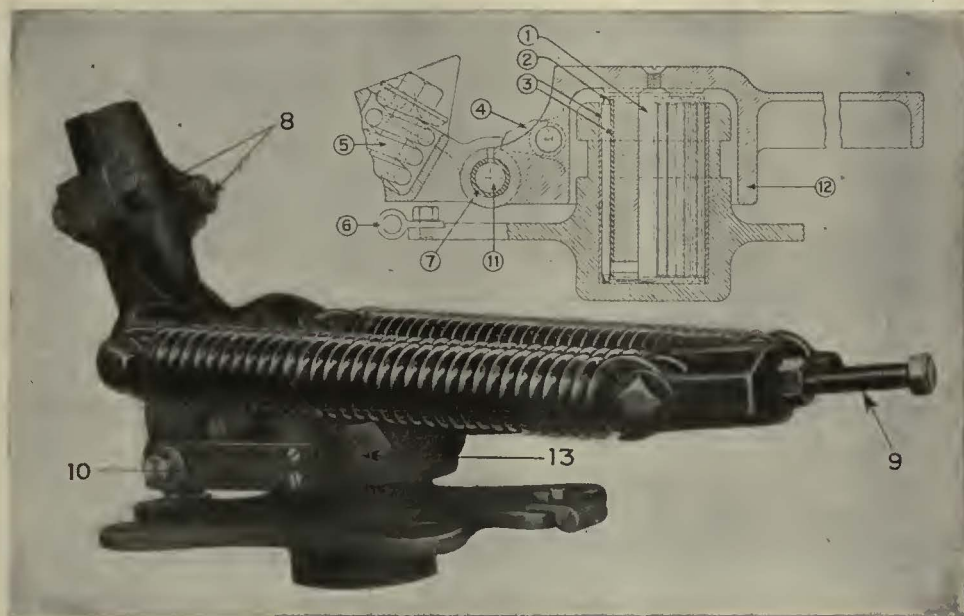
Dalton's theory was published in 1808. In that same year, Na-

oleon made his brother, Joseph, king of Spain. This was considered a political event of tremendous importance. But Joseph left no lasting impression, while Dalton, by his discovery, elevated chemistry from a mass of unclassified observations and recipes into a science.

Modern scientists have gone beyond Dalton. They have found the atom to be composed of electrons, minute electrical particles. In the Research Laboratories of the General Electric Company much has been done to make this theory practically applicable so that chemists can actually predict the physical, chemical and electrical properties of compounds yet undiscovered.

In a world of fleeting events the spirit of science and research endures.

General  Electric
General Office Company Schenectady, N.Y.



Lest You Forget

How many of the Famous Fourteen Points do you remember today? The average man claims to remember two, but can't just think what they were. He lets George remember them.

But here are Thirteen Points we will never let you forget—the Thirteen Points of superiority, efficiency, safety and economy of the Nuttall 13-E Trolley Base.

1. **Oil Reservoir.** Positively retains oil or grease and is exclusively a 13-E feature. To fill, remove the flat-head screw shown in top of swivel cap.
2. **Rollers and Cage.** Rollers are hardened and assembled in a cage, which maintains alignment and permits assembly as a unit.
3. **Races—Inner and Outer.** The races are made of "SHELBY" tubing machined, hardened and ground.
4. **Trigger Lock.** Locks Pole Socket in horizontal position, enabling one man to change poles in the barn under low headroom.
5. **Buffer Spring.** Cushions the pole socket in case the wheel leaves wire.
6. **Terminal Connector.** Cast Bronze Connector for sweating to Motor Lead insuring good contact. Clamp type furnished if preferred.
7. **Pole Socket Bearing.** Hardened Steel Bushing maintaining indefinitely a good close fit with axle pin No. 11.
8. **2-Bolt Pole Socket.** Two Bolts insure firmer grip and require less time for applying pole.
9. **Adjusting Screw.** One adjustment for all four springs.
10. **Shunts.** Heavy phosphor bronze straps for shunting the current from Pole Socket and Swivel to Base.
11. **Axle Pin.** Pole Socket Axle Pin made of hardened steel.
12. **Dust Guard.** Protects Roller Bearing from dust and water.
13. **Accessibility.** By removing these heavy locking screws and unhooking springs, the bearing cap can be removed, exposing swivel portion of base.



Every Gear Registered

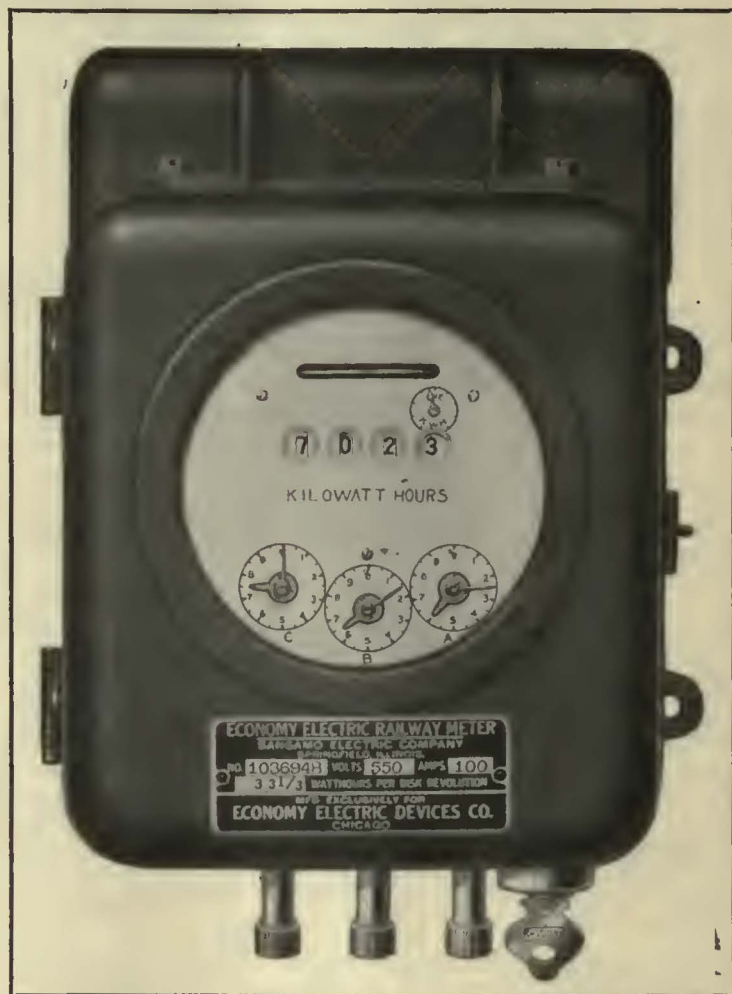
R.D. NUTTALL COMPANY
PITTSBURGH  PENNSYLVANIA

All Westinghouse Electric and Mfg. Co. District Offices are Sales Representatives in the United States for Nuttall Electric Railway and Mine Haulage Products.

In Canada: Lyman Tube & Supply Co., Ltd., Montreal and Toronto.

Nuttall

"Chicago Surface 3000 Economy



How It Inspects

This is a rugged watt-hour meter. Top dials for motormen's power-saving records. Lower dials for car inspection use.

When the meter-driven hand on dial A reaches the marker set for this car at 6, the barnman knows that the brakes and controllers have done their work and are due for an inspection equivalent to that otherwise made daily.

Likewise dial B shows when the car has done sufficient work to require oiling. This supplants the usual time or mileage period for oiling.

Dial C shows when the car has done sufficient work to require general inspection.

After any inspection the meter-driven hand is set back to zero by means of its reset rod at the bottom of the case.

A lock prevents unauthorized resetting of inspection dials.

The Economy meter with inspection dials is readily adaptable to any electric car or locomotive operating condition.

**To Save Power At The Car
To Save Labor At The Car House**

Meter The Energy—

Lines" Buys Meters

With Car Inspection Dials

This notable purchase follows a thorough investigation of power saving devices. Every car operated by the Chicago Surface Lines will be equipped with an Economy Meter with power saving and car inspection dials.

Energy input is the correct measure of the relative efficiency of different men operating under similar conditions. The motorman has faith in a meter because with it he can prove that good operation gives him a good record and poor operation a poor record, in actual energy consumption. This power-saving device actually tells the motorman and the management whether power has been saved or wasted, and how much.

That, in brief, is the underlying reason for the success of the ECONOMY Meter.

The ECONOMY "Power-saving" and Car Inspection Meter provides a method that accurately and automatically shows when car inspection is needed. It also shows at a glance how much more work a car can do before inspection is needed, or, in case of a road failure, how much work the car

has done previous to the failure. All this without any clerical labor.

The ECONOMY Meter is a rugged device which requires remarkably little maintenance. Its principal element is also produced for central station and general metering. For this purpose more than 500,000 have been built. It is a standardized product, easy to maintain on a railroad at a cost averaging less than \$2.00 per year, per meter.

More than one hundred street or interurban railways are completely equipped and the saving resulting has more than wiped off the capital charges plus operating expenses of the meters in the first year.

The records from ECONOMY Meters are of high value for managerial and engineering purposes.

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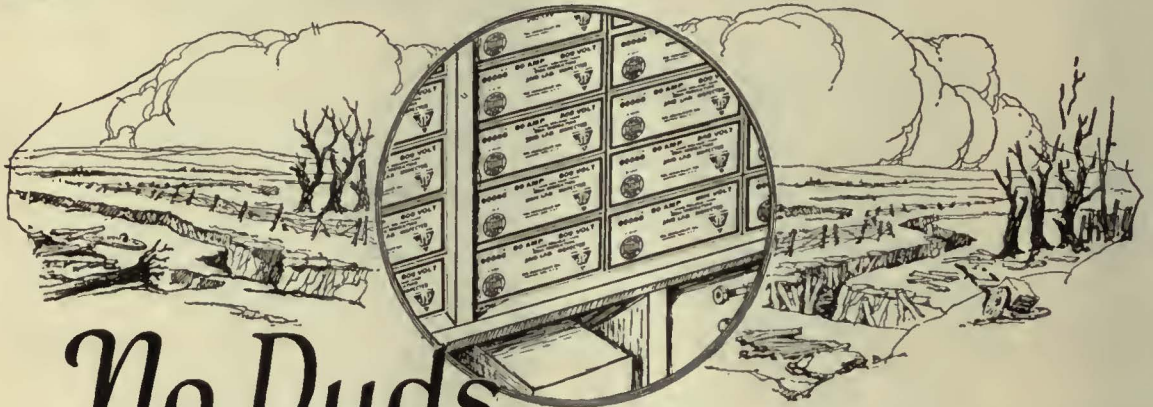
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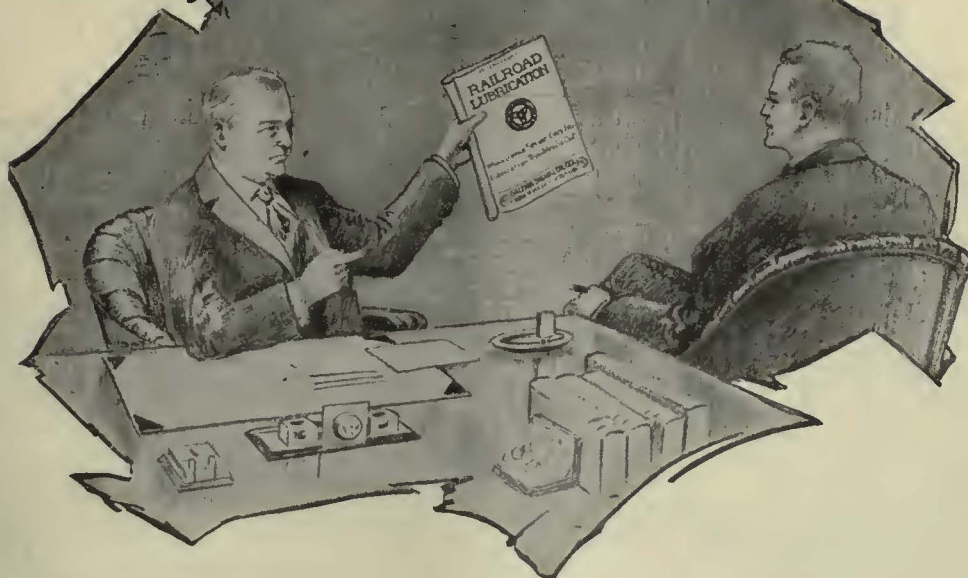
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Number 25

The Panacea for Railway Troubles Is Here

ANY ONE who read the interview with C. D. Emmons in last week's issue of this paper with the expectation of finding some great outstanding purpose which might account for his rise to the leading position in the industry, as well as chief executive of one of the prosperous utility companies, was doubtless disappointed. In fact, one of the important lessons that may be drawn from Mr. Emmons' remarks is the fact that there is no one great engineering or management feat that determines the prosperity or poverty of a railway system. The success of the undertaking lies rather in the accumulative effect of numerous small betterments and economies—the result of pursuing a policy of constantly striving for improvement with respect to every detail of operation all through a company. Mr. Emmons' success typifies that policy, for he has been open-minded about developments and agreeable to a trial of any suggested improvement that seemed at all practical and worthy.

The *Journal* has spoken many times before about the unfortunate attitude of some railway men in seemingly closing their eyes and minds to the detail advances of the art. They appear to be waiting for some panacea for all their troubles to take them out of their difficulties. Meantime they ignore or neglect the numerous things that are within reach, practical and proved, that would each play a part, if grasped, in modernizing and providing better service, reducing costs and attracting greater patronage. This applies both to operating methods and to equipment improvements, and devices that reduce costs.

The industry is by no means standing still. There may not be much expansion of track mileage going on, but there is an intensified activity with respect to developments that will surely keep the railways away from obsolescence and put them in line for profits, if the managements keep alive to progress and make the most of it. It is almost wholly a matter of a little improvement here and a little there, each in itself of no great moment, but summed up they make the panacea sought after.

National Standardization Will Not Reduce Engineering Committee Activities

NOW that the American Engineering Standards Committee is functioning, a question naturally arises as to its probable effect on Engineering Association committee work. Will the activities of the national committee supplant those of the several well-organized and effective committees which are now vigorously trying to improve the quality of electric railway construction and operating practices? They will not; in fact, the committee work, in the future, while it will be somewhat different in character from what it has been, will be similar in purpose and scope, and at least no less

in volume. It would be unfortunate if this was not to be the case.

The A.E.S.C. is essentially a balance wheel. Its function is to insure steady progress, but not to supply initiative and motive power. Its stamp of approval of a design or practice will give prestige to that upon which it is placed, but no more. It will supply assurance that the subject has been thoroughly reviewed and will give to the users of a national standard the confidence in its value that comes from its all-round consideration by various experts.

It is true that at the Chicago convention certain topics were, in a sense, laid upon the table pending the inauguration of work under them by the A.E.S.C. This, however, was not done with the idea that the national committee would shoulder responsibility for them, but rather to prevent duplication of effort. The elimination of such duplication will certainly be a relief to the Engineering Association committees and will give them more time for research. It will not, however, render any of them superfluous. The Engineering Association will require representation upon all national committees which will consider its proposals, as well as proposals from other interests which affect even remotely the electric railway industry. Behind these representatives will need to be well-qualified committees to give them technical and moral support.

The Unlimited Transfer— Unlimited as to Variety

TRANSFERS present an ever-old yet ever-new problem in electric operation. Although the purpose of all transfers is the same, namely, to require the passengers to make a continuous journey in the same general direction so that he cannot use the transfer as a return ticket or as a stopover to transact business on the way, there is a great difference in the forms of transfer used. For instance, here are some of the methods which have been used, or are being used, to indicate the route to which the passenger is limited in making his trip on the car to which he transfers: A skeleton map or printed list of the lines with the route to which he can transfer punched, a skeleton map or printed list of the routes with the line to which he is not allowed to transfer punched, color of ticket to indicate the general direction combined with printed list of the routes over which the ticket is available.

A still greater variety exists as to the way of indicating the time limit on the ticket. Where there is a time limit there must be some way of marking the ticket as to its expiration for the year, month, day of the month, hour and minute and whether the hour is in the morning or afternoon. Of course, the year and the day of the month do not have to be punched by the conductor. They can be printed on the ticket or punched at the carhouse. Where the day of the month is printed on the transfer, there is a possible greater waste of

stock, but large companies can afford this waste to make the day of issue more easily read by the receiving conductor. The device of the p.m. coupon (a comparatively modern idea) pretty well identifies the transfer as to issue before or after noon, but the ways of indicating the hour and the minute are legion. They have been shown by punching the hour and using different colors for the four fifteen-minute periods, by punching both the hour and the minute in a miniature clock dial or in numbers printed on the ticket and by tearing the ticket from a stub which is graduated according to the hours from 1 to 12.

Finally, practice varies as to whether the conductor should punch the time within which the transfer is valid or the time at which the car left its terminus. In the latter case the time during which the transfer is valid is shown by the time punched, plus the number of minutes printed on the front of the transfer opposite the name of each intersecting route.

Many other varieties of transfer have been devised for various purposes, even for trying to indicate the appearance of the receiving passenger, but space will not permit an enumeration of all of them. Enough has been said to show the enormous and probably the unnecessary variety in practice. There is, of course, not the same necessity of standardization in forms of transfer as in other electric railway equipment and methods. As the routes necessarily differ in name in each city, transfers are not interchangeable and have to be printed separately. Hence no great harm is occasioned by having a different arrangement and form of ticket. Nevertheless, it is evident that some forms and arrangements must be better than others, and it would be well for each company to study its own form to determine whether some improvement cannot be made. The mere fact that a transfer has been in use for five years or more without being subject to conspicuous abuse is not a valid reason for its continuance.

Interest and Initiative in Education Must Begin at the Top

THERE is little use in trying to push an educational program on any electric railway property unless the men who direct its affairs have strong convictions regarding the value of post-school training in the industries. The first task, therefore, which confronts the enthusiast who would like to have such a program started is to insure co-operation from headquarters. It may be that the manager will need to be convinced regarding such points as these: First, in its own interest every electric railway should supply special educational facilities to the men in its employ; second, the educational program should provide (1) for better performance of present tasks, (2) for training for promotion and (3) for education along the lines of general good citizenship. The need for special training in industry is urgent, partly because boys drop out of school on the average very young, and partly because nothing has as yet been developed to take the place of the old-fashioned apprentice system.

Provision of an educational program does not mean, necessarily, that a railway should run a school, although that is desirable in some cases. All that it does mean is a co-ordination, for the benefit of employees, of the facilities provided by organized educational agencies, supplemented by such special facilities as are not otherwise available. The awakening interest

in vocational education in electric railway circles is a sign that these facts are becoming evident. The efforts of the American Association to stimulate the interest, therefore, ought to be encouraged.

On every electric railway property there should be some one qualified person who is assigned the task and privilege of organizing the educational work. This person can study the individual and group needs and desires of the employees, can advise them as to procedure in meeting these needs, can co-ordinate the local educational agencies in so far as they relate to his own company's needs, and can plan for the special activities which his company should undertake. The work of this man will be fruitful, however, only if the management backs him up.

Statistics and Experience as Bases for Decisions

A CHARACTERISTIC of modern methods in electric railroading is the much more extended compilation and use of statistics than ever before. The full benefit is not always had from these statistics because the most important facts are not compiled or full use is not made of those obtained. Nevertheless, it is undoubtedly true that much more time and attention is being given to this matter than formerly, and in recent comments in these columns and in the "Letters to the Editors" in this paper some valuable suggestions have been brought out as to how the real worth of statistics may be measured.

To some of the older men in the business the attention paid to statistics in these days seems hardly worth while. At the same time, although they may not realize it, these older men really use the same process as that which they criticize where they decide a question on the basis of their experience. The only difference is that they keep the facts and figures in their heads rather than on paper.

Another element required to decide a business question correctly, besides experience or statistics, is intuition. This is power to draw conclusions from given facts, and while experience may sometimes be considered to include intuition, it is entirely correct to say that no written statement of facts or clear memory of them minimizes the value in business affairs of good intuition or judgment. This is particularly true in electric railroading on questions which concern persons rather than things. A good example is the matter of promotion in the service. Here statistics mean little, intuition much. On the other hand, there are many engineering questions where with sufficient facts future results can be predicted with absolute certainty. Here no intuition is required.

The conclusion to be reached in this matter is that it is not wise to generalize from very narrow experience and that the more extensive or complicated the facts on which to base a decision, the more important it is that these facts should be in definite—and preferably written—form. A statistician should not be allowed to manage a property unless he has other qualities than those of a statistician. Nevertheless, he can supply data on which a wise manager is able to base a sound judgment. In preparing this information the statisticians do a great deal of the grinding work and leave the manager more free to carry out his duty, which is to interpret these figures and apply them in the solution of problems for which he is responsible.



WIDE DOUBLE-DOOR OPENINGS FACILITATE ENTRANCE AND EXIT

Light-Weight One-Man Cars for Eastern Massachusetts Street Railway

Double-Truck Cars Weighing Less than 16 Tons and with a Seating Capacity of Forty-eight Have Been Placed in Operation—Several New Features

TWENTY-FIVE new light-weight, one-man, double-truck cars have been placed in service recently by the Eastern Massachusetts Street Railway. Completely equipped, these cars weigh 31,883 lb., which is from 12,000 to 16,000 lb. lighter than other double-truck cars which the company has in service. The cars were built by the J. G. Brill Company and have a steel underframe and semi-steel body construction. The underframe and superstructure were evolved from the light-weight Birney safety car type, with provision to meet adequately the larger passenger load requirement. Corner and side posts are of $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{8}$ -in. angles, which are continuous and form the carlines to support the poplar roof. The side sheathing is of $\frac{3}{8}$ -in. sheet steel. Dimensions are shown in an accompanying table.

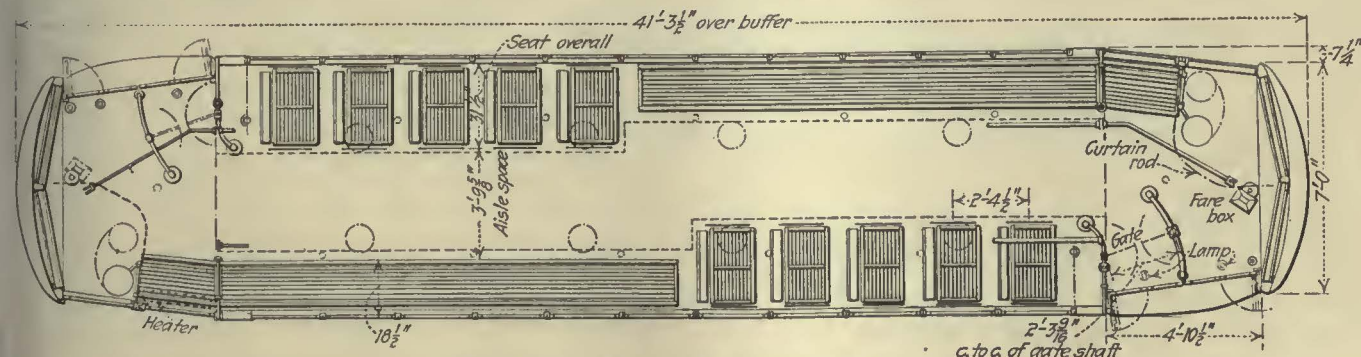
An essential feature of the construction is the use of two extra wide folding doors operated by air so as to provide two passageways, one for entrance and one for exit, thus permitting the simultaneous flow of

passengers inward and outward. The door openings are at diagonally opposite corners of the car, and the two-leaf folding doors inclosing these openings swing outward. Stationary steps are used in place of the customary folding type.

All side window upper sash are framed in one piece and the lower sash are arranged to raise 25 in. in clear. The single sash on the left-hand side of the vestibule directly in front of the operator is stationary, while that on the operator's right is arranged to drop.

PRINCIPAL DIMENSIONS OF EASTERN MASSACHUSETTS STREET RAILWAY LIGHT-WEIGHT CARS

Length over corner posts	28 ft. 1 $\frac{1}{2}$ in.
Length over platforms	39 ft. 9 $\frac{3}{4}$ in.
Length over bumpers	41 ft. 3 $\frac{3}{4}$ in.
Width over sides	8 ft. 2 $\frac{1}{2}$ in.
Extreme width	8 ft. 4 $\frac{1}{2}$ in.
Height rail to side sills	2 ft. 1 $\frac{1}{2}$ in.
Height rail over trolley board	11 ft. 1 $\frac{1}{2}$ in.
Height rail to step	15 in.
Height, step to platform	14 $\frac{1}{2}$ in.
Seating capacity	48



FLOOR PLAN OF EASTERN MASSACHUSETTS CAR

Another interesting feature is the seating plan adopted. This consists of two longitudinal seats, accommodating twelve passengers each, which extend from the platform at each end to the center of the car. On the opposite side of the car from the longitudinal seats are five two-passenger cross-seats. This



LARGE AISLE SPACE IS A PARTICULAR FEATURE OF THE INTERIOR

seating arrangement provides an aisle throughout the entire length of the car of twice the width which would have been possible if the cars were equipped exclusively with cross-seats. The staggered arrangement of the seating gives uniform loading conditions. While this type of car has a seating capacity of forty-eight passengers, the seating arrangement adopted gives accommodations to a large number of standees. The longitudinal seats extend the length of six windows in the body and one window beyond the corner posts. All seats are of a wooden slat type.

Pipe railings are provided at the door openings to direct the passengers and to separate the incoming and outgoing passengers. A sliding curtain is provided which surrounds the motorman in his position at the front left-hand side of the platform. The fare box is mounted just to the operator's right in a position central with the width of the car and at the front end. All electrical wiring is installed in metal conduits and the latest fireproof construction is employed throughout. The cars are provided with safety air brake equipment, as prescribed by the Public Utilities Commission, whereby passengers or the operator may, by applying the emergency cord, shut off power, apply the brakes, sand the rails and instantaneously release both front and rear doors. Weights of the various parts are given in an accompanying table.

The trucks are Brill low-level No. 77-E-1 type, with a 5 ft. 4-in. wheelbase, 26-in. diameter wheels and 3½x6-in. journals. In motor equipment fifteen cars are equipped with Westinghouse type 508-A motors and ten cars are equipped with G.E. 264-A motors.

Another novel feature for surface car operation is the use of Westinghouse special air brake equipment with variable load compensating device. This variable load equipment is the first ever installed on surface cars, but equipments having the same general features have been in use on the cars of the New York Municipal Railways since they were placed in service several years ago. The braking problem for light-weight cars has received considerable attention. With the light weight on the wheels a low brake cylinder pressure is essential

in order that slipping of the wheels may not occur with no load. If the same brake cylinder pressure is used with a loaded car, stopping distances will be excessively long, with increased danger on severe grades. The use of the variable load features has effectively solved this problem. Briefly this equipment limits the pressure passing from the operator's brake valve or from the emergency valve to the brake cylinder to a maximum amount which will not cause wheel sliding. It is thus possible to obtain an 85 per cent braking ratio with the car empty or fully loaded or with some intermediate weight. In operation when less than a full service

WEIGHTS OF CAR AND EQUIPMENT PARTS

Body, less electric and air equipment.....	15,583 lb
Trucks	9,000 lb
Electrical equipment on body.....	1,500 lb
Air equipment on body.....	1,200 lb
Motors and gears	4,600 lb
Total	31,883 lb

application is desired, the motorman can make a partial application with his brake valve and then graduate the cylinder pressure to that desired. The variable load apparatus, however, prevents getting into the cylinder any more pressure than the load of the car will justify.

The operation of this equipment can best be followed by referring to an accompanying diagram. As the car comes to a stop, the opening of the doors energizes two magnet valves through a door contactor. The upper one of these magnet valves shown in the diagram exhausts air so as to unlock the pressure limiting valve mechanism, while the lower magnet valve admits air to the strut cylinder. A rocker arm is mounted on the body bolster and the admitting of air to the strut cylinder extends the push rod of this cylinder so as to bring the foot plate of this rocker arm in contact with the truck transom. The other end of the push rod is moved out at the same time corresponding to the load on the car and adjusts the limit valve to its proper position.

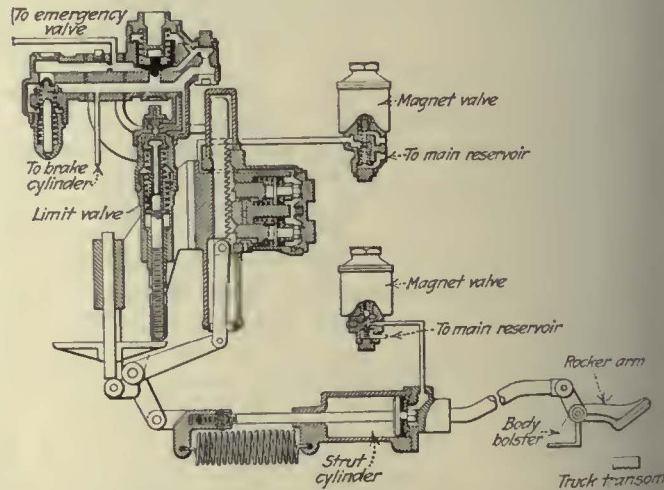


DIAGRAM OF VARIABLE LOAD EQUIPMENT

This limiting valve is in effect an adjustable feed valve and regulates the maximum pressure to the brake cylinder. With a light car 85 per cent braking effort is obtained with approximately 34-lb. brake cylinder pressure, and a completely loaded car with a load of 21,000 lb., which corresponds to 150 passengers, requires 57-lb. brake cylinder pressure to give 85 per cent braking effort. The closing of the doors de-energizes the magnet, locks the limiting valve and exhausts air

from the strut cylinder. The strut cylinder spring then pulls the cylinder so as to lift the foot plate from the truck transom, and thus the vibration of the car when it is moving is not transmitted to the variable load apparatus.

All air to the brake cylinder passes through the limiting valve. As this is adjusted at each stop to the load on the car the maximum pressure going to the brake cylinder is proportioned to the load on the car. In other words, it is possible to secure a cylinder pressure that will give 85 per cent braking ratio with a loaded car and yet hold the cylinder pressure for an empty car down to a value that will not cause wheel sliding.

Other features of the equipment provided for these cars include Brill exhaust type ventilators, eight per car, with ceiling register and removable shutter, also Brill vertical-handle, geared type hand brakes and "Dedenda" alarm gongs. Hunter illuminated destination signs are provided, and the sand boxes have Ohio Brass Company's air sanders. The Farraday electric buzzer system is used, and the heaters are Consolidated No. 1522-T. The door engines were furnished by the National Pneumatic Company. Golden Glow headlights, Keystone trolley catchers and Rico No. 7 hand straps are used. A Krantz safety type switch panel is used for the mounting of switches.

Anti-Friction Bearings for Electric Cars

A Review of the Results Obtained from the Use of Anti-Friction Bearings Here and Abroad,
Together with a Description of Some of the Principal Types—The Economies
Effected and Troubles Experienced Are Given

BY OSCAR R. WIKANDER*

Lang-Wikander Engineering Company, New York, N. Y.

ANTI-FRICTION bearings have been applied to the armatures, axles and journal bearings of electric cars in a considerable number of instances. The conditions governing their use for the three different types of bearings are somewhat different, and in the following discussion each will be considered in detail. The use of ball bearings on the armature shafts of railway motors has been advocated by progressive ball bearing manufacturers for several years. Such applications have been tried on a large number of roads with varying degrees of success.

Among the advantages claimed for the use of ball bearings, probably the one which has received the greatest amount of attention, is that of the decrease in starting current, due to the smaller starting friction of ball bearings over plain types. A decrease in the power consumption follows as a direct result. With properly constructed ball bearings, the wear at the bearing should be considerably reduced, and the danger of the armature wearing down in its bearings so as to cause rubbing on the field pole faces is reduced. A reduction in this bearing wear also makes it practical to reduce the air gap of the motors to a considerable extent, which would produce a lighter motor for the same power or a more powerful motor of the same weight.

Another advantage claimed from the use of ball bearings is that, due to the narrow construction at the bearings, it is possible to build the whole motor narrower so that a motor of greater power could be designed for a certain width between the wheels. The use of anti-friction bearings also should produce a considerable saving in the cost of lubrication, since this type of bearing should require lubrication only about every six months instead of weekly, as is the requirement for plain bearings.

While some installations have met with considerable success, others have failed and have caused great inconvenience. Bearings with insufficient load-carrying capacity have been applied, together with improper design of the bearing housing. As a result of this

last consideration bearings have been damaged while being mounted or when removed for the purpose of inspection. Other failures have resulted from stray current passing through the bearings, which may be due either to arcing at the brushes in cases of heavy overload on the motors; to a portion of the motor current passing through the housings, bearings and trucks on its way to the rails, or to local current induced in the housings and shafts in the motor. Ball bearings are very sensitive to the influence of electric current, and even a very slight amount passing continuously through a ball bearing will cause pitting and premature destruction.

Another difficulty which has been encountered in the use of anti-friction bearings is that they are subjected to heavy shocks, particularly in the case of old and worn tracks. Ball bearings are quite sensitive to shock loads, due to the fact that their capacity to carry even temporary overloads is not much larger than their continuous load-carrying capacity. While proper selection and mounting may to a considerable extent overcome such failures and while several arrangements have been proposed for overcoming them, still in spite of the great efforts made to design reliable ball bearings for railway motors, the margin of safety obtainable is not quite satisfactory.

SOME ADVANTAGES OF ROLLER BEARINGS

Properly designed roller bearings possess the same advantages as ball bearings in this application and the additional one that they do not appear to be subject to pitting by electric current to anywhere near the same degree as ball bearings. They are, furthermore, capable of sustaining comparatively heavy shock loads. It can conservatively be said that a roller bearing will carry about 60 per cent more load than a ball bearing of the same outside dimensions and stand more than double the shock load. For the above reasons the results obtained with roller bearings in electric railway service have been on the whole far more satisfactory than those obtained with ball bearings. Manufacturers of railway motors in Germany agree that precision roller bearings are by far the best solution of the bearing problem for electric railway motors.

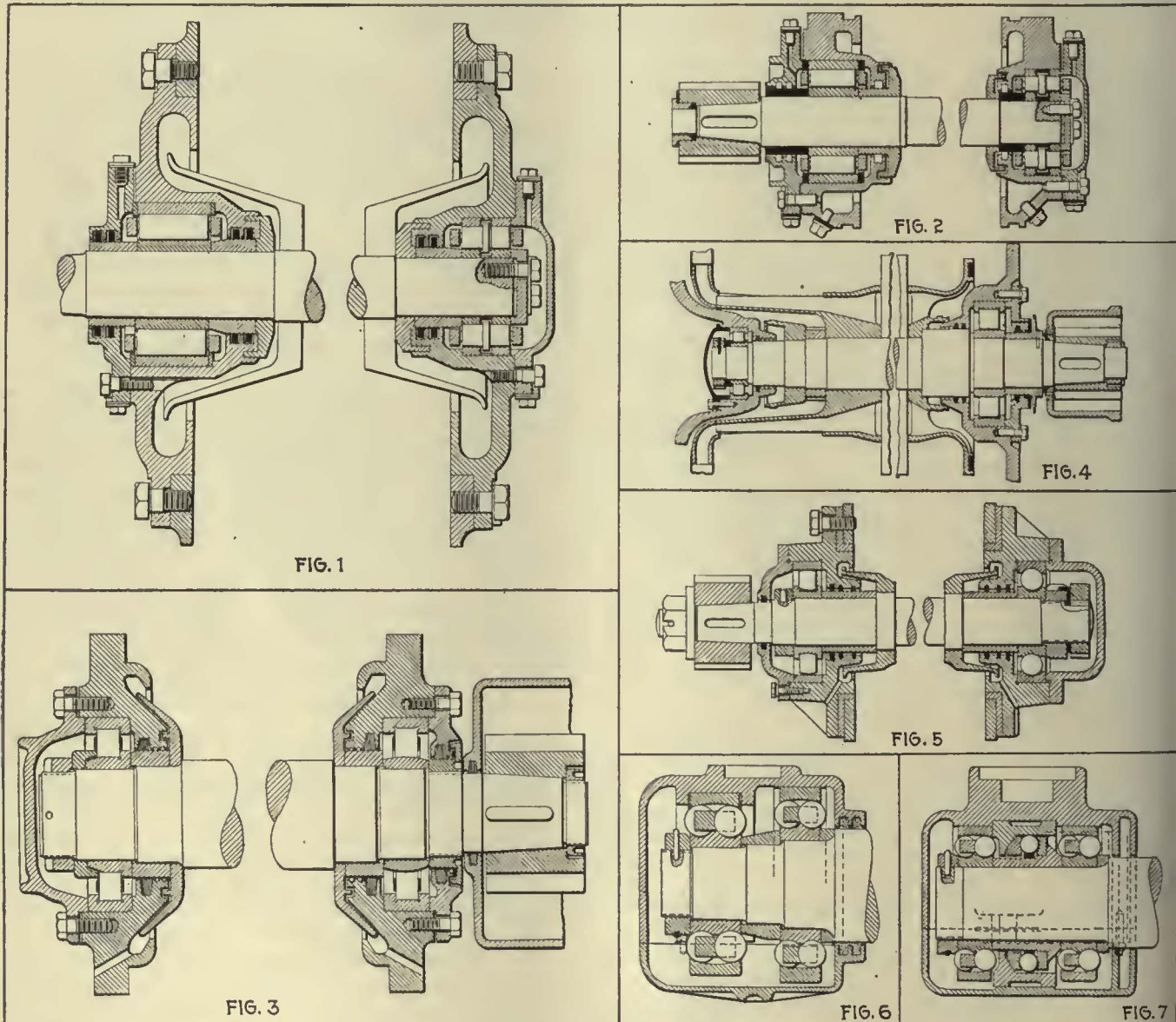
*Member American Society of Mechanical Engineers; formerly consulting engineer S.K.F. Industries, Inc.

Roller bearings have seldom been used for electric railway motors in America. The reason for this is that precision roller bearings, as they are termed in Germany, have not as yet been marketed to any large extent in the United States. The term precision roller bearings is applied to those which are manufactured of as high grade material as the best ball bearings, are of equal precision in the workmanship and have about the same coefficient of friction. The commercial roller bearings most widely marketed in America do not measure up to these standards. They have a coefficient of friction which is from two to five times larger than that of high-class ball bearings and do not meet the requirements for railway motor service. Several installations with such bearings have, however, been made in this country. The first one probably was that by the Interstate Consolidated Street Railway at Pawtucket, R. I., about twenty-five years ago. This is referred to again later in the article.

A short description of some of the German designs of roller bearings which have proved most satisfactory may be of interest. The mounting of a Jaeger

roller bearing as manufactured by G. & J. Jaeger in Elberfeld, Germany, is shown in Fig. 1. This type of bearing is used to a large extent by the Greater Berlin Street Railway. Cylindrical inner and outer races and cylindrical rollers are used. An important feature of the Jaeger bearing is the very rigid and substantial cage which guides the rollers at both ends, thereby securing a true rolling motion and effectively preventing them from skewing. The bearing on the commutator end is provided with rollers of a very characteristic shape. Projecting from the middle of each roller is a cylindrical flange which is guided between shoulders in the inner as well as in the outer race. The object of these flanges is to carry any thrust loads. The bearing at the pinion end permits the shaft to float longitudinally and adjust itself to any expansion and contraction which may be produced by temperature changes.

Another mounting of these bearings, as used for a split-frame motor, is shown in Fig. 2. According to an article by H. Behr published in *Zeitschrift des Vereines Deutscher Ingenieure*, Vol. 49, 1921, fifty-five motor cars



VARIOUS TYPES OF ROLLER AND BALL BEARINGS

Fig. 1—Mounting of a Jaeger roller bearing as used by the Greater Berlin Street Railway.
 Fig. 2—Roller bearing mounting for a split frame motor.
 Fig. 3—Armature bearing mounting designed by the S.K.F. Norma Company.

Fig. 4—Armature bearing recommended by the Riebe-Werke.
 Fig. 5—Armature bearing mounting with a floating barrel at the pinion end.
 Fig. 6—Journal box construction used for service cars.
 Fig. 7—Journal box bearing construction used for locomotives.

in Berlin have been in satisfactory operation with Jaeger roller bearings for about seven years. In the year 1921 the Greater Berlin Street Railway equipped 184 motor cars or 368 railway motors with Jaeger roller bearings, and at the time of the writer's visit, nine months later, they were giving satisfactory service.

The "Norma" bearing, which is marketed by the S.K.F. Norma, Riebe-Werke, and others, is designed with

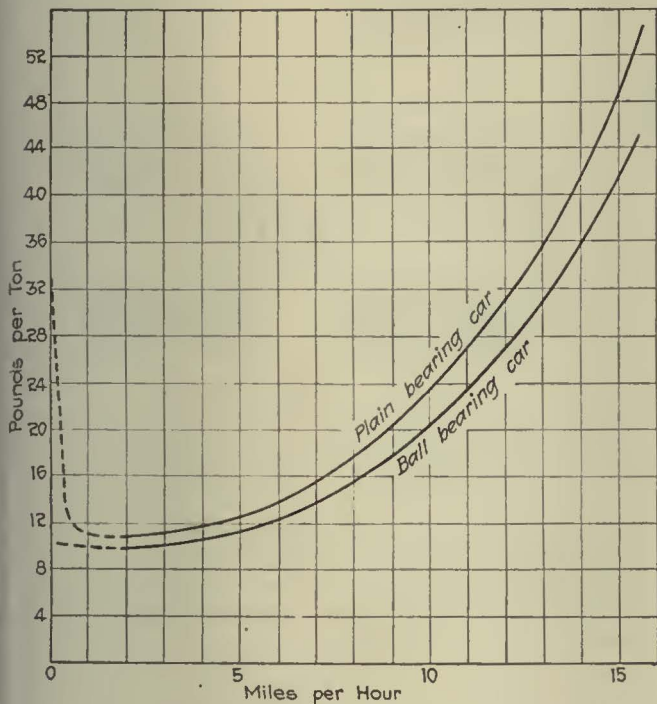


FIG. 8—GRAPHICAL RESULTS OF TESTS OF PLAIN AND BALL BEARINGS

cylindrical inner (or outer) race and cylindrical rollers. The outer (or inner) ring is slightly convex in longitudinal section, so as to permit of a slight misalignment of the motor shaft. Fig. 3 shows such a bearing in a mounting, designed by the S.K.F. Norma Company, while Fig. 4 shows an armature bearing mounting, recommended by the Riebe-Werke. An important feature of the Norma roller bearing is that the rollers are guided between flanges in the ring, which has a cylindrical raceway, so as to prevent skewing and secure true rolling.

The earlier designs of Norma roller bearings had hollow rollers running on pins, which were riveted to side rings so as to form a substantial cage, but it was found that the lubricant did not always get the proper access to the inside of the rollers, thereby causing hot bearings, and that the hollow rollers were more liable to develop hardening cracks than solid ones. For these reasons the hollow rollers have been abandoned and solid ones adopted. In the designs shown in Figs. 3 and 4 the thrust is taken up by the end surfaces of the rollers at the commutator end.

A mounting used by Kugelfabrik Fischer in Schweinfurt-am-Main, in which a floating barrel bearing is used at the pinion end, is shown in Fig. 5. At the commutator end, which has a much smaller bearing reaction, a deep groove type ball bearing takes the radial and thrust load. The bearing at the pinion end has barrel-shaped rollers, a cylindrical outer race and an inner ring with guiding flanges on both sides of the rollers and a raceway which fits the curved outline of the rollers.

With the exception of the above-mentioned company in Pawtucket, R. I., G. & J. Jaeger & Company in Elberfeld, Germany, is the only firm which to the writer's knowledge has ever attempted to apply anti-friction bearings to the axle suspension of railway motors. The bearings used by the latter firm are, of course, of the Jaeger type, and the main advantage claimed is that when anti-friction bearings are used for the axle suspension as well as on the armature shaft, the center distance of the speed reduction-gear will remain constant. It is expected that the life of the pinion and gear will be considerably increased on account of this feature. In addition there are, of course, the advantages of power saving and saving in cost of lubrication and bearing maintenance. This application requires, however, either a split type bearing design or an extremely reliable bearing, because it will be necessary to remove one of the car wheels in order to replace a broken bearing of the single-piece retainer type. In view of the comparatively light load on axle bearings it appears, however, that the application can easily be made perfectly safe.

The application of ball bearings to electric car and steam-road journal boxes has been tried in Germany, Sweden and the United States. These have operated satisfactorily at low speeds and over good track. For higher speeds and with defective track the bearing breakage has become excessive due to the fact already stated that ball bearings are not capable of carrying heavy shock loads. In some cases stray electric currents have also been an additional cause of premature destruction of such bearings.

The most extensive tests of the application of ball bearings to street cars and railroad car journals have probably been carried out by the S.K.F. Company in Sweden and, due to the high grade of material and workmanship used as well as to the engineering skill exercised in the selection and mounting of these bearings, the results were comparatively encouraging. The mounting shown in Fig. 6 was used on fifty ore cars and has been in satisfactory operation for about seven years. The service has, however, been comparatively light and the maximum speed did not exceed 25 m.p.h. The

yearly renewals of the bearings did not exceed 2 per cent, which may be considered a very satisfactory figure. Tests were also made by the same firm on ten passenger cars and on ten locomotives. The mounting used for the passenger cars was similar to the one shown in Fig. 6, while the one used for the locomotives was similar to the one shown in Fig. 7.

While the results were satisfactory from the point of view of operation, and fuel savings of more than 10 per cent were obtained, the annual replacements, which varied greatly from year to year, are understood to have been rather high. For the latter reason these tests have been abandoned and precision roller bearings

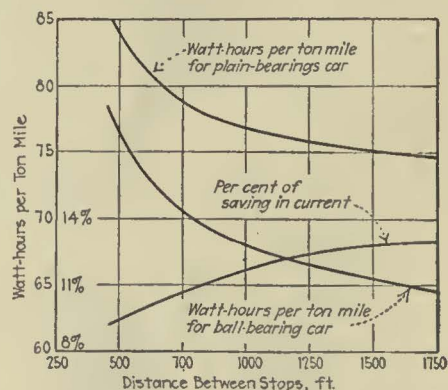


FIG. 9—POWER CONSUMPTION FOR CAR WITH BALL AND PLAIN BEARINGS

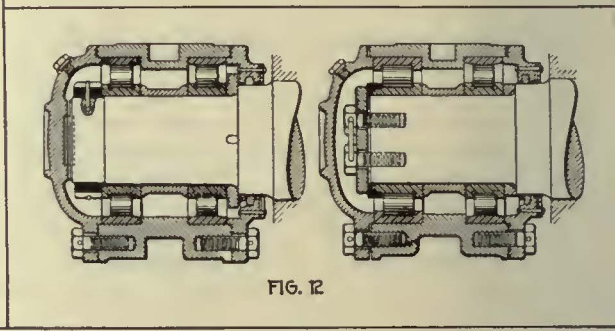
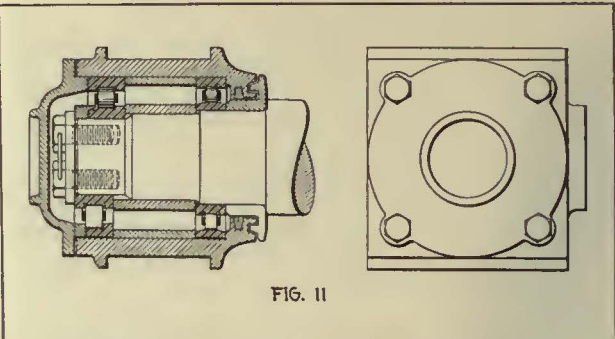
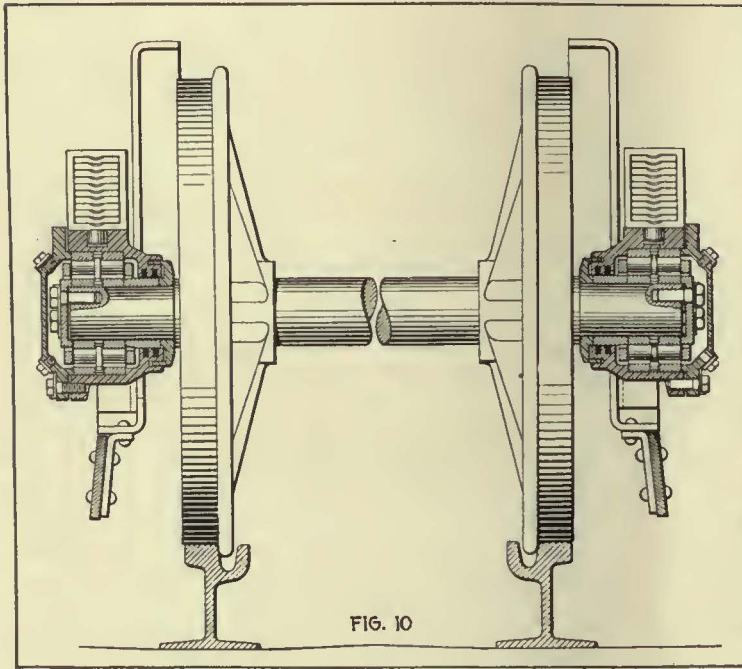


FIG. 10—ROLLER BEARING OF FLANGE TYPE APPLIED TO RAILROAD JOURNAL BEARING BOX. FIG. 11—NORMA BEARING AS APPLIED TO RAILROAD JOURNAL BOX. ALTERNATIVE DESIGNS ARE SHOWN ABOVE AND BELOW THE CENTER LINE OF THE AXLE. FIG. 12—RIEBE-WERKE DESIGN OF TWO BEARINGS MOUNTED IN A JOURNAL BOX

are at the present time being tried on the Swedish State Railways, apparently with success, though so far as the writer knows no details have been published up to the present time.

The operation of the Swedish ore trains showed that the same locomotive could pull thirty-nine loaded ball-bearing cars with greater ease than twenty-nine loaded cars with plain bearings, the fuel consumption being about the same in both cases. The theoretically possible saving in power obtainable in the express train service on the Swedish State Railways, computed on the basis of the following data, amounts to 18.4 per cent.

Distance from Stockholm to Malmö.....	375 miles
Schedule time for one run.....	11½ hours
Number of stops.....	12
Starting acceleration.....	0.56 m.p.h.p.s.
Braking retardation.....	1.56 m.p.h.p.s.
Weight of total train.....	462 tons

The same train running as a local with sixty stops and thirteen hours schedule time would show a theoretical saving in power of about 17 per cent. The writer understands that the actual saving in fuel in express service amounted to about 13 per cent.

A number of tests of ball bearings in street car journal boxes were made by the Greater Berlin Street Railway and published by Leonard Adler in *Mitteilungen des Vereines Deutscher Strassenbahn und Kleinbahn Verwaltungen* in March, 1917, page 177. The measurements which were made on this installation are less fa-

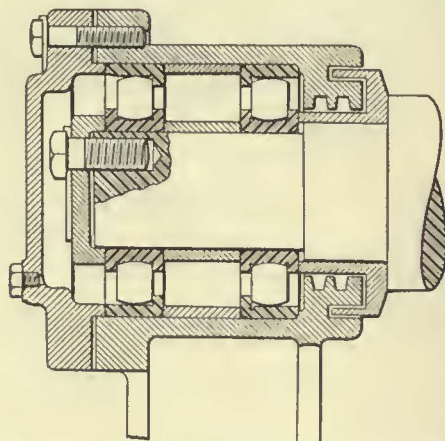


FIG. 13—FISCHER BARREL BEARING MOUNTED IN JOURNAL BOX

vorable to anti-friction bearings than any other tests which have come under the writer's observation. Here are a few of the results and conclusions:

It was found that nearly three and one-half times greater drawbar pull (35.4 lb. per ton) was required to start a motor car with plain bearings in the axle journals than one with ball bearings (10.6 lb. per ton). In order to start a trailer with plain bearings a drawbar pull 4.15 times greater (17.3 lb. per ton) was required than when the same car was equipped with ball bearings (4.18 lb. per ton). A motor car fully loaded, weighing 18 tons, was pulled over a level track at different speeds and the corresponding required drawbar pull measured. They are graphically shown in Fig. 8. These curves show a percentage difference in favor of the anti-friction bearings of about 15 per cent up to speed of about 15 m.p.h. For higher speeds the percentage difference would, however, probably be less.

It is frequently supposed that with increasing numbers of stops the greater will be the saving in power resulting from the use of ball bearings in the journal boxes. As a matter of fact the contrary is the case; the longer the runs between stops the greater is the saving in power. The main saving in power is obtained by long stretches of coasting, it being possible to keep the power cut off a much longer time when anti-friction bearings are used. When frequent stops and starts are made a large amount of energy is used for acceleration of the moving mass, and this energy is, of course, the same regardless of the type of bearing. The percentage saving in power is therefore greater for long runs. The graphs in Fig. 9 give the power consumption for the motor car referred to above with ball and plain bearings for different lengths of run. It will be seen that the percentage power saving varies from 8.4 to 12.9 with increasing length of run.

The above data all refer to motor cars with ball bearings in the journal boxes only. If in addition the armature shafts were equipped with anti-friction bearings it is conservative to state that the above savings would be at least from 9.6 to 14.7 per cent, and if

the suspension bearings were thus equipped the theoretically computed savings would at least be from 10.8 to 16.5 per cent. The actual percentage savings in power measured as averages of many runs and with different cars were as follows:

Motor car A alone	8.2 per cent saving
Motor car B alone	9.3 per cent saving
Motor car A with trailer	7.2 per cent saving
Motor car B with trailer	8.0 per cent saving
The number of stops per mile were about	6
Average running speed	8 m.p.h.
Acceleration	1.56 m.p.h.p.s.
Braking retardation	2.00 m.p.h.p.s.
Weight of loaded car	18 tons

Fig. 10 shows a Jaeger roller bearing of the flanged type applied to a railroad journal box. Such journal boxes have been installed on a number of German street car systems with success, and a number of cars of the German State Railroads are being so equipped at the present time. Fig. 11 shows the Norma bearing as applied to a railroad journal box. The design shown above the center line is particularly interesting, because it permits the pulling off of the entire housing as soon as the thrusting of the outer bearing is removed and without removing the inner rings of the bearings. About ten cars of the German State Railroads are at the present time being equipped with such bearings.

Fig. 12 shows the Riebe-Werk's design of two Norma type bearings mounted in a journal box, the general arrangement being similar to the preceding one. Fig. 13 shows the Fischer barrel bearings mounted in a railroad journal box. The bearings are both alike, one taking the thrust in one direction, the other in reverse direction.

SOME AMERICAN TEST RESULTS

The earliest experience with anti-friction bearings in electric car journal boxes in the United States must probably be credited to the Interstate Consolidated Street Railway of Pawtucket, R. I., which equipped one of its cars on the line from Pawtucket to Attleboro with roller bearings about twenty-five years ago. Bronze rollers were used, which rolled directly on the ground axles, polished cast-iron bearing sleeves forming the outer race. It is interesting to note that not only the journal boxes but the axle suspension and the armature as well were equipped with roller bearings. The test did not lead to any further use of such bearings in street car service, probably because they proved to be too short lived.

The first bearing built in the United States, which properly may be called a precision roller bearing, was designed by Julius A. Perkins about twenty years ago. Mr. Perkins was probably the first one to recognize the following fundamental conditions for the successful operation of a roller bearing: (1) Use of highest grade steel, properly heat treated and highly finished for rollers and races. (2) Greatest precision in workmanship, the rollers all being ground to the same size within very small tolerance limits. (3) The necessity of a very rigid cage, in which the rollers are positively guided so as to keep their axes permanently in parallel with the axis of the shaft, thereby securing a true rolling motion and avoiding any skewing of the rollers.

An interesting feature of the Perkins bearing is that the ends of the rollers are journaled in small ball bearings which are mounted in the cage. The load is carried by the rollers exclusively and the ball bearings are only subjected to the comparatively small loads

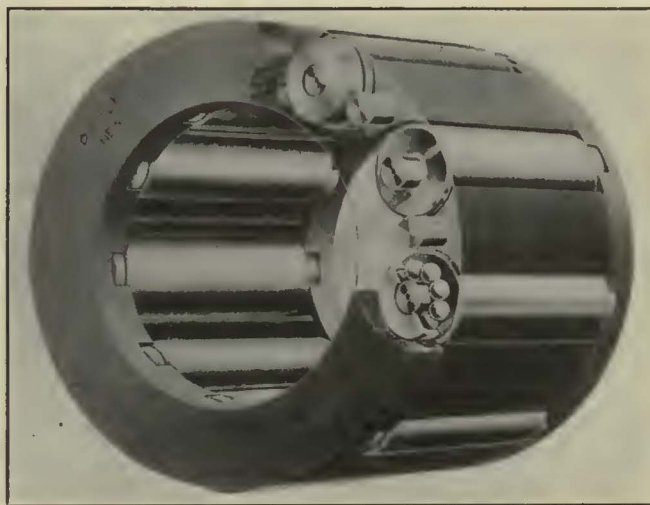


FIG. 14—PERKINS DESIGN OF ROLLER BEARINGS

which are required to keep the rollers in proper alignment. Fig. 14 illustrates the design of the rollers, their bearings and the cage of a Perkins bearing. The inner race is made of hardened and ground steel and forms a part of the car axle itself. The outer race is made of cast steel hardened and ground and forms a part of the housing, thereby permitting the building of the whole box so narrow that it can be made interchangeable with existing journal boxes with plain bearings, which of course is of enormous importance in order to facilitate the adoption of roller bearings for existing street or railroad cars.

Fig. 15 is a sectional drawing of a Perkins roller bearing, designed for a Birney safety car. It will be noted that double-acting ball bearings are used to carry the occurring thrust loads. Bearings of this type have been in continuous and successful operation on a number of cars of the Third Avenue Railway of New York City for over ten years.

PENNSYLVANIA RAILROAD TESTS

A most interesting test of ball bearings for railroad journal boxes was carried out by the Pennsylvania Railroad during the years 1913 to 1915. First, one 60-ton all-steel day coach was equipped with ball-bearing journal boxes and gave satisfactory service for several months. Then a complete train consisting of seven cars was so equipped and operated satisfactorily for about fifteen months, after which time the bearings began to deteriorate and were replaced by plain sleeve bearings. It is understood, however, that the railroad company became thoroughly convinced as to the great operating advantages of anti-friction bearings in rail-

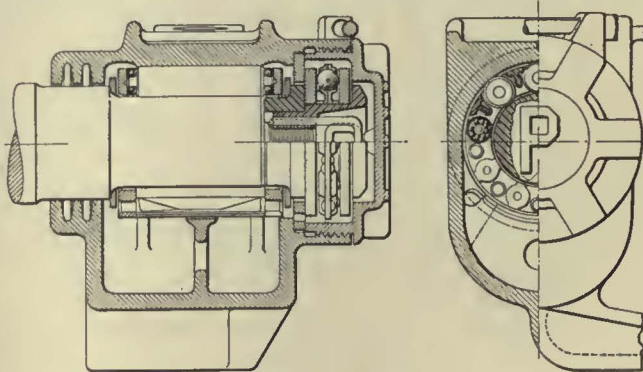


FIG. 15—SECTIONAL VIEW OF PERKINS ROLLER BEARING

road journal boxes and is experimenting with roller bearings at the present time.

A very complete report of an American test of ball bearings in railroad journal boxes was published in the *Electric Railway Journal* of Dec. 25, 1915, page 1263, by Gaylor M. Cameron. The calculated power saving in this installation was 14.9 per cent and actual tests showed a saving of 14.1 per cent.

The actual saving in dollars and cents which can be obtained by the introduction of anti-friction instead of plain bearings varies of course very largely according to the conditions of each case and can, even in specific cases, only be computed roughly on account of the many uncertain factors entering into the problem, the principal one being the life of the anti-friction bearings. If a number of cars are equipped with anti-friction bearings, experience indicates that all of them will by no means have about the same length of life. Some will have to be replaced the first year, some the second and so on. As a rule it is found that the number of necessary replacements is larger during the first two or three years and thereafter decreases. It may further be stated that an average number of replacements of more than 10 per cent is generally considered excessive and this figure may be considered the maximum which will be tolerated.

The results of tests with ball bearings on about a dozen other roads which have come under the writer's observation have corroborated that ball bearings do not, on the whole, furnish a sufficient margin of safety for this application. Recent experiences, principally in Germany, have, however, proved that modern precision roller bearings meet the requirements of railway service and the writer dares to prophesy that before very long the railroads of the United States will be equipped with anti-friction bearings to a considerable extent, not so much on account of the saving in cost of power and maintenance, but because the use of such bearings will permit hauling about one-third longer trains with the same locomotive and thus increase the carrying capacity of our railroads to a very large extent for a comparatively small investment.

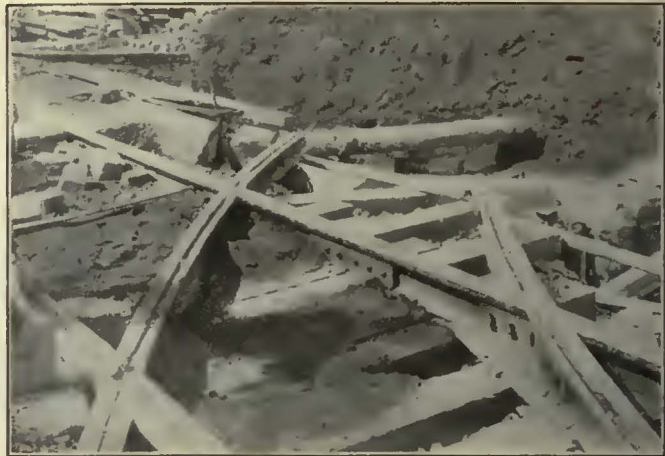
Emergency Special Trackwork Made in Short Time

By L. R. BROWN

Office and Field Engineer New York State Railways,
Rochester Lines

RECENT construction work in the city of Rochester demanded that the New York State Railways construct a complete double-track branch-off in less than one week's time in order to maintain car service on three car lines of the city. This branch-off was needed in connection with detour tracks to carry service around a bridge in Main Street which was to be removed. Often in similar cases some old second-hand special trackwork or some new special trackwork held in stock for some other location can be used temporarily for such a purpose, but in this case there was nothing on hand except some second-hand switches and mates. Thus the only thing we could do without holding up the work was to construct the six additional frogs.

A plan was made by the engineering department to a very large scale. For convenience the design was made exactly like another layout in stock which was to be used shortly. The second-hand switches and mates were of the proper radius for use with this layout.



THERE IS GOOD JOINERY ON THIS EMERGENCY JOB

The plans and information were given to Louis Kubiak, the special trackwork foreman, who has charge of the blacksmith repair shop, and he made the required six frogs in four days. To do this he had the six new frogs brought in and bolted up in the shop for a pattern. Guard rails were bent to the proper radius for the curved portion and straight guard rails cut and fitted to form the proper devil strip. Splice bars were bent and used to bolt the rail together as shown in an accompanying illustration. Large $\frac{1}{2}$ -in. steel plates were placed under each frog point and the bases of the rails were electrically welded to these plates when the whole was in proper alignment. The grooves across the head of the curved rail was then ground out to permit the passage of the flanges on the straight track and the bottom of the grooves on both the straight and curved rail was filled in with manganese weld to provide flange bearing over the frog points. The frogs were then cut apart to facilitate handling and the job was all completed in less than one week.

The alignment was nearly perfect, and there have been no derailments on the branch-off up to the present time. The illustrations show the appearance of this work. The cost of the six frogs was less than one new manufacturer's frog and the time of delivery shorter by the same ratio. This branch-off will probably not see six months service, but we have had similar home-made frogs in use over five years.

H. A. Abell, engineer of way and structures, Rochester lines, New York State Railways, was in charge of this work.



DOUBLE-TRACK BRANCH-OFF CONSTRUCTED WITHIN WEEK IN ROCHESTER, N. Y.

Some Practical Experience with Troughwork Construction

The Protecting of Metal Construction so as to Safeguard the Trolley Wire and Connections from Being Grounded Often Becomes a Serious Problem for the Line Engineer

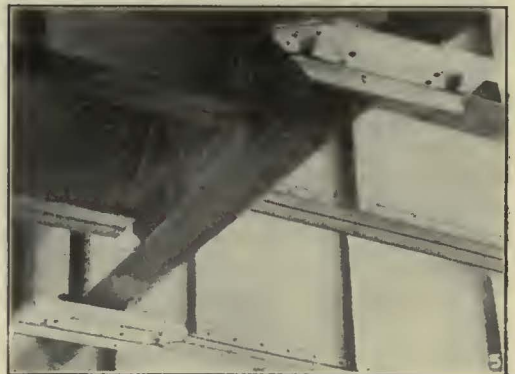
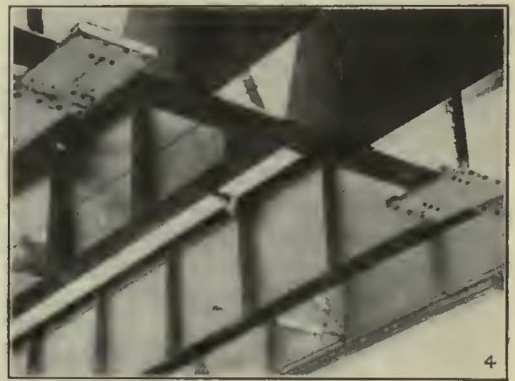
BY G. H. MCKELWAY

Engineer of Distribution Brooklyn (N. Y.) Rapid Transit Company

SOME form of sheathing or trough construction is quite necessary at locations where there is metal work through which the trolley wire could be short-circuited by a wild trolley pole. Such accidents occur most frequently at bridges and elevated structures and in carhouses. The positions that a trolley pole can assume and the points that it can reach are fre-

evident that a dangerous condition will still exist, for there is a possibility of the pole striking the straps and causing a ground through them.

Where the metal to be protected is quite extensive, it will be best to use troughwork or some similar form of construction. The form adopted will be influenced to a large extent by the height of the trolley wire and



PROTECTIVE COVERINGS FOR OVERHEAD WORK
 No. 1. Wooden sheathing under girder.
 No. 2. Long trough construction.
 No. 3. Putting up long troughs in place of flashboards.
 No. 4. Flashboard construction.
 No. 5. Short troughs.

quently quite unbelievable. A straight pole will ground to metal work within a considerable radius and a bent pole will reach almost impossible positions. The second pole of a two-pole car is another fruitful source of trouble, as this pole is sometimes raised either by accident or design while the other pole is still on the trolley wire. Exposed metal is not the only kind of construction that requires protection, as severe grounds have occurred when live trolley poles came in contact with reinforced concrete. The reinforcing rods often form very good conductors, even though they are covered with a layer of concrete.

Where the metal pieces to be protected are few usually the best plan will be to sheath them with wood. This construction not only provides the greatest protection, but also is as cheap as or cheaper than a type of construction employing troughwork. When installing this sheathing care should be used to make certain that the straps used to bind the sheathing to the metal work do not touch the grounded metal. Otherwise it is quite

the height and arrangement of the metal work. With low iron work requiring the carrying of a trolley wire at a low level and where the metal work is practically continuous, as with girders parallel to the trolley wire, or where there is a bridge floor above the wire, long troughwork should be used.

The long trough construction usually consists of one or two bottom boards with wooden sidings extending down each side of the bottom. The number, width and thickness of the bottom boards will vary with different railways. The thickness usually runs from 1 to 2 in., but a single 1-in. board will usually be found pretty thin, especially where the trough is installed in locations subject to the weather or where the distance between supports is quite long. If it is installed in carhouses, the distance between supports can be lengthened over that used outside. For outside work, the thickness should be at least 1½ in. and preferably 2 in. The width of the bottom trough should be sufficient to permit installation of the ears without the necessity for

removing the siding. Some companies get along with a comparatively narrow bottom board by using short ears 9 or 10 in. in length. This enables a single board to be used of not more than 12 in. in width. Where the ordinary 15-in. ear is used the board will have to be at least 16 in. wide. Single boards of that width are quite expensive and this has led to the use of two narrower boards. When two boards are used their total width should be greater than that necessary with a single board, as the hangers should be placed slightly off center, so that any water which may leak through the cracks between the boards will not cause grounds. Water carries dust and dirt from the top of the trough and hangers of high insulating quality are an advantage.

LONG LEAF YELLOW PINE FAVORED

The kind of wood to be used is another variable, but long leaf yellow pine appears to be better than most other varieties. Oak is sometimes used, but it is not only more expensive but does not seem to weather as well as pine and warps more easily. The length of the pieces will be influenced by the price and the ease with which they can be handled. Twelve feet is a good minimum, and a better length is 16 ft. Boards longer than that will be found too costly.

The sidings should be of the same kind of wood and approximately of the same length as the bottom boards, but need not be as thick. One inch is a good thickness for the side boards. The width of the siding should be such that its bottom edge will extend down to a point slightly below the bottom of the trolley wire, otherwise there will be danger of the pole grounding on some vertical column or a low horizontal beam.

In nailing the siding to the bottom board it is best to use copper clad nails, as trouble has been experienced in some cases from the rusting of nails at points where the crack between the bottom board and the siding allowed water to run down on them.

Where the ends of the trough are left square and without protection they soon become battered out of shape by the striking of wild poles against the end grain of the wood. A satisfactory type of construction is to cut the ends back so as to form a V. With this construction the poles that hit on either side of the center of the V glance off. To prevent damage from poles striking fairly on the point, the ends should be guarded by the use of angle irons bent as shown in one of the accompanying illustrations. The use of two pieces of angle iron fastened to the end, one on each side of the point, is not a satisfactory construction, as there is a chance of the pole striking just where the two pieces of iron meet, which would force them apart. The leaving ends of the trough are not armored ordinarily where installation is on a double-track line, but the ends should be reinforced with strips of wood running across the ends of the bottom boards. The ends of the sidings are not usually strengthened, but it is well to cut them back as shown in the accompanying illustration. This prevents a glancing pole from catching between the bottom and the siding so as to pry them apart.

Where the trough is supported from transverse girders crossing just above it and with no clearance between them, it may be attached to the girders by buttons. These buttons are made of oak notched out so as to fit over the flange of the girder. Two of them are used at each girder, one on each side, the trough being bolted to the buttons which rest on top of it.

In locations where the girders are too far above the line of the trough to permit fastening with buttons or where intermediate supports are needed between girders, a satisfactory type of construction is to fasten the trough directly to the blocks or crossbeams, which are in turn supported by iron hangers attached to the structure above. At one time it was common practice where the trough was suspended from longitudinal girders to place beams on the lower flanges of these girders and suspend the hanger irons from them. With this type of construction it was found that a wild pole would sometimes strike these crossbeams and knock them out of place, so that the trough would sag. This can be prevented by having the hangers themselves clamp the flanges of the steel. Where there are two tracks it is best to join the troughs by the wooden beams, as this provides a stiffer construction than with the troughs hung separately. Where the hangers are very long still more stiffness can be obtained by having braces which run down to the center of the beams, turnbuckles being cut into these braces for tightening.

For connecting the various sections of the bottom board splices are used. These usually consist of short pieces of wood, but sometimes iron plates are an advantage. These plates are bolted onto the top of the trough, half of the bolts passing through the end of one board and half through the next. In installing these bolts they are installed from underneath and are pushed up through the holes in the bottom board, so that the nuts will come on top. This permits their being tightened readily with a wrench, which would not be possible if they were installed under the trough. While the iron plates make a neater and perhaps stronger splice than wood, yet there is the objection that they may be made alive by trolley wheels touching both the wire and one of the bolts at the same time.

SHORT TROUGH CONSTRUCTION

The construction used for making short troughs is the same as that for the long, but instead of being continuous for long distances and extending all the way from one cross girder to the next they are usually but 5 or 6 ft. in length and give protection only to the cross girders to which they are buttoned. The trolley wire hangs free between the short troughs and thus the troughs make a succession of hard spots in the line which is flexible between them. The short trough construction thus is not as satisfactory as that of the long trough, but it is much cheaper.

Where the girders are all high above the level of the trolley wire it can be supported from spans in the usual manner, and the girders can then be protected by flashboards buttoned on to their lower flanges. These flashboards are merely forms of wooden protection about as long as a short trough. They are usually made of three boards placed side by side so as to give the required width, the boards being held together by wooden crosscleats at the ends.

As a protection against the weather the trough should be painted and two coats of paint should be applied, one of these before the various pieces are assembled. This will permit all sides of every piece to receive a coat of paint, and after the trough has been erected a final coat should be given. To make sure that all of the lumber receives both coats of paint it is well to use paint of different colors for the two coats. A satisfactory method is to use white lead for the first coat and a color that will harmonize for the second.

Equipment and Its Maintenance

*Short Descriptions and Details of New Apparatus of Interest
to the Industry. Mechanical and Electrical
Practices of All Departments*

Use of Dump Cars in Cleveland, Toledo and Pittsburgh

**Double-End Control of Three-Car Trains Is Provided by
Having a Single-Cab Four-Motor Car at Each End
with a Trailer in the Middle**

THE electric railway has a greater variety of repair work to do than any other public utility, and in most cases this must be carried on with a minimum of interruptions to the regular service. Consequently all available means are utilized to get the required results without subjecting passengers to annoying delays in reaching their destinations, or causing other delays in service.

To assist in making rapid repairs a large number of railways have been adding to their repair equipment dump cars having several new design features that have advantages in reducing the number of delays in traffic, where repair work is in progress. Generally, most of the delays are a result of a carload of sand, gravel, or other repair material along the right-of-way, being unloaded by hand where no side track is available, which of course results in a tie up.

Accompanying illustrations show some of the uses which the Cleveland Railway is finding for Differential dump cars. Some recent equipments were put into service about the first of September and have been operating with entire success. This company has been using such cars for years, both for repair work and extensions on its lines. Originally the company used the cars in trains consisting of one four-motor equipment, with Westinghouse Type HL multiple-unit control, and two trailers, each with two motors. This gave

them a train with a cab and master controller on one end only. Later it was found that at less expense the company could secure smoother operation and double-end control by putting a single-cab, four-motor equipment at each end and a trailer with no motors in the middle. Bus line connections between the two end cars permitted the train to be operated from either master controller in different directions, power being furnished



PICKING UP A LOAD WHILE TRACKS ARE BEING RECONSTRUCTED

through either or both trolleys. At the present time the Cleveland Railway has eight dump cars with quadruple equipments of Westinghouse Nos. 340 and 532-A motors and HL control and seven trailers.

A train of this kind can easily be run in between cars operating on a five-minute headway, drop all or any part of its load where desired, and move on out



SIDE DUMP IS OF ADVANTAGE FOR FILLING IN

of the way before the following car can catch up with it. Another use the company has made of its trains is for hauling ties. By dropping down or removing the car sides and piling the ties in crosswise, as is done on a flat car, a very satisfactory method of transportation is obtained. To be sure ties are not as easily dumped as gravel, but if the whole load is to be dropped at one place, the body can be tilted and most of the ties will slide clear of the car. The others can be handled very easily from this position as one end is already down near the ground.

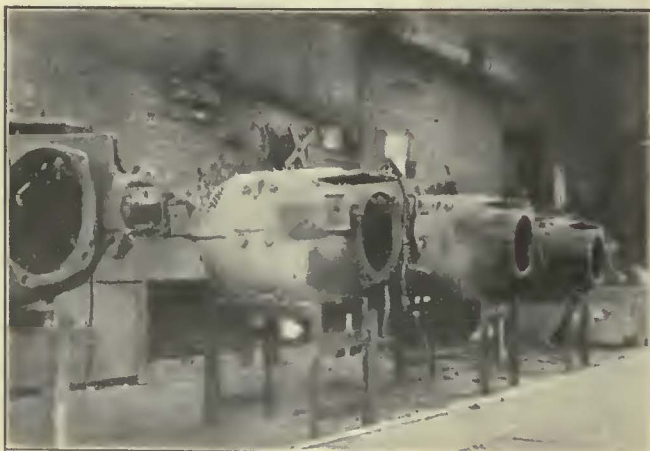
In the winter some of the motor cars are converted into snow plows by the addition of a plow and side boards, and serve to keep the snow over near the curb. It is a common sight on some of Cleveland's main streets, after a heavy snow storm, to see so many automobiles using the railway tracks, which have been well cleared of snow, that the street cars are nearly crowded out.

The Pittsburgh Railway has lately added two double-end Differential type cars to its rolling stock. These are equipped with quadruple equipments of Westinghouse 532-A control and "K" controllers and are mounted on 26-in. wheels. This company has a great quantity of contract work to carry on besides its regular repair work, and it finds this type of car very useful in moving slag and ore or even for carrying away rubbish. Two Differentials are used continually in disposing of ashes from the boilers at the plants of the Duquesne Light Company.

The Community Traction Company of Toledo, Ohio, is another that has recently acquired some "dump" trains for track repair and general hauling. The equipment consists of a three-car train of one motor car and two trailers. The motor car is equipped with four Westinghouse 548-C motors and HL control. The total motor capacity is 400 hp., but the car has been geared so that when loaded to a total weight of approximately 100,000 lb. it will operate and exert the same tractive effort as a 50-ton locomotive. In this manner it is capable of handling six or seven loaded cars in addition to the three cars in the regular train. The Community Traction Company uses the cars for switching around the yards, in addition to the regular track repair and dump service.

Convenient Stands for Motor Overhauling

THE accompanying illustration shows several motors mounted on angle-iron stands while being overhauled in the shop of the Wheeling (W. Va.) Traction



OVERHAULING STANDS FOR RAILWAY MOTORS

Company. These stands are made of 1½-in. x 1½-in. angle irons bent to a U shape and fastened together by 2-in. x ½-in. iron straps at each end. In order to provide additional support for the motors, the angle part at the top is filled in with wooden blocks. These are cut out to give clearance for projections on the motor frame, and their use is also of added advantage, as it is found that the motor frames are less liable to slip on the wood surface. By the use of these stands the motors are brought to a convenient height for overhauling, so that the work can be done more rapidly and efficiently.

Quick Installation of Noiseless Crossings in Cleveland

Old Intersections Were Cut Out and New Ones Put in Place and Connected up in Each Case Between 2 a.m. and Daylight—Near-by Residents Much Pleased with the Result

THE Cleveland Railway has been receiving favorable comment from residents and storekeepers in two neighborhoods where Balkwill articulated crossings were installed recently at street intersections. These intersections were East 105th Street and Euclid Avenue, and Harvard Avenue, S.E., and Broadway. It

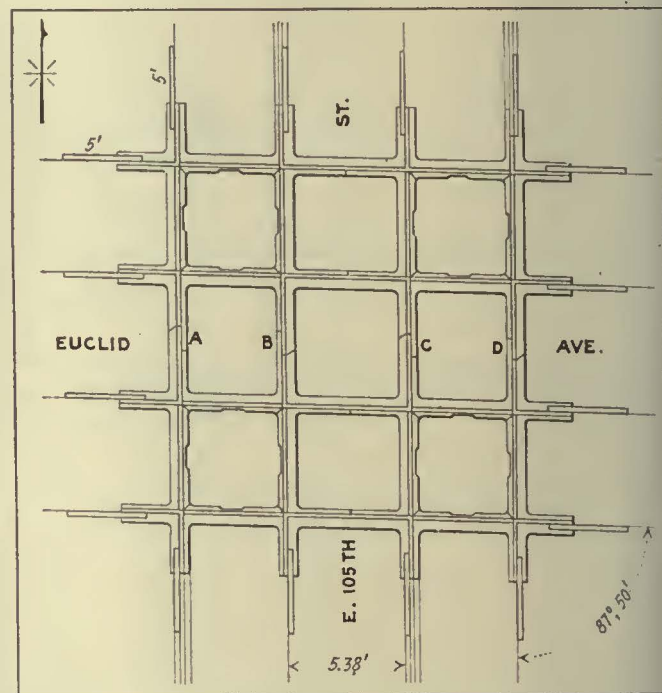


FIG. 1—DETAILS OF CLEVELAND NOISELESS CROSSING LAYOUT, SHOWING LOCATIONS OF DEVILSTRIP SCARF JOINTS

was recognized by the railway company that while the noise caused by electric railway cars passing over intersections cannot be eliminated in many cases it can be reduced. The difficulty is greatest where the crossing angle is practically 90 deg. The articulated crossings have overcome the difficulty at these two points, where the crossings are both double track. The work in each case was done between 2 a.m. and daylight, the old crossing being cut out by means of acetylene torches. It was done under direction of C. H. Clark, engineer of maintenance of way Cleveland Railway.

The Balkwill articulated crossing, of which noiselessness is but one feature, is appropriately named because it is made up of a number of castings bolted together to form a rigid structure. The pieces are manganese

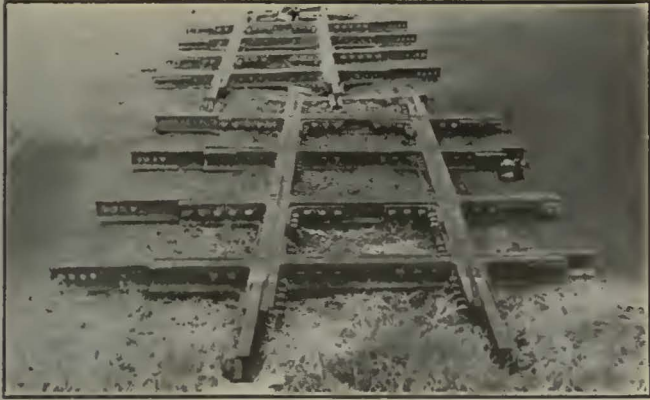


FIG. 2—CLEVELAND NOISELESS CROSSING IN TWO PIECES READY FOR INSTALLATION

Service Car Constructed from Old Passenger Car

THE Trenton & Mercer County Traction Company has recently built in its shops a service car of the type shown in the accompanying illustration using the underframe of an old passenger car. The sides of the underframe, which were originally 8 in. wide, were reinforced with steel plates $\frac{1}{2}$ in. x 12 in. The steel plate thus projected 4 in. above the wooden sills. These were tied together at the ends and in the middle with steel plates 1 in. x 4 in., and cross-members were also installed of the same dimensions. A false floor was then laid over this of $1\frac{1}{2}$ in. flooring and this was covered with $\frac{1}{8}$ in. sheet steel. An operating cab 5 ft. square was constructed at either end, and equipment was installed for double-end operation. Air brakes were added.

Removable sides were constructed for carrying ballast, rail and light material. These sides are constructed in two sections, with three stakes to a section. The stakes set in pockets in the floor of the car and the

steel castings and they are assembled with $1\frac{1}{4}$ -in. bolts in the Cleveland job, with castellated cube nuts, spring nut locks and cotter pins. The make-up of the Cleveland crossing is as shown in Fig. 1. It is composed of four single crossings of the sixty-four-bolt type, there being ten bolts in each outside angle and three in each inside one. Fig. 1, examined in connection with the reproduced picture of the crossing in halves, shows not only the method of assembly but also the cuts made to facilitate handling. These cuts are designated "A, B, C, and D," and through the tread they are made at an angle of 20 deg. to minimize their effect on wearing quality. The four cuts shown are the only ones intersecting the tread. Fig. 2 gives details of joints A, B, C and D.

The Balkwill construction is designed primarily to provide a crossing of great durability, with elimination of possibility of breakage in the flangeway. The crossing is the flange-bearing type, the groove being but $\frac{3}{8}$ in. deep through the intersection when new. The flangeway floor begins to rise at 15 in. to 20 in. from the intersection, gradually approaching the crest as mentioned. Thus the car wheels go through the special trackwork with wheel treads clear of the rail tread.

The Cleveland crossings were made by William Wharton, Jr., & Company, Inc., one of the score or more of special trackwork manufacturers licensed under the patents of Stephen Balkwill of Cleveland. Mr. Balkwill's crossing inventions were described and illustrated in issues of this paper for Jan. 26, 1918, page 192, and July 6, 1918, page 19, where more detail of purpose and design will be found.

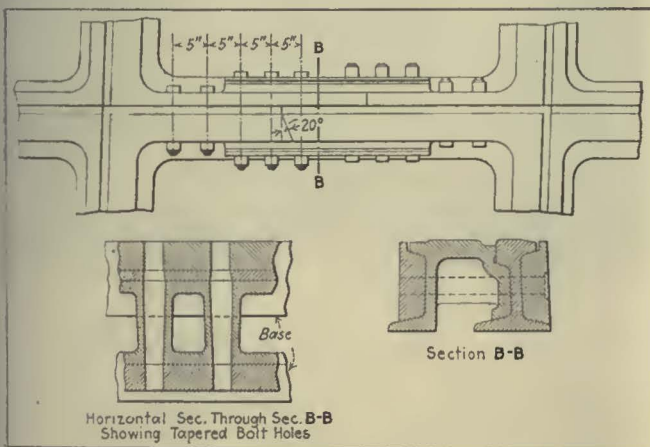


SERVICE CAR BUILT IN TRENTON SHOP

sides are 18 in. high. The car is 30 ft. long and 8 ft. wide and has a capacity of 20 tons of ballast.

This is the second car of this class which has been constructed in the shops of the Trenton & Mercer County Traction Company, and provision has been made to use these for snow removal during the winter season. Snow noses 58 in. deep have been constructed of planks 10 in. wide x $2\frac{1}{2}$ in. thick and with a $\frac{1}{8}$ in. steel plate on the outside. These have a steel nose at the point and are held together by two braces at the back made of 1-in. x 5-in. iron. A hood made of $\frac{3}{4}$ -in. wood tongued and grooved covers the top of the nose.

For fastening this nose in position on the ends of the car two T-rails are used. These extend 12 in. above the floor of the car and down to within 9 in. of the rail. The cross-braces of the noses have two cleats with a lip which fits over the bottom part of the rail. Thus the snow noses will slide up and down with the rail as a guide. A 6-in. x 12-in. brake cylinder has been installed on each end of the car for raising the snow noses. Air is admitted to this cylinder through a brake valve installed in the cab. When the snow nose has been raised to its proper position, it is held by chains, the upper



Horizontal Sec. Through Sec. B-B Showing Tapered Bolt Holes

DETAILS OF DEVILSTRIP SCARF JOINT IN CLEVELAND NOISELESS CROSSING

part of the rails being slotted so that a link of the chain will just fit in the slot. The lower ends of the chains have hooks, which are hooked about the bottom braces of the snow nose on the inside. A similar equipment is provided for each end of the car.

Short Versus Long Contact Tips for Brush-Holders

By J. S. DEAN

Renewal Parts Engineer,

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

A FAMILIAR type of contact tip used on the brush-holders of a large number of the older type of railway motors is shown on the left-hand finger of the brush-holder in the accompanying illustration. These are made of either a copper drop forging or machined from a strip of extruded brass metal. As it is the common practice to use carbon brushes in railway service without pig tails or shunts, the question of the wearing action of this tip on the top of the unpro-

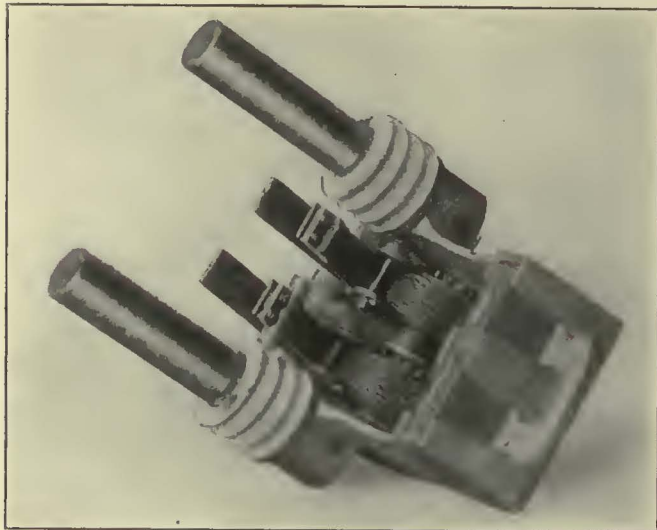


EXHIBIT SHOWING WEAR OF CARBON BRUSHES WITH STANDARD TIP ON LEFT AND TIP WITH EARS SAWED OFF ON RIGHT

tected carbon has often been raised by operators, and it seems to be the general consensus of opinion that it is good practice to make the ears on these tips as long as practicable to increase the contact area, the idea being that this will minimize the wear on top of the carbon at this point.

It has been noted that in the operation of brush-holders with these long ears on the contact tips there is a possible chance, after parts of the moving mechanism become worn in service, of a faulty operation of the brush-holder, resulting in a reduction of spring pressure on top of the carbon due to the following reasons:

1. Ears on contact tips riding on top of carbon box.
2. Ears on contact tips riding on top of both carbons; in the case of brush-holders using more than one carbon in the same box.
3. Tendency for the ears on contact tips to jam against the inside of the carbon box as the brush wears down in service.

In addition to the tendency to lose the effective spring pressure, there is always a large percentage of carbons that have the tops broken out due to this type of contact tip.

To secure some information on this subject, a sample

brush-holder using two carbons was made up with the tip on the left-hand finger standard, and the tip on the right-hand finger having the ears cut off flush with the sides of the finger, as shown in the picture. The construction of all other parts of the brush-holder pressure fingers was in every other respect identical. With the spring pressure on both fingers of this brush-holder set at approximately 6 lb. and fitted with two new carbons of the same grade, it was mounted in a motor operating in regular service, and after about three months of continuous service it was removed with its carbons and photographed as shown in the illustration. Measurements taken on both test carbons showed practically the same wearing depth on top of carbons and the same end wear.

A second test was made with a similar brush-holder on a different type of motor and the results obtained were the same as outlined above, which indicates that the extensions or ears on the contact tips do not reduce the wear on the top of carbons.

In view of the above findings, the following reasons might be advanced as a possible explanation of results obtained:

1. The wear on the top of the carbon may be due largely to burning action rather than mechanical wear.
2. The long tip is subject to more vibration with more arcing, hence more total wear.
3. The shorter tip has more direct pressure, thus less vibration and less total wear.
4. The shorter tip has greater pressure per unit, hence less arcing and total wear.

Severe Service Test for Welded Drawbridge Axle

IN THE AUG. 7, 1920, issue of *Electric Railway Journal* a description was given of the making of a thermit weld on a 6-in. diameter pinion shaft used for turning a large drawbridge in North Chelsea, Mass. Cars of the Eastern Massachusetts Street Railway are operated across this bridge and any long delay would mean a serious suspension of operation.

The accompanying illustration shows this shaft, which has broken again after two and one-half years



SHAFT BROKEN OUTSIDE OF PREVIOUS WELD

service. The break, however, was at a location considerably outside the previous weld which is shown in the illustration. An idea of the service test to which the weld has been subjected may be gained from the fact that the starting torque transmitted through this pinion shaft is 520,000 lb.

What's New from the Manufacturers

Side Bearing Trolley Wheel

THE accompanying illustration shows a new type of trolley wheel, which is being marketed by the Thornton Trolley Wheel Company, Inc., Ashland, Ky. Among the new features incorporated are side bearings and a grease lubricating system which is designed for service over an extended period without attention. A large contact spring is provided on either side of the wheel for conducting the current, and a large grease reservoir with a hole for filling forms the outside portion.



New York Subway Turnstile on the Market

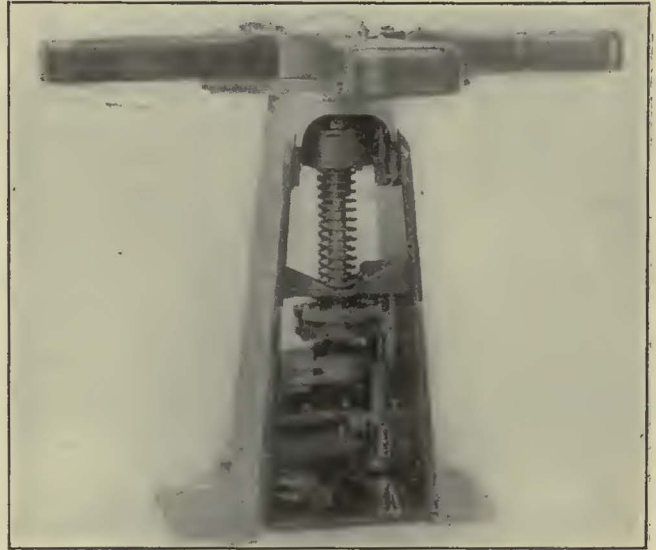
ONE of the features of the General Electric Company's exhibit at the recent American Electric Railway Association convention at Chicago was the new electrically operated turnstile developed for the Interborough Rapid Transit Company of New York City. The General Electric Company is now marketing this turnstile and 430 are being installed in the New York subway.

The complete equipment consists of two elements, the turnstile and the fare box. The latter is mounted near the guide rail to the right of the turnstile and contains electrical contacts, which, when closed by the dropping of the passenger's nickel, permit the turning of the stile enough to admit one person only and lock it in the reverse direction. The stile is, however, designed for free operation in the other direction, so as to permit the free egress of passengers.

On the shaft of the turnstile is mounted a double ratchet wheel with two pawls and below it a cylinder carrying four contact-making plates 90 deg. apart. One of the pawls controls the operation of the stile in the entrance, and the other in the exit direction. The pawls are mounted on a short common shaft, to which is attached the armature of a magnet coil supplied with current from contacts in the fare box.

When the stile is ready for operation one of the contact plates on the cylinder is under the fingers that complete the circuit to the relay coil of the fare box. The pawl which holds the stile from turning in the entrance direction is engaged with its ratchet, the other is free. When a nickel is dropped in the fare box it lands between two contacts, completing the circuit to the relay coil. The energizing of the relay completes the circuit of the magnet coil and its armature turns the shaft carrying the pawls enough to disengage the entrance direction pawl, leaving the stile free to operate in that direction when pushed by the incoming passenger, and to engage the exit pawl, locking the stile in that direction. When the stile has been rotated through 90 deg. by the incoming passenger the relay circuit is broken by the moving of the current carrying plates from under the fingers, the magnet

armature is released and the pawls return to their original positions. The relay coil in the fare box actuates a small lever that knocks the nickel away from between the contacts into the chute to the receiving box, thus breaking the contact in the box. Should a dime or a cent be dropped in the fare box by mistake, their smaller diameter permits them to drop free between the contacts into a chute that returns them to the passenger. A centering cam is located on the turn-



NEW YORK SUBWAY TURNSTILE

stile shaft which returns the cross arm to its normal off position, no matter what position it is left in. Stop pawls are provided which stop the cross arm momentarily every 90 deg., thus preventing the arm from spinning.

A special feature of the fare box is the provision for exposing slugs or foreign coins. Each nickel as it is dropped in the fare box is held before a magnifying lens, strongly lighted, which gives an illuminated image about twice the size of the nickel. The coin remains in that position until the next one is dropped. The enlarged coin is thus visible to a distance of 20 ft. and can be readily detected by the platform attendant.

New Air Brush for Paint Spraying

THE accompanying illustration shows a form of air brush for paint spraying which is being marketed by the Dayton Air Brush Company, Dayton, Ohio. It is constructed of aluminum and brass and weighs 21 oz. In size it is 6½ in. x 11¼ in. The brush, together with air hose, coupling, nozzle and aluminum container, constitutes the equipment necessary for connecting to the air line. Among the advantages claimed for this new brush is that it will handle material varying in weight from the lightest disinfectant to the heaviest lead and oil paints, without special preparation. It is self-cleaning and requires but a few seconds to change from one color to another.



NEW PAINT-SPRAYING BRUSH

Graphite Lubricated Trolley Wheel

A TROLLEY wheel and harp of new construction is now being marketed by the Dayton Manufacturing Company, Dayton, Ohio, under the trade name of the "Feist" self-lubricating trolley wheel. The bearing or axle of this wheel is made of a special grade of axle steel and is case hardened and ground. This enables worn wheels to be replaced with new ones on the same bearing.



Graphite Plugs

Three spring-compressed plugs of hard graphite are inserted in the bearing which keep the interior convex bearing surface of the wheel lubricated. The three bores or chambers containing the lubricant are preferably located at that side of the bearing opposite to the side where the wheel engages the trolley wire, thus avoiding a reduction in area of the bearing surfaces at the points where these surfaces receive the pressure from the trolley wheel. This provides a maximum contact surface for conducting the current from the trolley wheel to the axle.

The "Feist" trolley wheel harp is made of malleable iron, and is of split design, as shown in the accompanying illustration. At points where nuts or bolt heads project, protection is afforded by ribs formed on the outer sides. These serve to deflect the trolley wire past the bolt heads or nuts, should the trolley leave the wire.

SELF-LUBRICATING TROLLEY WHEEL AND HARP

New Lubricating Feature for Trolley Retriever



SPECIAL LUBRICATING FEATURE FOR TROLLEY RETRIEVER

THE accompanying illustration shows a new lubricating feature which forms the latest development of trolley retrievers manufactured by the Trolley Supply Company of Massillon, Ohio. An oil chamber is provided in the control portion with an opening to keep the axle lubricated. Oil is supplied to the reservoir through an opening with a

screw plug which effectively closes the oil hole in the reel and prevents any leakage. This design makes it unnecessary to dismantle the retriever or remove it from the car in order that it may be lubricated.

New Light-Weight Motor Developed

TO MEET the requirements of mass transportation with large light-weight double-truck cars and with safety cars heavier than the universal standard, a new light-weight motor has been developed by the Westinghouse Electric & Manufacturing Company. This

new motor, known as type 510-A, is of the box-frame, commutating-pole type of 35-hp. capacity. Improvements in construction of the shaft, bearing, housing, and brush-holder are embodied in this new development. The ventilation paths are of the very latest design and afford ample protection when the motor is mounted on small-wheel cars. The 510-A motor is especially suitable for replacing obsolete motors on single-truck or double-truck cars when changed from two-men to one-man operation.

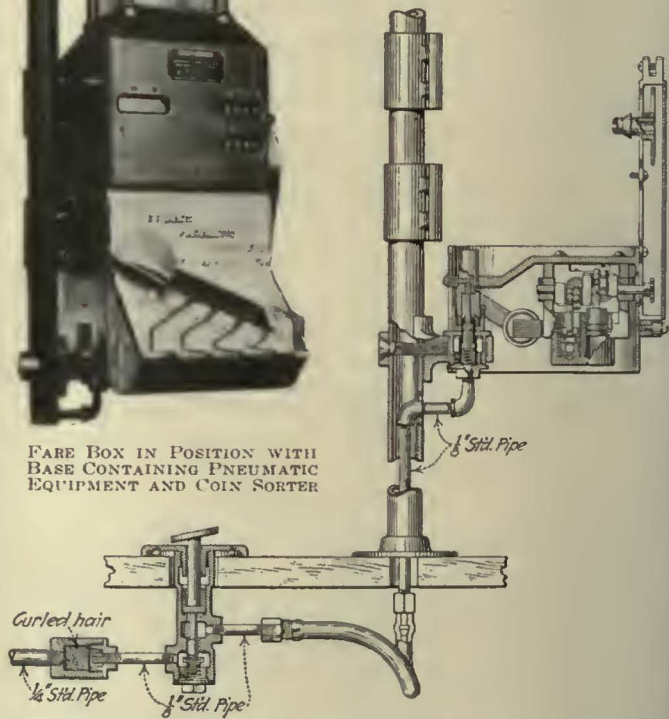
Pneumatic Operation of Fare Boxes

OPERATION of cars by one man has now reached such extensive proportions that considerable effort is being devoted to designing devices which will reduce the labor of the operator. The cranking of a fare box is one of the things which consumes considerable time at points where the operator's attention could be devoted more advantageously to operating the car. To

simplify this work the St. Louis Pneumatic Devices Company has brought out a pneumatically operated mechanism for registering and sorting fares.



FARE BOX IN POSITION WITH BASE CONTAINING PNEUMATIC EQUIPMENT AND COIN SORTER



PNEUMATIC OPERATING EQUIPMENT FOR FARE BOXES

The accompanying illustrations show this equipment. In service the operator presses downward on a pedal and the fares which have been passed by the inspection tray in the fare box are promptly registered in the same manner as is accomplished by hand. The operating mechanism is self-contained in a separate compartment at the bottom, and if the fare box is to be used without the pneumatic attachment it can be readily lifted off and the usual hand-lever operation can be restored without alteration.

The pneumatic equipment consists of the pedal which operates a pneumatic valve installed underneath the car floor or a raised portion of the vestibule if such is desired. The pneumatic valve admits air through a curled hair strainer directly from the air system of the car to

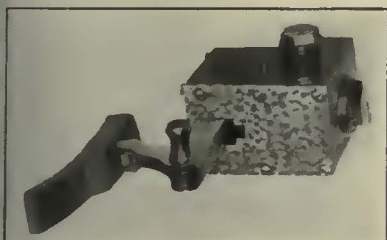
the operating mechanism at the bottom of the fare box. Connection is made through the stanchion which supports the fare box. The operating equipment consists of a small pneumatic motor which operates the fare registering mechanism through gearing and a chain belt.

A coin sorter has also been added as a part of this equipment. It can be attached to the fare box either in conjunction with or independent of the pneumatic device. As soon as the coins have been properly registered they drop into their respective pockets and can be removed without visual inspection. The use of these devices makes it possible to register and remove the coins without diverting the attention of the operator from the roadway. The car operator can perform this registration by using his foot either while receiving fares or after the car has been put in motion. The pneumatic method handles the fares more rapidly than can be done conveniently by hand, but the real time saving lies in the fact that pneumatic registration can be done with much less effort and coincident with other duties.

Automatic Bell Ringer and Controller Lock

ACCOMPANYING illustrations show equipment recently brought out by the National Safety Devices Company, Waterloo, Iowa, for automatically ringing the gong of an electric car as the car is started. The controller lock is 3½ in. x 6 in. in size and weighs 7 lb.

The apparatus is arranged for attachment to the standard type of controller. An air pipe connects the main casting of the controller lock with the air supply of the car and a second pipe runs from the casting to the bell-ringing



CONTROLLER LOCK OF BELL-RINGING DEVICE



CONTROLLER LOCK AND BELL-RINGING DEVICE APPLIED TO THE CONTROLLER OF A SAFETY CAR

device. When mounted the movement of the controller handle operates the lever of the lock, thus opening a valve which admits air to the bell-ringing equipment. A safety feature is also provided in that the equipment locks the controller handle in position so that it cannot be moved should the air pressure be insufficient to apply the brakes. The bell is rung during the first forward movement of the handle and further movement stops the ringing. A rocker arm attached to the operating lever permits the throwing off of the controller without moving the lever or ringing the bell.

Section Insulator with New Features

THE Ohio Brass Company, Mansfield, Ohio, has developed a new type section insulator, designated as type A-4. A rocker clamp is used for holding the trolley wire which has a cam action, so that as the trolley tension increases the hold on the clamp increases. The clamp is notched to grip the wire firmly and is attached by two bolts. All of the trolley tension



NEW SECTION INSULATOR

is carried in this insulator by two 1¼-in. wood strains in the same horizontal plane as the wire. This is done to prevent buckling of the beam. Pull-off eyes are also in the same plane as the wire, which prevents the tendency of the break to tip in case the strain is slack on one side.

The device is fitted with renewable .6-in. cam tips and a renewable runner piece. Feeder lugs are provided on each end casting. The insulator is usually direct suspended from the span, but the yoke casting may be removed and a standard insulated hanger substituted.

Letter to the Editors

Side Conduit in Brussels

SYRACUSE, N. Y., Dec. 5, 1922.

To the Editors:

On page 856 of the issue of the *Electric Railway Journal* for Nov. 25, 1922, mention is made of conduit track construction in Brussels, Belgium. This particular track construction, I believe, is unknown in American practice.

The accompanying illustration, a photograph taken this fall on one of the main streets in Brussels, plainly shows the location of the slot in the street.

The conduit is not located in the center of the track but on the side, adjoining the inside track rail. The slot is formed by one track rail and a slot rail, the



SIDE CONDUIT IN BRUSSELS

slot rail performing the function of the paving lip of the usual type of girder track rail. The plow is suspended from the side of the truck frame of the car. Two plows are used, suspended side by side. Only light single-truck cars, usually hauling one trailer, are used. This type of track construction does not permit of the use of cross-overs, but track loops must be used at the end of double-track car lines.

J. KAPPEYNE.

Mechanical Engineers Hold Annual Meeting in New York

Power Generation Was an Outstanding Topic, Stokers Being Exhaustively Considered—High-Pressure Steam, Feed-Water Heating, Boiler Baffling and Other Power-Plant Subjects Were Considered—The Relation of the Engineer to the Public Was Not Overlooked

THE forty-third annual meeting of the American Society of Mechanical Engineers, held in New York City, occupied the four days from Dec. 4 to 7. It was characterized by a number of joint sessions with other organizations, including the American Society of Safety Engineers, and by the evidences of great committee activity. Engineering economics was a topic stressed strongly, and the ideal relation of the engineer to the state was pictured. The leading editorial in the issue of this paper for Dec. 9 brought out some of the high spots in the presidential address of Dean Dexter S. Kimball, in which these features were outlined.

The meeting was attended by 1,200 registrants. While this was but about two-thirds the number in attendance last year, the lack of numbers was made up in efficiency and enthusiasm.

RESULTS OF ANNUAL ELECTION

Early in the meeting the tellers announced the result of the annual election, as follows: President, John L. Harrington, formerly of Waddell & Harrington, and now head of the firm of Harrington, Howard & Ash, consulting engineers, Kansas City, Mo.; vice-presidents, William H. Kenerson, Walter S. Finlay, Jr., Earl F. Scott and Henry H. Vaughan; managers, A. G. Christie, James H. Herron and Roy V. Wright; treasurer, W. H. Wiley.

Secretary Calvin W. Rice reported on his South American trip, during which he attended the International Engineering Congress at Rio de Janeiro, Brazil. He stated that V. L. Havens, editor of *Ingenieria Internacional*, who represented the American Electric Railway Engineering Association, had been elected secretary of the Congress.

STOKER IS COMPREHENSIVELY TREATED

One of the outstanding technical features of the meeting was the attention given to the grates and stokers of boiler furnaces. Papers were read on these subjects by a number of experts.

As to the modern chain grate, T. A. Marsh, Green Engineering Company, said that this type of grate is best for burning high-volatile, free-burning, high-ash clinkering coals. Maintenance cost is low and the auxiliary power requirements are small. Efforts to improve efficiency have been directed toward eliminating excess air and reducing furnace and ashpit losses. The forced-blast chain-grate stoker is adapted particularly for free-burning coals that require agitation of the fuel bed to prevent caking.

George I. Bouton, Murphy Iron Works, spoke regarding overfeed inclined stokers. These, he said, are of

two classes, side-feed, double-inclined, or V-type, and single-inclined. Those of the first type may have either a flush-front setting (for small boilers) or a Dutch oven setting. They are made with 1 sq.ft. of projected grate area for each 62.5 sq.ft. of heating surface in large boilers, and with 50 sq.ft. in small ones. The fuel bed is 8 to 10 in. thick at the upper end of the grates, thinning down gradually to the clinker grinder. Forced draft is sometimes added to this type of stoker where more than about 200 per cent of rating is desired. As high as 300 per cent can thus be secured.

The speaker referred to the well-known Roney stoker, as illustrating the second type, and also to the Wetzel stoker. The latter consists of bars extending from front to rear, the whole being given a peculiar rocking motion.

The underfeed stoker was covered in papers by H. F. Lawrence, American Engineering Company, and A. H. Blackburn, Underfeed Stoker Company of America. Both traced the development of this type. Mr. Lawrence said that it is particularly adapted for burning bituminous and semi-bituminous coals, and can be adapted for lignites and coke braize. It is quick to respond to load demands.

Automatic regulation was stated to be receiving much attention, but Mr. Lawrence said that probably no regulating apparatus would be developed that would obviate the necessity for occasional adjustment. Clinker adhesion to furnace side walls, one of the most serious operating difficulties encountered, has been largely obviated by the use of perforated firebrick blocks along the clinker line through which air is blown from the stoker air duct, by high-side tuyères, by cast-iron side-wall air boxes, or in some cases by the use of carborundum brick.

Mr. Blackburn traced the developments in stokers from the first Jukes patent in 1838 up to the present day. He covered underfeed single and multiple-retort stokers, underfeed lateral-retort stokers, overfeed inclined-grate stokers, and traveling and chain-grate stokers.

PIONEER INVENTOR HEARD FROM

The extemporaneous discussion on stokers was opened by W. R. Roney, inventor of the Roney stoker, who reviewed stoker history and emphasized the importance of the human element. The consensus of opinion was that the chain-grate stoker is best adapted for burning high-ash Western coal.

In connection with the operation of the chain-grate stokers, however, T. L. Mainz pointed out that among points to be watched is the amount of carbon

in the ash and trouble with the seal at the end of the stoker. He said that the best results could be obtained by having a uniform size of coal sent to the grate and that this was a part of the function of the coal-handling system. Another point he mentioned was that the boiler-room dirt must be eliminated when using forced draft under the chain-grate stoker. Further discussion brought out the fact that several types of the modern stoker had solved these problems successfully.

GETTING HIGHER EFFICIENCY OUT OF THE POWER PLANT

A number of papers were presented at a special power session of the convention. In these and the following discussion the interest centered in the utilization of more of the energy available in steam. An important paper was one by Geo. A. Orrok, consulting engineer, New York City, on the commercial economy of high pressures and temperatures. He concluded that as long as the present Rankine cycle is used in the developing of mechanical power from steam there can be little, if any, economic gain by increasing either pressure or temperature beyond present commercial limits. The conclusion is subject to modification in cases of changes in the relative cost of fuel and equipment. Under present conditions the chief hope of increased economy lies in perfecting details and obtaining a larger percentage of the theoretically available heat.

Mr. Orrok's conclusions were vigorously debated, one speaker pointing out that the question of a small thermal saving is not nearly so important as low first cost, simplicity and absolute reliability. Opinion was divided as to the practicability of providing fittings for high pressures and temperatures, although in general it appears that this is possible for values within the present range of practicability.

FEED WATER HEATING FOR HIGH EFFICIENCY

A paper on the economics of feed heating, based on a 25,000-kw. plant, was presented by Linn Holander, Westinghouse Electric & Manufacturing Company. He investigated conditions using single-stage and multiple-stage condensate heaters, both with and without economizers, and treated the subject from the thermal standpoint only.

For power plants using single and multiple stage heaters of the condenser type, the temperature of the boiler-feed water as it leaves the heater should not be less than 150 deg. F. when using economizers and not more than 260 deg. F. when not using economizers. Heat balances showed that when using single-stage heating and no economizers better results were obtained from heating the feed water by combining steam from the house turbine and that bled from the main unit than when using the steam from a house turbine alone. Double-stage heating with no economizers also

showed better thermal efficiencies when using a larger amount of steam from the main unit than from the house turbine.

Practically the only adverse criticism made by those who discussed the paper was that perhaps too much attention had been paid to the house turbine, the opinion being that the house turbine as an important factor in power-plant economy would soon generally be replaced by bleeding of the main units. F. Hodgkinson, Westinghouse company, said that the only excuse for the house turbine is to secure reliability of auxiliary power, which can be obtained in other ways. Practically all large turbines are now designed to permit of bleeding, a common plan being to allow four connections, 140 deg. F., 200 deg. F., 50 lb. absolute pressure and 120 lb. absolute pressure.

RESULTS OF EXTENDED BOILER TESTS WERE GIVEN

One of the striking papers presented was by Paul W. Thompson, Detroit Edison Company, on boiler tests at the Connors Creek plant, aggregating fifty in number and involving four grades of coal and four arrangements of baffling.

As a result of these tests seventeen of the large boilers have been rebaffled with considerable improvement in efficiency and degree of superheat, and the Babcock & Wilcox Company has developed a new design of this type of boiler. The baffling arrangement selected exposed two layers of tubes to the radiant heat of the furnace and allowed the gases to cross the inner bank of tubes at the top, pass the superheaters and then return along the outer bank of tubes to the stack. With this arrangement an average increase of 50 deg. F. in superheat was obtained, the flue-gas temperature was reduced 70 deg. and the draft was reduced 38 per cent.

Discussion of the paper showed appreciation of such careful work as was reported.

THE PROBLEM OF ASH HANDLING

An elaborate paper on this subject was presented by John Hunter and Alfred Cotton, St. Louis, Mo. It covered all phases of ash handling and forms a treatise in this field. The discussion brought out the fact that, while water and fuel-handling problems of the power plant have been satisfactorily solved, those of ash handling are difficult and elusive. The quantities to be handled are apt to vary widely and the disposal of ashes often is difficult. Continuous quenching by spraying was advocated and also the frequent replacing of worn metal in conveyors rather than the attempt to prevent wear.

RAILWAY-MOTOR PINION TOOTH STRESSES VISUALIZED

Electric railway equipment men will find interesting information regarding gear-tooth stresses in a paper presented

by Dr. Paul Heymans, of the faculty of the Massachusetts Institute of Technology, and A. L. Kimball, General Electric Company. They applied what is known as the photo-elastic method for their purpose, that is they subjected celluloid models of the teeth to stress and passed polarized light through them. The deformation produced by the stress was thus made visible. In the paper photographs in colors were given, as well as diagrams worked out on a quantitative basis. They emphasized the value of this method as compared with ordinary engineering analysis.

The authors studied the effects both of inside radial pressure, such as is due to driving or shrinking a pinion on the shaft, and of applied torque load. They checked their scientific analysis by tests on actual pinions and upon steel rings forced on a tapered plug. Their tests showed that the gear pinion is weaker than the plain circular ring whose outside diameter is equal to the root diameter of the tooth. Gears, they say, fail due either to (1) poor design; (2) excessive load, or

(3) excessive radial pressure due to procedure in mounting on the axle.

VOCATIONAL TRAINING VIGOROUSLY DISCUSSED

A report was presented by the A.S.M.E. committee on education and training for the industries which was the subject of lively discussion. The report and discussion were summarized at the close by President Ira N. Hollis of Worcester Polytechnic Institute. He said that the tendency today is not to educate for menial positions, but to train for the best citizenship. An education must train men, first, to make a living, and second, to use their spare time for advancement, intellectual as well as professional. He deplored the desire on the part of many colleges to create an "intellectual aristocracy," to limit the number of college students to the future leaders. Who knows, he said, who the future leaders are to be?

In the discussion the value and relative fields for apprentice training, correspondence and extension courses, etc., were thoroughly covered.

Live Railway Topics Practically Discussed

At a Well-Attended Meeting of the Eastern Section of the Engineering Council of the Central Electric Railway Association, Equipment and Other Technical Problems Were Discussed Frankly and Fully

THE November meeting of the eastern section of the engineering council, Central Electric Railway Association, was held at the Hotel Windsor, Wheeling, W. Va., on Nov. 14. Forty members and railway specialty men were in attendance. L. E. Earlywine, secretary of the association, had issued questionnaires which formed the basis for discussion. The same questions will be discussed by other sections, and the entire council has been asked to send replies to the association office at Indianapolis, where they will be tabulated and distributed to the members. The questions, together with a summary of the discussion which occurred at Wheeling, are given below:

What is the effect on motor and gear maintenance of too much wear on body and collar of axle bearing? (a) What is permissible wear on the body of axle bearings? (b) What is permissible wear on collar of axle bearings?

In a lively discussion of these questions it was brought out that excessive wear on the collars or flanges of axle bearings permits the motor to lunge from side to side as the car hits sharp curves or sways from side to side. This aggravates the condition, causes the armature to pound its bearings, and results in sparking at the commutator. It permits misalignment of the gear and pinion faces and results in more rapid and uneven wear of both. This wear causes the tooth loading to be thrown upon the tips of the teeth, resulting in tooth breakage if allowed to continue for any length of time. The following allowances were given by some of the members: C. W. Folwell,

$\frac{1}{8}$ in.; Daniel Durie, $\frac{1}{8}$ in.; F. C. Martin, $\frac{1}{8}$ in. on shaft or $\frac{1}{4}$ in. on collar; A. B. Creelman, $\frac{1}{8}$ in. F. W. Hickling, Westinghouse Company, stated that good practice places the maximum allowable wear on the body of axle bearing at $\frac{1}{32}$ in. With new bearings it should not exceed 0.012 in. as the bearings go into service. The amount of wear on axle bearing flanges is not so vital if the wear is taken up by means of the axle collar. The clearance permitted should not exceed $\frac{1}{16}$ in. With new bearings this should not exceed $\frac{1}{32}$ in. upon going into service.

There appears to have been but little improvement in gear case design for twenty years. What suggestions for improvement in design are recommended?

Mr. Hickling stated that gear cases have been materially improved, both with respect to the pan and the end support. Since the advent of the pressed pan, the principal improvements have been in the supports. The development along this line is in the direction of making a support strong enough to meet severe service conditions. The discussion further brought out the fact that supports were continually breaking and appear not to be heavy enough. Also heavy cases appear to break supports, due to vibration, more than do light sheet steel cases.

What are the advantages, if any, in the use of overhead ground wire for high-voltage transmission lines? (a) What kind of wire is used? (b) How installed? (c) Method of grounding.

Mr. Hickling said that briefly summarized the records of his experience

with overhead ground wires show the following:

1. Overhead ground wires do afford a certain protection to insulators. Quantitatively, however, the extent and value of this protection are uncertain.

2. Overhead ground wires do not afford any appreciable protection to wood poles in addition to that afforded by individual grounding wires on each pole (except possibly in regions where grounding conditions are exceptionally poor).

3. There is evidence that overhead ground wires do afford protection to station apparatus. The preponderance of evidence indicates, however, that the amount and value of this protection are not material.

4. It is not definitely known whether overhead ground wires tend to reduce disturbances which result in interruption to service without occasioning damage to lines or equipment.

5. Overhead ground wires tend to give better relaying conditions on systems with a grounded neutral. Their value in this respect will depend upon type of relays employed, individual ground conditions and other local conditions.

6. Overhead ground wires add to the longitudinal stiffness of transmission line structures when attached directly to the structure, and to a small extent when carried on a bayonet or crossarm. The extra wire, however, increases the wind and ice loading on the line.

Discussion brought out the fact that stranded steel wire is generally used, its size being fixed by mechanical considerations because the size of the ground wire has very little effect on the capacity to the line wires. On wooden pole lines some companies carry the wire on insulators and others do not. On steel tower lines the wire should be grounded at every tower. On wooden pole lines the general practice is to ground at every fourth or fifth pole.

What effect, if any, does fast controller feeding have on equipment?

The discussion showed as follows:

Effects are most noticeable in city service where frequent stops occur with close headway of cars. Generally, too rapid notching causes more equipment failures and increased maintenance cost. Also, on small railway systems wide fluctuations occur in line voltage and in substation loading.

On short runs, fast controller feeding frequently is one cause of overheating of motors. The tendency of some motors to flash is also increased because the motor is saturated magnetically from the high accelerating current while the rapid notching imposes sudden and wide voltage variations in the motor. Excessive heating dries out insulation, thus producing loose bands and windings. The excessive accelerating currents set up magnetic stresses which produce severe mechanical strains in the windings and sometimes cause broken armature leads.

Gears and pinions are subjected to

severe shocks because of the rapid and wide variations in the tractive effort. Controllers wear out contacts and fingers unduly because of the excessive currents handled. Circuit breaker operation is more frequent. Large drafts of power from the line may reduce line voltage too low for satisfactory operation of multiple-unit equipment. Flickering of car lights becomes a source of annoyance to passengers.

What is the best practice for making emergency stops to avoid accidents?

The general opinion seemed to be that the length of stop depends on the condition of the rail and the best judgment of motorman. On dry rail sand should be dropped and brakes applied to emergency. On wet rail sand should be dropped and air used with judgment and if necessary current should be applied to keep wheels moving to prevent sliding.

It was agreed that reversing a car has some effect on a jury verdict, in serious accident cases; that reversing might do at very low speed and, if reversing is necessary, the reverse handle and not the power handle, should be used.

What is the most economic size and shape of trolley wire: (a) for city cars; (b) for interurban cars?

The discussion indicated that No. 00 round is most universally used, with the exception of some of the larger cities. Chicago uses No. 000 round and Philadelphia both No. 00 and No. 0000 round. The No. 00 round wire is easier to install because of less load on cross bands. This is of considerable importance where there are wide streets and steel poles are used without back-guys.

Mr. Hickling said that Westinghouse engineers believed that for interurban lines the No. 0000 grooved trolley wire is the best. Interurban work is mostly high speed, and with the grooved trolley wire a smooth under-run is obtained. This results in the elimination of sparking at the trolley ears and also reduces maintenance as with round trolley wire and drawing heavy currents, the trolley ears would need to be frequently renewed.

Should track bonding be installed and maintained by track or overhead departments?

There was considerable difference in opinions which included line and track departments and a special engineering department to take charge of this.

What effect has bad track in the upkeep of equipment?

A lively discussion took place on this subject as to the damage to equipment. The cost of upkeep varies in some proportion to the condition of the track. Probably 80 or 90 per cent of the maintenance cost on motors is due to troubles resulting from vibrations. One source of these vibrations is bad track, which tends to hammer at the bearings and gears and set up vibration of the brushes, which is a common cause of flashing. It is due to the prevalence of bad track that railway motors have to be made as rugged as they are.

On motors mechanical troubles predominate, and the bearings suffer the most. Brushes come next, and loosening of windings and covers last. Flashing may occur by the bouncing of brushes, or broken windings occur from the extreme poundings. Controllers of the drum type are not affected to great extent. Remote control relays and some types of contactors may be bounced shut or open, thus giving false operation. Riveted and bolted joints frequently open. Undue strains may be thrown on the supports, air piping or on the apparatus frames, thus causing breakages and delays in service.

The effect of bad track upon the upkeep of equipment might be compared to a leak in a steam or air line. It rapidly goes from bad to worse, and an expensive luxury. The continuous poundings vertically and laterally cause general deterioration of all equipment both electrical and mechanical. It tends to loosen all bolted and riveted parts, causes brush and brushholder chattering; produces sparking and flashing of commutator; breaks off the leads both on the armature and on stationary parts of the motor, and adds severe strains to the gear and the bearings. It causes rapid wear of trolley parts and increases the breakage of overhead structures.

A. B. Wilson, sales manager of the Copper Products Forging Company of Cleveland, presented to the meeting the features of the "Cleveland" all copper trolley wheel, and L. E. Gould, president of the Economy Electric Device Company, explained the new aluminum fields for railway motors.

After the meeting adjourned a trip was made by special car to the Windsor power plant of the West Penn Railway at Beach Bottom, where interesting features of the large power station were observed.

The New York Railroad Club Celebrates Fiftieth Anniversary

THE dinner this year of the New York Railroad Club took the form of a golden jubilee, as the club was organized in 1872. About 2,300 members and guests were present at the banquet which was held at the Hotel Commodore on Dec. 12. H. H. Vreeland, Interborough Rapid Transit Company, was toastmaster, and the principal addresses were given by John J. Cornwall, ex-Governor of West Virginia and general counsel of the B. & O. R.R., and George A. Post, chairman railroad committee Chamber of Commerce, U. S. A.

New England Street Railway Club

THE December meeting of the New England Street Railway Club was held in Boston last Thursday. The afternoon meeting was at the Engineers' Club and was addressed by Joseph C. McCune, Westinghouse Air Brake Company, on recent developments in air brakes for electric cars.

The evening meeting was at the Copley Plaza, and W. L. Underwood of the M.I.T. gave an illustrated lecture on hunting big game with a camera in New Brunswick.

Meeting of Committee of One Hundred

THE Committee of One Hundred, which was organized in 1919 shortly prior to the Federal Electric Railways Commission hearings to give currency to electric railway facts, held a meeting at the Railroad Club in New York on Tuesday, Dec. 12, and decided to continue its existence indefinitely and broaden the scope of its work. About twenty-five members of the committee were present and after a report from Gen. Guy E. Tripp, chairman of the committee, was presented, the plan for continuing the work of the committee was unanimously approved.

General Tripp's report showed that since the establishment of the advertising section at association headquarters on Jan. 1, 1920, much information of a constructive character has been cleared to the press and electric railway companies and other channels of advertising and publicity. The good results obtained have been attributable in great measure to the determination of the committee not to make a mere "press agent" service of its information department but to render a real information service to all who desire facts about electric railways. The greatest care has been taken, it was emphasized, to tell the whole truth in each situation and to avoid coloring statements either to the benefit of electric railways or the detriment of their opponents.

Among those who discussed the committee's work, after General Tripp had read his report, were C. D. Emmons, P. H. Gadsden, Barron Collier, F. R. Coates, G. E. Hardy, J. N. Shannahan, J. H. Pardee, J. K. Newman, J. G. White, L. S. Storrs, Thomas N. McCarter, S. Z. Mitchell, O. D. Young and Secretary J. W. Welsh of the association.

All the speakers emphasized the importance of General Tripp and Henry R. Hayes remaining at the head of the work as chairman and secretary of the committee respectively and also of retaining as many members of the committee as possible regardless of whether they were actively engaged in the electric railway business or were in affiliated lines. Several speakers, particularly Messrs. Gadsden and Pardee, paid tribute to the actual handling of the advertising and informational work of the committee. This is carried on by Labert St. Clair, of the Barron G. Collier, Inc., staff, who handled the news of the Federal Electric Railways Commission hearings. Mr. Collier also makes available, without charge to the committee, the service of his entire art and copy departments.

General Tripp's report also told of how information was made available to magazines, the press, public speakers and others, and then summarized the

other work of the committee operating through the Advertising Section as follows:

Preparation of booklets, posters, suggested newspaper advertisements and similar advertising material dealing with current situations and forwarding this matter regularly to all electric railway companies in the United States.

Giving counsel and suggestion for special campaigns, when requested by individual companies.

Co-operating with the committee on co-operation of manufacturers by preparing good will electric railway advertising literature and disseminating it through these companies.

Issuing monthly a bulletin publication called "Truth" containing from six to fifteen news items, editorial comment or other material of general interest which may be used in house organs, speeches, interviews and in other ways. This bulletin is distributed to the number of 3,000 copies monthly.

Co-operating with the twenty-five state committees on public utility information, supplying them with regular informational material and rendering special service to meet their local situations.

Co-operating with the National Elec-

tric Light Association, American Gas Association and other public utility organizations, as well as the Investment Bankers' Association and other national organizations interested in the welfare of public utilities in the dissemination of facts.

Conducting an Advertising Section in *Aera*, the American Electric Railway Association monthly magazine, giving suggestions for bettering public relations and illustrating the articles with advertising material gleaned from the field:

Henry R. Hayes read a financial report showing that the work of the committee has been financed by voluntary subscriptions to date, and it was decided to continue to meet the expenses of the committee by this method.

Those present were: Messrs. G. E. Tripp, J. K. Choate, J. N. Shannahan, E. E. Quantrell, E. W. Sanderson, Frank Silliman, J. H. Pardee, C. M. Clark, G. E. Hardy, S. M. Curwen, P. H. Gadsden, H. V. Bozell, J. W. Colton, F. R. Coates, Barron Collier, C. D. Emmons, R. P. Stevens, O. D. Young, H. R. Hayes, J. G. White, L. S. Storrs, T. N. McCarter, S. Z. Mitchell, H. H. Westinghouse, J. K. Newman, J. W. Welsh and Labert St. Clair.

American Association News

Power Distribution Work Laid Out

THE two-day meeting of the Engineering Association committee on power distribution, held Dec. 11 and 12, was a miniature convention in itself. Seventeen of the twenty-two members were present, besides several guests, and one absentee was represented by deputy. Chairman M. B. Rosevear announced the composition of the sub-committees as follows:

1. *Specifications for catenary construction*—C. H. Jones, chairman; R. L. Allen, S. H. Anderson, L. W. Birch, H. M. Hobart, John Leisenring, W. Schaake.

2 and 4. *Trolley-wire wear and specifications*—H. S. Murphy, chairman; J. W. Allen, H. G. Burd, L. E. Delf, L. F. Griffith, H. D. Hawks, A. Hughes, Jr., H. A. Pharo.

3. *Pole reclamation*—L. F. Griffith, chairman; S. H. Anderson, James Scott.

5. *Inductive co-ordination*—John Leisenring, chairman; D. D. Ewing, H. A. Pharo, A. Schlesinger.

6. *Temporary connections to trolley wire*—L. E. Delf, chairman; L. W. Birch, James Scott.

7. *Overhead construction for trackless trolley*—F. McVittie, chairman; L. W. Birch, H. M. Hobart, W. Schaake.

8. *Review of existing specifications and recommendations to A. E. S. C.*—A. Hughes, Jr., chairman; R. W. Eaton, H. M. Hobart, F. J. White.

Next C. H. Jones was appointed vice-chairman of the committee, after which reports were submitted by representatives of the association on the A. E. S. C. sectional committees. A letter from S. L. Foster containing many practical suggestions was read and discussed. The several sub-committee assignments were then taken up with the following general results: No. 1, Not discussed. Nos. 2 and 4, Subject will be covered under two heads; trolley wire wear by the whole sub-committee, and preparation of specifications by Messrs. Murphy, Burd and Hughes. These three men will co-operate with the A. S. T. M. No. 3, It was suggested that cleaning and treating of poles in service be studied and cost data gathered, for publication, on the whole subject of pole reclamation. No. 5, The discussion on this subject brought out the desirability of co-operation with other organizations as opportunity offers. No. 6, Data on this subject will be collected with a view to suggesting the best present and possible practises. No. 7, The sub-committee was given a free hand to gather and analyze information with a view to presenting the high spots in present practice. No. 8, The sub-committee will not only review existing standards but will suggest those which should be submitted to the American Engineers Standards Committee.

On the second day of the meeting the several sub-committees met and made substantial progress in planning the season's work.

News of the Electric Railways

FINANCIAL AND CORPORATE :: TRAFFIC AND TRANSPORTATION
PERSONAL MENTION

Commission Appointed

Last Act of Mayor Couzens Outlines Plan for Municipal Operation— Will Serve as Adviser

The last official action of Mayor James Couzens with respect to the street railway question in Detroit before resigning to become United States Senator was to appoint four of the five men who are to make up a special commission to study Detroit's rapid transit situation. This rapid transit commission was authorized about two months ago, when the City Council also authorized the appropriation of \$50,000 to carry on the work.

MR. WALDRON CHAIRMAN

The former Mayor outlined the general plan of operation for the rapid transit commission and stated that in his belief a practicable solution of the city's needs should be submitted to the voters by April, 1924. The recommendations of Mr. Couzens on the appointment of the commission were accepted by the Council, and four of the five men named have agreed to serve. The fifth member of the committee is to be appointed by acting Mayor John C. Lodge.

The men named are: Sidney D. Waldron, former vice-president of the Packard Motor Car Company, chairman; Willard Pope, civil engineer; H. W. Alden, vice-president of the Timken Detroit Axle Company, and C. W. Hubbell, former city engineer of the city of Detroit.

In outlining the work the commission will have to do, the Mayor pointed out that that body will have in mind the discussed Metropolitan district, the possible Detroit-Windsor bridge and the need for more rapid interurban service such as the commuting service around New York, Chicago and Philadelphia. All citizens with constructive ideas will be welcome to appear before the commission or to send in their ideas to it.

BUDGET SCHEME PROPOSED

The Mayor stated that it was his understanding that the commission will prepare a budget for prompt submission to the Council, and that expenditures are to be approved by the Mayor and city controller before submission to the Council for payment. The commission will serve without pay.

Mr. Couzens on Dec. 5 resigned as Mayor of Detroit and as acting general manager of the Department of Street Railways, having been informed by the corporation counsel that the offices of Mayor of Detroit and United States Senator were incompatible.

At the conclusion of the Mayor's last meeting with the street railway com-

mission, a statement was issued by Ross Schram, assistant general manager of the Detroit Municipal Street Railway system, to the effect that there will be no changes in the management or policies of the department of street railways, which the members of the commission are satisfied is efficiently organized and operated now.

The commissioners, after conference, decided to accede to Mr. Couzens' request that he be not asked to assume the duties of general manager, but wish to avail themselves of his offer to serve in an advisory capacity, so that they may have the benefit of his ideas, knowledge and experience.

There is no intention of appointing a general manager, pending the return of Joseph S. Goodwin, now on sick leave. In the meantime the necessary duties will be divided among the commissioners.

Agreement Renewed—Proposals Accepted

At a referendum taken on Dec. 6 the trolley men's unions voted to accept the proposals made to them by the Springfield, Worcester Consolidated, Milford, Attleboro & Woonsocket, Interstate Consolidated and Attleboro Branch Railways for the renewal of the working agreement which will expire on Dec. 31. The general terms governing wages are to remain as in operation since March 1 last under the Storrow award. There are several minor changes affecting wages and working conditions.

The arrangement of a seven-hour guarantee in a fourteen-hour spread has been changed to make the outside time twelve hours instead of fourteen. An hour's time will be allowed hereafter to spare men reporting for duty but not sent out, or whose starting may be delayed for that period. Time and a quarter is to be paid for the thirteenth hour or fraction thereof and time and a half thereafter.

Men on schedule runs of seven and a half to nine hours are to receive nine hours pay. The minimum at present is eight hours.

A rearrangement has been made governing method of payment for late-in-time, computations to be made separately for each day, instead of being taken collectively at the end of the week, putting Springfield and Worcester on the same basis.

Maximum rates for blue uniform men which are to be continued for one year by the vote thus taken are 58 cents an hour on the Springfield and Worcester systems, 53 cents on the Milford, Attleboro & Woonsocket, and 56 cents on the Interstate Consolidated and Attleboro Branch roads.

Decision Reversed

Circuit Court of Appeals Rules Seattle Is Not Compelled to Use General Fund for Railway Operation

Seattle taxpayers have won another victory in their fight to protect the general tax fund of the city from invasion as a means of meeting the cost of operation and maintenance of the Seattle (Wash.) Municipal Railway. The United States Circuit Court of Appeals has reversed the decision of Federal Judge E. E. Cushman, in the suit brought by the Puget Sound Power & Light Company to put the tax fund behind the \$15,000,000 of railway purchase bonds. This is the decision which the city has been awaiting before taking action on the 5-cent fare on city cars. The decision reversing Judge Cushman was filed by the Circuit Court in San Francisco, and the case was sent back to the District Court in Seattle for dismissal.

Judge Cushman's decision, which has been reversed, held that the city must draw from the general tax funds, or any other available fund, in event the revenues of the railway at any time become insufficient to pay the cost of operating the street cars, after payment of bond interest and principal. The reversal of this decree has the effect of holding that the city is not compelled to invade the general fund for the purpose of operating the railway, if the revenue ever becomes insufficient for that purpose. The holding is similar to that of the State Supreme Court in the "fourteen taxpayers" suit, in which the state court held that the general tax fund cannot be invaded for support of the railway.

Telegraphic notice received in Seattle by attorneys in the fourteen taxpayers case, announcing the decision, said the federal suit had been remanded to the lower court for dismissal "without prejudice to any right the power company may hereafter have for future breaches of ordinances or bonds."

JUDGE CUSHMAN OVER-RULED

This decision also removes Judge Cushman's jurisdiction over the railway system, which he assumed in the decree which has been reversed, to enforce specific performance of the terms of the contract under which the railway was purchased from Stone & Webster.

The Circuit Court finding held that the Cushman decision was unnecessary because the railway is paying expenses out of its revenues, and that the municipal officers of Seattle had acted within their rights in effecting a transfer from the general fund for the purpose of investigating charges that the city had been defrauded in the purchase of the system. The passage of the enabling ordinance to make effective the terms

of the bond contract the court also found to be fully sustained by law, and not subject to attack because it was passed by the City Council, and not by the electorate as a whole.

One of the provisions of the Cushman decree which had a bearing on street car fare was that under which the Federal Court retained jurisdiction of the case, and under which the power company was given the right to call the city into court on twenty days notice in event any steps were taken in conflict with the interests of the power company. As this provision has been stricken out by the Circuit Court's decision, attorneys point out, the jurisdiction of the court has been removed, and the company would have to begin new litigation, in event it considered its efforts were being jeopardized.

James B. Howe, attorney for Stone & Webster interests, who brought the specific performance suit in the Federal Court, states that he is not prepared to say whether the case will be appealed to the United States Supreme Court until he has seen the decision of the Circuit Court.

Mayor B. J. Brown and City Councilmen predict that with the favorable court decision, early adoption of a 5-cent fare on the lines of the Seattle Municipal Railway will be possible. However, it is agreed that no change would be politic before Feb. 1.

Numerous suggestions for reducing fare in the city have been offered by Councilmen and railway officials, but to date no agreement has been reached. The suggestion of Councilman John E. Carroll that the weekly pass system be tried has not met with the approval of the Council, and the suggestion has been permanently tabled.

The Council is now considering a report of Superintendent of Public Utilities George F. Russell, requested by Councilman Erickson, which indicates that there will be a monthly operating loss of from \$70,000 to \$200,000 from the various fare reduction plans. The report did not take into consideration a probable increase of 13 per cent in business of the railway, which the utilities chief said might result from the reduced fare. For the various proposed plans, his report indicates the following estimated operating losses:

Five-cent fare, with 1½-cent transfers (Mayor Brown's plan); net operating loss of \$129,227, and including the \$70,250 monthly allotment for redemption of bonds, a loss of \$199,477 a month.

Five-cent fare, with free transfers, net operating loss of \$146,880, with bond redemption, \$217,130 monthly; 5-cent fare with 2-cent transfers, total operating loss of \$188,825 a month; 6½-cent fare with free transfers, total operating loss \$142,961; 6½-cent fare with 1-cent transfers, total operating loss \$128,759; 6½-cent fare with no transfers, a net operating gain of \$16,055, but a total operating loss, counting bond redemption of \$54,195; 5-cent fare, and no transfers, net operating loss of \$75,967, and with bond redemption, \$146,217 a month.

Superintendent Russell pointed out that under the present 8½-cent fare, counting the \$57,000 depreciation charge (a mere book account, for which only \$20,000 is actually set aside) there is an average monthly fictitious operating loss of \$12,101.

In ten months of 1922, Superintendent Russell said, the expenses of the Municipal Railway were decreased \$405,491 as compared with the corresponding period in 1921, a decrease of 10.91 per cent. The decrease in expense next year, he predicted, will be even greater than this.

Franchise Awarded

San Diego Railway Pays One Hundred Dollars for Privilege of Building Cross-Town Line

The franchise for the cross-town line on Sixteenth Street, San Diego, was formally awarded to the San Diego Electric Railway by the City Council on Dec. 4, after a stormy fight, which was finally decided by the issue being submitted to the people at a special election on Oct. 10, and at which election the company won its point, the electors approving the franchise by a small majority.

The company first made application to the City Council for the franchise in April, 1922, stating that the cutoff was necessary to facilitate reconstruction work then under way, and also for rerouting of cars to meet the needs of the growing city. The granting of the franchise was opposed by an association of merchants with establishments located on lower Fifth Street and Market Street, who asserted that if the franchise were granted the company would so reroute its cars as to kill their section of the city as a retail district. The Council heeded the merchants and refused to grant the franchise. The company renewed its application in July, having procured the approval of its plans by the State Railroad Commission, but again the Council listened to the merchants' association and refused the franchise. The company then took the fight to the people, circulating petitions, and secured the necessary signers to a petition calling a referendum election on the question, and at the election the people approved the franchise.

Opponents of the franchise then took the fight to the Superior Court, asking that the City Council be enjoined from granting the franchise as voted by the people, claiming that the election was not authorized under the city charter, that franchises were not a subject for referendum elections and that the power of granting franchises rested solely with the City Council. A temporary injunction was granted, but at the hearing attorneys for the plaintiff, the city and the railway company being heard, the court dissolved the injunction. The plaintiff gave notice of appeal.

The franchise was then put on the City Council's calendar for action on Dec. 4. Early that morning the attorney for the opponents of the franchise again applied for an injunction on the ground that the franchise should not be granted while the question of validity of the election was on appeal, but the court denied the application

without even asking for argument, stating that the court could not see where any irreparable injury was threatened. The claim of the merchants that their business would be adversely affected by rerouting of cars, the court said, was not well founded, as no one could foresee what the results of the rerouting would be.

The Council then sold the franchise to the San Diego Electric Railway for \$100, it being the only bidder. The general terms of the franchise are the same as those of the general franchise held by the company.

Claus Spreckels, general manager, announced that construction of the Sixteenth Street line would begin as soon as the material could be assembled, which will be in about two weeks. The work will be done according to the new standard adopted by the company—twin-steel ties, 100-lb. rails, all electric welded and embedded in 14 in. of concrete. It will be necessary to build four blocks of double-track line on Sixteenth Street to connect existing lines, or the equivalent of a little more than one-half mile of single-track.

It is estimated that the company will save \$10,000 a year in car mileage to and from the carhouse at Fifteenth and L Streets through use of this new line. National City and Chula Vista cars also will be routed over the new line, and probably the Logan Avenue line, leaving the Imperial Avenue and Market Street lines to serve lower Fifth Street.

Council Adopts Agreement—People Will Vote in January

The City Council of Ottawa, Canada, by a vote of eighteen to three, on Dec. 8 adopted the report of the civic street railway committee which provides for submission to the voters questions affecting the operation of the Ottawa Electric Railway. The proposed franchise agreement, including Robert M. Feustel's recommendations for extensions, was referred to in the *Electric Railway Journal*, issue of Nov. 25.

The questions on which the people will vote are whether the city shall sign an agreement for a new franchise allowing a flexible rate of fare and a guaranteed return of 7½ per cent to the company on \$4,500,000, and on \$500,000 to the city, which is the city's equity in the road, or whether the city shall buy out the Ottawa Electric Railway Company, its property and assets for \$4,500,000, and have it operated by an independent commission. This commission, it was explained, would consist of three members, who would be appointed by the City Council.

The Council also passed a motion authorizing the city solicitor to have a synopsis of the agreement prepared for publication three times in each of the three daily newspapers.

The present agreement does not expire till August of 1923, but in the event of the new agreement being approved the company is willing to date the agreement from January and start at once on the extensions.

Commission Holds Hearing on Extension Application

Permission to construct an extension of its Monrovia-Glendora line easterly 4 miles to connect with its San Bernardino line at San Dimas Junction, along with the necessary permits to cross twenty streets and the tracks of two different steam road lines at grade in and near Glendora, Calif., was asked on Dec. 6 by the Pacific Electric Railway at a hearing held before Examiner W. R. Williams and engineers of the State Railroad Commission at Glendora. When this line is completed, this cutoff will enable persons living at Glendora, or between that city and Los Angeles, to travel east to San Dimas Junction and other points on the company's lines in that territory without coming to Los Angeles and going out on a parallel line as has been necessary in the past. It also will make it possible for persons living at San Dimas and points east thereof to go to Glendora and other near-by points, including Mount Lowe, without coming first to Los Angeles. The railroads which the company asks permission to cross are the Atchison, Topeka & Santa Fé and the Southern Pacific.

Vote Down Renewal Franchise

The renewal of the franchise of the Rockford-Interurban Railway, a subsidiary of the Commonwealth Power, Railway & Light Company, was voted down at a special election in Rockford by a vote of 7,300 to 4,100. The City Council had previously voted for renewing the franchise, over the Mayor's veto.

The franchise expires in October, 1923. The terms of the new franchise grant were referred to in the *Electric Railway Journal*, in the issue of Oct. 21, 1922.

Construction Awaits Amicable Settlement of Differences

The County Board of Revenue of Jefferson County, Birmingham, has threatened to withdraw \$450,000 set aside for street construction within the city limits, unless the City Commissioners and the Birmingham Railway, Light & Power Company can get together on their long standing controversy as regards the right-of-way over certain streets of the city.

For some months it has been planned by the County Board of Revenue and the City Commissioners to pave certain streets leading from the center of the city, in conjunction with the federal aid appropriation. The right-of-way over these roads is owned by the Birmingham Railway, Light & Power Company. The city and the company have been in a controversy over this right-of-way for some time, and the matter remains unsettled.

City Commissioner W. E. Dickson stated that he believed this right-of-way could be secured before Dec. 15, the date set by the County Board of

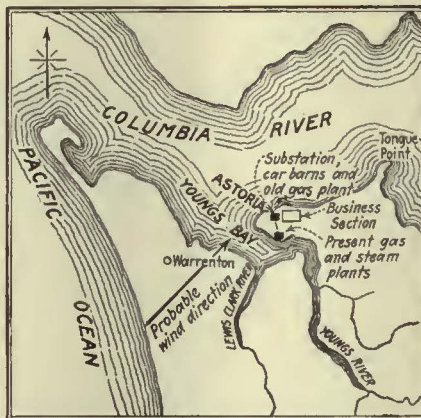
Revenue to withdraw the appropriation, in the event the right-of-way was not secured by that time.

Astoria System Hard Hit

But Speedy Resumption of Electric Service Follows the Fire in That Oregon City

Destruction of the electric light and power distribution system in about thirty-five city blocks in the heart of Astoria, Ore., was caused on Dec. 8 by the fire which started at 2:30 a.m. and burned until noon. The loss includes that of the meters and transformers in the burned area, which included the main business section of the city and some residence blocks.

The part of the city destroyed was built principally on filled-in land, some parts of which have been filled to the



SKETCH SHOWING VULNERABILITY OF ASTORIA TO FIRE

street level, but the part which burned first was filled to within about ten feet of the street level. The paved streets in this section were supported on timber trestles, and the tunnel thus formed was used for electric light and telephone cables, gas and water mains and sewers. This tunnel construction provided a flue for the burning timber that carried the fire throughout the burned area in a short time, causing the failure of both the gas and water mains because of the loss of the supporting structure and the falling of the street pavement. The failure of the water supply in certain sections from this cause proved a serious handicap in fighting the fire. At least fourteen blocks of street-railway track were destroyed and through service permanently interrupted.

The Pacific Power & Light Company owns and operates the street railway, electric light and power and gas properties, and much credit is due the company for the promptness with which service was resumed by all these properties. Fortunately the main electric feeders for the burned district were on Boundary Street, just beyond the fire zone, and this area was soon cut off from the rest of the city. Many arc lights were back in service on the first night, and within twelve hours after

the fire nearly every light and power customer outside the burned area was receiving uninterrupted electrical service. The new steam-electric plant and the Young's Bay gas plant, as well as the Astor Street substation, were outside the fire zone, but the local offices were burned. Virtually all the records, however, were saved.

It has been reported that the property loss of the Pacific Power & Light Company will amount to at least \$175,000. The industrial district of the city was not harmed, but the entire commercial section was wiped out and no one has yet hazarded an estimate as to what the revenue loss will be to the various utilities.

Legislature Will Consider Bus Regulation

That some effort will be made during the coming session of the Iowa Legislature to restrict the irresponsible bus competition from which city railways have suffered during the past two years seems to be a foregone conclusion. The Iowa League of Municipalities, made up of city officials from many of the cities and towns, has interested itself in the bus problem and promises to attempt some relief during the biennial session of the state Legislature which meets in the city of Des Moines early in January.

A. E. Gnagey, Mayor of Waterloo, is the chairman of a committee appointed by the league to investigate the matter and offer a solution, and he is now preparing a bill which will be introduced in the Legislature. Mayor Gnagey claims that bus owners and operators, paying only a nominal fee, have full use of city streets without any restrictions except those which apply to individual motorists. He calls attention to the fact that by establishing a "carriage rate" and not actually accepting a fare for a "within the city" haul buses have escaped taxation under ordinances governing taxicabs.

Mayor Gnagey is now drafting a bill and while it is not complete it is known that it will seek to give municipalities power to regulate buses and provide an operating tax which will compensate cities for injury to streets by the operation of buses.

Will Have Uniform Bookkeeping System

By an order of the Tennessee Public Utilities Commission, which will become effective in 1923, the entire bookkeeping system of all the privately owned gas, electric light, water works, street railways and power companies in Tennessee will be changed. The order requires all companies to keep their accounts in a uniform manner and in strict accordance with definite rules laid down by the commission. The new classification will conform with the accounting plan recently adopted by the National Association of Railroad & Utilities Commissioners.

Hydro-Radials an Issue

Construction of Proposed Lines Will Depend on Vote of Toronto Ratepayers

The ratepayers of Toronto, Ont., will vote at the municipal election on Jan. 1 on the question: "Are you in favor of the hydro-radial agreement passed by the City Council on Sept. 6, 1922?" Upon the answer given, the construction of the Toronto-Niagara Radial will be proceeded with or will be abandoned.

The agreement of July 27 provided for the building of the radial in question as a co-operative enterprise. As the *Toronto Globe* explains the matter Toronto's obligations under the adopted plan are twofold. The city agrees to guarantee bonds to the amount of \$4,240,000, representing 85 per cent of the cost of a line from the foot of Bay Street, Toronto, to Port Credit, and to furnish free of cost that part of the right of way from the Humber to the terminal, which will pass over public property.

In pursuance of the July agreement the City Council, on Sept. 6, adopted a supplementary agreement, providing for the needed right-of-way. The agreement confers on the Hydro-Electric Commission, as trustee for the associated municipalities, the right to use for fifty years a strip of land 105 ft. wide extending from the Humber on the west to Morley Avenue on the east, and to construct and operate an underground line on Bay Street from the radial terminal, near the waterfront, to the City Hall.

The Bay Street tube and the tracks for an eastern entrance for radials are not to be constructed at present. According to the *Globe* nothing can be done by the Hydro-Electric Commission upon these portions of the enterprise without the express consent of the City Council, which may or may not vote the needed money should the commission propose at any future time to proceed with the work. The lease of the eastern right-of-way is a "reservation," and for the present nothing more. If no steps are taken within six years toward utilizing it in the bringing in of radials from the east the lease is then cancelled automatically.

The question goes to the people because a majority of the Harbor Commission is opposed to giving up the land needed without a direct vote of the ratepayers authorizing them to do so.

The membership of the Harbor Commission consists of three representatives appointed by the city, which has provided most of the land and the money for harbor improvements; one by the Dominion Government, and one nominated by the Board of Trade. Two of the city's representatives, R. J. Fleming and Home Smith, not only object to the grant of the right-of-way as provided for by the agreement of July 27, but are of opinion that the city should own and operate the radial entrance and terminals, through the agency of the Toronto Transportation Commission, instead of entering into partnership with the other municipalities through whose territory the proposed radials are planned to run. As the *Globe* sees the matter the ratepayers must choose between the two principles—municipal co-operation and the opposite as presented in the phrase "Us for Toronto."

Paint Shop Destroyed

Thirty-One Cars Lost by International Railway in Blaze at Cold Spring Plant

Thirty-one cars were destroyed by fire and a workman was burned to death in a blaze which completely destroyed the paint shops of the International Railway, Buffalo, on the morning of Dec. 13. Prompt work on the part of the firemen prevented the destruction of the Cold Spring carhouse of the company, which adjoins the paint shops. The damage is estimated by Herbert G. Tulley, president of the International, at more than \$350,000, fully covered by insurance. The cause of the blaze had not been determined late in the week and an investigation is being made by the company.

CARS DESTROYED WERE AWAITING OVERHAULING

The cars which were destroyed were in the paint shops for overhauling. They consisted of nine Peter Witt type center exit cars; eleven double end cars; three near side P.A.Y.E. cars; four interurban cars and four converted one-man cars. The building, a brick and frame one-story structure, and the equipment are a total loss and the company will be crippled for some time to come as the paint shop was being worked at capacity repairing and overhauling the company's equipment in preparation for the winter. There are

no paint shops connected with any of the other carhouses in the city.

The fire was discovered shortly after 4 o'clock in the morning. Before the first battalion of firemen arrived, the entire structure was in flames. The grease and oils in the building and the high wind caused the blaze to spread rapidly and the firemen had difficulty in keeping the flames confined to the paint shops and adjoining dwellings. The main car sheds at Cold Spring, housing more than 500 cars, were not damaged in the least.

Edward McQuivey was burned to death in the fire. He was employed as a painter and night watchman. His charred body was found by firemen after the blaze was extinguished.

The company has received several letters from individuals who have threatened to fire the Cold Spring carhouse and in some quarters suspicion is directed toward strikers or their sympathizers. One attempt was made some time ago to destroy the structure by the explosion of a bomb placed on the roof of the building. Since the start of the strike on July 1, 1922, the carhouse has been under heavy police guard.

Adjournment on Car-Bus Hearings

Quick settlement to determine the result of the street car-bus franchise that was submitted to the electors of Saginaw, Mich., on Nov. 7 has been removed with an adjournment on the hearings for orders to show cause issued by the Circuit Court until Dec. 21.

The hearing on the order secured by the opponents and the hearing on the order secured by the proponents will be combined, as both measures have been consolidated. Attorneys interested in the election from both sides will fight it out through the courts.

The franchise, if carried, would have meant the resumption of street car service with motor bus extensions, but apparently it was defeated on the original returns by fifteen votes. On the recount the measure lost by fifty-seven. More than 1,000 ballots are now in dispute, the opponents having asked the courts to pass on a majority of them because of alleged technicalities. No matter which side secures the decision in the lower court, the entire question, it is believed, will be carried to the State Supreme Court for a decision.



MASTEN STREET SIDE OF THE PAINT SHOP AFTER THE FIRE



GENERAL VIEW OF THE RUINS OF THE PAINT SHOP WITH THE WRECKED CARS

Financial and Corporate

Extra Common Dividend Declared

At a meeting of the board of directors of the United Light & Railways Company, Grand Rapids, Mich., held on Dec. 6, 1922, the regular quarterly dividend of 1½ per cent was declared on the first preferred stock payable Jan. 2, 1923, to stockholders of record on Dec. 15, 1922. There was also declared the quarterly dividend of 1½ per cent on the participating preferred stock payable Jan. 2, 1923, to stockholders of record on Dec. 15, 1922.

A quarterly dividend of 1½ per cent

on the common stock of the company was declared payable on Feb. 1, 1923, to common stockholders of record on Jan. 15, 1923. An extra dividend was announced of ¼ of 1 per cent on the common stock of the company payable on Feb. 1, 1923, to stockholders of record on Jan. 15, 1923.

Net Income \$97,059

The accompanying table shows the results of operation by the Department of Street Railways, Detroit, Mich., for October and September, 1922.

Results Under Service-at-Cost

Youngstown Commissioner Says 300,000 More Passengers a Month Must Be Carried to Avoid Deficit

The report of an audit of the accounts of the Youngstown Municipal Railway, authorized by the City Council, has just been made to that body by H. W. Feather, the accountant employed by the City Street Railway Commissioner for the purpose. The period covered by the audit is from Jan. 16, 1919, when the service-at-cost ordinance under which the Youngstown city railway lines are operated, became effective, to Aug. 31, 1922.

Mr. Feather prefaces his report with the statement:

The entire accounting system including that in the storeroom is exceptionally good, and the check on cash receipts is accurate and complete. Every courtesy was shown me by the officials of the operating company.

In the period covered by the audit Mr. Feather found that the gross revenue was \$5,747,624, while the operating and maintenance expenses, including taxes, were \$5,413,356. The latter item is increased to \$5,439,387 by certain special expenditures authorized under the ordinance, leaving a balance of \$308,237 applicable to depreciation and interest on capital.

The agreed capital value under the service-at-cost ordinance on Jan. 16, 1919, was \$4,370,480, and the additions to capital since that time up to Aug. 31, 1922, were \$98,276, making a total of \$4,468,757 on which, under the terms of the ordinance, a return is to be paid, the rate on the original agreed value being 7 per cent and on the capital additions the actual cost of the money. These charges against operating income and depreciation charges, Mr. Feather's audit shows, amount to \$1,162,168, or \$853,931 in excess of the balance left after paying operating charges and taxes. This excess is carried as a debit balance in the stabilizing fund, the state of which fund controls the rate of fare to be charged under the service-at-cost ordinance.

In this regard, the audit report points out:

The present physical condition of the company's property is such as to warrant the capitalization of this deficit plus any additions since Aug. 31, 1922, that portion of this deficit represented by unpaid interest on capital value bearing interest and the balance being non-interest bearing.

Mr. Feather found that the company during the period of his audit had operated a total of 13,030,069 car-miles, carrying 77,898,884 original passengers and 17,341,096 transfer passengers. Basing his calculations on the fare revenue received, he found that the average fare per original passenger was 7.34 cents, while including the items of interest and depreciation, in part accrued, the cost per original passenger was 8.48 cents.

Mr. Feather points to the falling off in the number of passengers carried and the increased cost of carrying them, due to the "unsettled business conditions with resultant labor troubles, increased cost of materials (particularly

CITY OF DETROIT Department of Street Railways

INCOME STATEMENT AND OPERATING STATISTICS, OCTOBER, 1922, COMPARED WITH SEPTEMBER, 1922

Operating Revenue	October, 1922 31 Days	Cents per Car-Mile	September, 1922 30 Days	Cents per Car-Mile
Revenue from transportation				
Passenger revenue	\$1,525,249		\$1,444,326	
Parlor, chair and special car revenue	62		72	
Miscellaneous transportation revenue	1			
Total	\$1,525,313	.3921	\$1,444,399	.3795
Revenue from other railway operations				
Station and car privileges (advertising)	\$6,772		\$6,660	
Rent of track and facilities	81,557		81,867	
Miscellaneous	366			
Total	\$88,696	.0228	\$88,527	.0233
Total operating revenue	\$1,614,010	.4149	\$1,532,927	.4028
Operating expenses				
Ways and structures	\$178,998		\$166,398	
Equipment	97,817		89,829	
Power	157,365		149,006	
Conducting transportation	563,433		545,082	
Traffic	310		290	
General and miscellaneous	129,445		122,809	
Total operating expenses	\$1,127,370	.2897	\$1,073,416	.2820
Net revenue railway operations	\$486,640	.1252	\$459,510	.1206
Deduct taxes assignable to railway operations and miscellaneous rents	\$54,573	.0140	\$52,901	.0139
Net operating income	\$432,066	.1112	\$406,609	.1069
Non-operating income				
Net income from miscellaneous property	\$1,182		\$1,697	
Income from unfunded securities and accounts	15,123			
Income from sinking fund and reserves	2,960			
Total non-operating income	\$19,266	.0050	\$1,697	.0004
Gross income	\$451,332	.1162	\$408,306	.1073
Deductions				
Pro rata sinking fund provision on \$15,000,000 original bond issue	\$38,471		\$37,747	
Pro rata reserve on D. U. R. purchase contract	143,274		142,015	
Pro rata sinking fund provision on \$4,000,000 bond issue	11,324		11,111	
Pro rata interest fund provision on \$15,000,000 bond issue	59,706		58,583	
Pro rata interest fund provision on \$4,000,000 bond issue	14,715		14,086	
Pro rata interest fund provision on deferred payments on D. U. R. purchase contract	86,528		83,736	
Amortization of expense on funded debt	253			
Total deductions from gross income	\$354,273	.0911	\$347,280	.0913
Net income	\$97,059	.0251	\$61,025	.0160
Ratio operating expenses to revenue from transfers	73.9 per cent		74.3 per cent	
Ratio operating expenses to operating revenue	69.8 per cent		70.0 per cent	
Ratio net income to operating revenue	6.0 per cent		3.9 per cent	
Revenue car-miles operated	3,882,888		3,798,386	
Non-revenue car-miles operated	7,628		7,377	
Total car-miles operated	3,890,516		3,805,763	
Earnings per car-mile	.3921		.3795	
Earnings per car-hour	2.0358		1.9703	
Expenses per car-mile	.2897		.2820	
Expenses per car-hour	1.5047		1.4640	
Revenue passengers carried	28,530,594		27,025,653	
Transfer passengers carried	9,221,851		8,744,410	
Total passengers carried	37,752,445		35,770,063	
Ratio of transfer passengers to revenue passengers	32.3 per cent		32.3 per cent	
Revenue passengers per car-mile operated	7		7	
Transfer passengers per car-mile operated	2		2	
Total passengers per car-mile operated	9		9	

fuel), increased cost of labor and the general business depression starting early in the fall of 1920 and extending to late summer of this year." He continues:

During 1920 there were 727,626 fewer original passengers carried than during the 11½ months of 1919, and in 1921 6,136,408 fewer than in 1919. The entire year of 1922 will probably show an increase of about 3,000,000 passengers over 1921, but still fewer by 3,000,000 than 1919.

Regarding the weekly pass, Mr. Feather found that the average fare per original ride on passes was 4.97 cents. He says:

There has been a steady growth of passengers carried since the installation of the weekly pass, which was started in October, 1921. Better business conditions are probably responsible for some of this increase, but the greater part of the increase is, no doubt, due to the pass. August, 1922, showed an increase of 566,854 passengers over August, 1921, or more than 50 per cent.

Without attempting to solve the problem of the number of these passengers who would not have been carried were it not for the weekly pass, Mr. Feather comments:

Unfortunately the use of the pass has lowered the average fare per passenger to such an extent that unless the weekly pass is discontinued the company must carry 300,000 more passengers per month to avoid a deficit.

Memphis Reorganizations Progressing

The management of the Memphis Power & Light Company, Memphis, Tenn., successors to the Memphis Gas & Electric Company, and the Memphis Street Railway, will be directed by T. H. Tutwiler, executive head of the street railway, it is stated. Following the sale a few days ago of the gas property, the owners will be ready to take charge by Jan. 1. Just as soon as the details of reorganization of the gas company are completed, preliminary steps will be taken looking to the sale of the Memphis Street Railway at auction on an order of the Federal Court. The Electric Bond & Share Company, New York, contemplates the purchase of the street railway property as has been done in other southern cities and will proceed with immediate reorganization of the street railway.

Securities at Auction

Electric railway securities sold by Adrian H. Muller & Company on Dec. 6 at the Public Auction Room, 14 Vesey Street, New York, were as follows:

- 200 shares Albany Southern Railroad common; \$11.50 per share.
- 100 shares Albany Southern Railroad preferred; \$26 per share.
- 230 shares International Railway Company common, voting trust certificates; \$13 per share.
- \$14,000 Second Avenue Railroad first consolidated mortgage 5 per cent bonds, due 1948, Guaranty Trust certificates of deposit, 1½ per cent.
- \$16,900 Dry Dock, East Broadway & Battery R.R. Company registered refunding mortgage income gold bonds, series C, due 1960, with \$239 scrip, \$600 lot.
- 225 shares North Jersey Rapid Transit Company, common, \$7 lot.
- \$37,500 North Jersey Rapid Transit Company first mortgage 5 per cent bonds, certificates of deposit, \$200 lot.
- 15 shares Nova Scotia Tramways Company, common, \$100 lot.
- 50 shares Nova Scotia Tramways Company, preferred, \$2,000 lot.

Toronto Purchase Arbitration Completed

The Toronto Railway arbitration has been concluded and the next and vital step will be the announcement of the award.

The *Financial Post* of Toronto says that surrounding this matter are the questions:

Will it be acceptable to both sides?

Will there be further litigation—an appeal to the Privy Council?

According to the *Post* there are those who contend that both sides will be anxious to avoid a further piling up of costs, but such a contention is hardly borne out by experience. The company may appeal on some questions of law, but it seems more reasonable to believe that the city, not always given to weighing the dollars and cents of the people before rushing in to spend, would be more liable to take the jump than the company. On the other hand, says the *Post*, if the award is unacceptable to the company, and especially if there is a hitch in the interpretation of a clause of the franchise, the company is certain to appeal. In further explanation of the matter the *Post* says:

During the past few years, since the wave of public ownership has hit the country, franchises and agreements have been likened more to a scrap of paper. The Privy Council, however, has been the only standby. There an agreement is respected and an interpretation on the strict letter of the paper, devoid of any sentiment, is usually forthcoming. However, both these conjectures might be termed "crossing bridges."

For the present the guessers have sufficient to conjure with in the possible award. The guesses already vary. Some place the figure between \$10,000,000 and \$12,000,000. The city is willing to pay around \$7,500,000 and this does not include a considerable amount of the company's real estate, including the office building, Scarborough Park and the steam plant site. To this would be added the \$3,000,000 which the company already has in its treasury from the clean-up deal, including interest on the award, which dates back to Sept. 1, 1921.

There is another point to consider, as to whether the city is likely to get the road at its figures with Chicago experts placing the value of the property at \$20,000,000. Each side must pay its share of the arbitration cost, but it is said that the company has already set aside sufficient to care for this. An approximate cost is given as \$2,000,000, and the company has a reserve on hand greater than this amount to care for such a charge. The company is to be paid in 6 per cent bonds of the city, dated Sept. 1, 1921, so that if there is an appeal, no matter by the city or company, this interest continues. Thus it can be said that on the interest alone the stock is worth 6 points more than it was a year ago. The uncertainty which surrounds the matter caused a pronounced weakness in the stock lately and a drop of about 12 points from the recent high.

Seeks Discontinuance of Line

The San Diego (Calif.) Electric Railway has applied to the State Railroad Commission for permission to discontinue service over the main portion of the Woolman Avenue line—that portion extending from Twenty-fifth Street and Imperial Avenue to the Intersection of Fifth and K Streets—a distance of about three-fourths of a mile, it is announced by General Manager Claus Spreckels. Service over that part of the line was discontinued about Dec. 1 because of the poor condition of the track, and Manager Spreckels states

that service will not be resumed except under orders from the commission.

In April the company applied to the City Council for a franchise for a line on Twenty-fifth Street from K Street to Broadway, with the intention of running the Woolman Avenue cars over this route and abandoning K Street, which is closely paralleled by the Imperial Avenue line on the south and the Market Street line on the north. This franchise was granted by the Council, but with conditions added which are not in the company's general franchise and which General Manager Claus Spreckels declared he will not accept. At present residents of the Woolman Avenue district are being served by a stub operated from Twenty-fifth and Imperial, with transfers to and from the Imperial Avenue line.

Manager Collins Made Receiver

John S. Collins of Jackson, general manager of the Michigan United Railways, was named by Federal Judge Arthur J. Tuttle on Dec. 13 as receiver for his company, following filing of a petition for receivership by the Commonwealth Power, Railway & Light Company. The Michigan United Railways serves about forty cities and towns in the western and central parts of the State.

Financial News Notes

Seeks Increased Capital Stock.—The Port Arthur (Tex.) Traction Company has filed an amendment to its charter under which the capital stock is increased from \$300,000 to \$400,000. Under the recent order from the city to move all car tracks to the middle of the street, the company faces heavy expenditures and additional capital is needed.

Transfer of Rights Sought.—The Richmond Light & Railway Company, New York, N. Y., has applied to the Transit Commission to transfer the railroad property of the company to the Richmond Railways, Inc., and to make and transfer certain issues of securities. This is a step in the reorganization of the company now in the receiver's hands, and which was recently acquired by new interests. Permission is sought to transfer the franchises and properties comprising the electric railroad system of the Richmond Light & Railway Company to the Richmond Railways, Inc., in consideration of receipt by the Richmond Light & Railway Company of 6 per cent 30-year mortgage bonds in the face amount of \$2,000,000 and capital stock of no par value to the amount of 20,000 shares. None of the securities to be issued is to be sold. A hearing was held by the commission Dec. 13 and decision was reserved.

Traffic and Transportation

Reduction Not Likely

Connecticut Commission Believes Five-Cent Rate Impracticable in Large Cities—Service Satisfactory

In the opinion of the Public Utilities Commission of Connecticut the installation of a flat 5-cent or 6-cent fare without transfer privileges would not give satisfaction in large cities taking the cities as a whole. Bridgeport and Norwalk lent themselves to the adoption of reduced fare zones because of the particular geographical layout and also because of the trend of traffic. These statements were made in the annual report of the commission which was recently presented to Governor Lake.

The report covers in full electric railway operation in the State of Connecticut. The announcement of the impracticability of the 5-cent fare in Connecticut comes at a critical time when Mayor Kinsella of Hartford has announced his intention of taking up with the commission body the matter of reducing fares in his city.

The present rates of fare charged by the Connecticut Company are based upon a flat rate of 10 cents for a single cash fare with a ticket rate of 8½ cents or three for 25 cents. Bridgeport and Norwalk are exceptions to this schedule. They have a 5-cent zone fare without transfers. This schedule was authorized by the commission in November, 1921, for a trial period of ninety days, and thereafter until changed by the commission. The results of the eleven months' operation in Bridgeport referred to in *Electric Railway Journal* of Dec. 9 showed an increased operating income but provided an amount below what would be considered a reasonable return on the investment or fair value of the property. This condition obtained also in Norwalk. The test period expired in the early spring and the temporary order has not been revoked. The report says on this point:

It was the hope and reasonable expectation of the commission that the ticket rates of the Connecticut Company could before now be reduced from 8½ cents to 7½, or two tickets for 15 cents, and at such time a proper modification of the temporary orders in Bridgeport and Norwalk might be made; but industrial depression and unfavorable weather during the summer months operated against more favorable gross and net operating revenues of the Connecticut Company.

Believing the cut detrimental the report continues:

The commission is strongly imbued with the theory that any utility company, to give good service, must be in a healthy financial condition, and that any reduction of rates or diminution of revenues of any necessary utility, operating under efficient and economical management, which will seriously impair its financial standing and fail to afford a fair return upon a conservative valuation of its property used and useful in the service, will ultimately and surely be extremely detrimental both to the company and to the public which requires its service, and which service should be reasonably dependable and satisfactory.

It may be assumed that the services of a public utility are essential for the well being of the state and for the comfort and happiness of its citizens, and that only by financially successful and carefully managed companies, as in any other line of business, can such service be satisfactorily maintained.

Under public regulation there should be little chance for undue profits or discriminatory service, but any policy of regulation which will arbitrarily and without sound reason reduce utility rates or diminish the revenues to an extent that utilities are unable to pay a fair return or raise new money for necessary capital improvements, betterments and extensions, will very much diminish the power of the regulating body to compel good service.

The report says further:

The companies are gradually increasing mileage of open track, which is to be commended, and on side location and inter-urban lines they are constructing earth landing places which enable passengers to be handled more safely.

Automatic signals have been installed on a number of lines. This substitution of modern signal equipment for older types should be continued as extensively and as rapidly as practicable.

Traffic and operative signs show considerable progress toward standardization, as advocated by us in previous inspection reports; however, a few turnouts and calling points still remain unlabelled. Highway crossing signs were found in only a fair condition of maintenance; some with broken wings or sadly out of plumb, others obscured by tree limbs which should be kept trimmed.

The report concludes by saying that street railway service on the whole has been satisfactory and that the companies, particularly the Connecticut Company, have shown better financial results and have been able to meet with some degree of success their state tax obligations.

Applies for Seven-Cent Fare Continuance

The United Railways & Electric Company, Baltimore, Md., has filed an application with the Public Service Commission for a continuation of the 7-cent fare. In discussing the application H. B. Flowers, general manager, said that almost half of the total receipts of the company were returned to the 5,000 employees in wages in the last ten months.

In commenting on the affairs of the Company, Nelson Cook & Company, bankers of Baltimore, in their December pamphlet say in part:

There are naturally many people in Baltimore who selfishly and without reason would like to see a lower street car fare. There are many, perhaps, who would be glad to ride on the street cars without any fare. It would make little difference to them who paid the freight so long as it cost them nothing. It is against thoughtlessness of this character that the Public Service Commission of Maryland stands as a bulwark in the protection of property rights.

A large Baltimore labor body is reported to have passed a resolution asking the return of the pre-war 5-cent carfare. As the United Railways Company is one of the most extensive employers of labor in Baltimore, we wonder what labor would say if the company sought to cut the wages of its employees to a point where the former 5-cent fare would be possible. Until the time comes when wages can be materially reduced and the cost of transportation correspondingly lowered our street car fare must remain at its present 7-cent rate to enable the company to earn a sufficient sum to maintain its credit and thereby maintain public service.

Cut in Cleveland Fare Expected

As a result of a settlement between the City of Cleveland and the Cleveland (Ohio) Railway, regarding the disposition of a number of funds, it appears certain that the Cleveland car riders will receive another reduction in fare on March 1. The adjustment of funds just made involves a grand total of \$986,022. This sum has been carried for several years in so-called "suspense accounts."

In the agreement between the city and the company, \$476,151 is transferred to the interest fund, which is the fare barometer. Because of the transfer there was in this fund on Nov. 1, \$588,522. When this total reaches \$700,000 the fare is automatically reduced. There is today a large accumulation in the operating reserve surplus which must be transferred to the interest fund on March 1, making the fare reduction almost sure.

Cleveland car riders are now paying 5 cents cash fare or five tickets for a quarter with 1 cent for transfer. The next lower rate of fare is the same, except that riders may get eleven tickets for 50 cents. In view of the fact that this next lower rate of fare varies so slightly from that now in effect, it is not at all unlikely that a further reduction will be made to 5 cents cash or six tickets for a quarter with 1 cent for transfer.

In the adjustment made in the agreement between the city and company, \$305,982 went to the maintenance, depreciation and renewal reserve; \$82,536 to the road equipment reserve and \$6,982 to the operating expense reserve.

None of the Cleveland Railway executives will be quoted as to the certainty of a fare reduction on March 1, but there is a general accord that unless there is a totally unexpected drop in business during the next few months, or some extraordinary expense is incurred, the fare will go down probably two notches on March 1.

School Tickets Reduced

According to a recent announcement of the Connecticut Company, pupils can hereafter ride at one-half the metal ticket rate instead of one-half the cash fare.

Fares on all Connecticut Company lines were reduced 16 per cent on March 1, 1922. The fare unit had been 10 cents and it was provided that three metal tokens be sold for 25 cents, at the rate of twelve for \$1. Single cash fares remained at 10 cents, when tokens were not used. School children have continued to pay one-half of the 10-cent rate, buying books of twenty tickets for \$1. Under the decision of the Connecticut Company directors, they will be able to buy books at one-half of the token rate, saving 16 per cent.

Books of tickets are issued to school children, when the fact of their attendance at public or parochial schools is attested by parents and school authorities.

Plan in Effect to Reduce Fares and Maintain Revenue

On Dec. 8 the San Diego (Calif.) Electric Railway started a thirty-day trial of a plan calculated to reduce fares to the street car rider and still maintain the usual revenue for the car company. The plan is fostered by an organization known as the Merchants' Transportation Coupon League, and its promoters claim that it will promote business for the merchants who are members of the league and also increase street car patronage during the hours when traffic is usually light.

In brief the plan is as follows: The company issues to the league a special red token at 7½ cents each (the regular outer zone fare in San Diego). The merchants who are members of the league sell these tokens to the public at two for 15 cents, and with each token sold give two coupons valued at 2 cents each in trade. Merchants who are members of the league accept these coupons as cash on purchases in their establishments at the rate of one 2-cent coupon for each 25 cents worth of goods purchased. Thus if the patron purchases two tokens for 15 cents for the round trip to town and back, and makes purchases at league stores amounting to \$1, the coupons can be turned in for 8 cents, thus reducing the actual fare paid to 7 cents for the round trip, or a reduction of more than 50 per cent of the regular fares. The league promoters have secured 100 merchants as members of the league, representing practically all lines of business, both downtown and suburban, so street car patrons desiring to purchase the new red tokens will find them at convenient points throughout the city.

The railway company has placed the following restrictions on the use of the red tokens: They will be accepted in payment of fare only between the hours of 9 a.m. and 4 p.m., and from 6 p.m. until midnight. During the peak-load hours regular tokens must be used. No transfers will be issued on the red tokens.

Whether the plan becomes permanent or not depends upon the showing made by the thirty-day trial, it was stated by Claus Spreckels, general manager of the San Diego Electric Railway. If the expectations of the promoters are realized the plan will be made permanent.

Seeks Another Extension of Seven-Cent Fare

An application for another extension of the 7-cent fare has been made by the United Railways Company, St. Louis, Mo., before the State Public Service Commission at Jefferson City.

The commission has extended the 7-cent rate several times, the last occasion being up to Dec. 31, 1922. The application filed recently asks that the extension be granted until the commission has completed the valuation of the property of the United Railways Company now being made and has promulgated and put into effect a permanent

order authorizing the collection of a fare that is predicated upon the final valuation.

In the event that the commission does not see fit to grant the extension upon those terms the petition asks that some extension at least be given.

Supreme Court to Decide

Opponents of Increased Fare in the City of Dallas Will Take Issue to Higher Court

The fight on the 6-cent fare in Dallas, Tex., will be taken to the Supreme Court, according to attorneys for those opposing the higher fare, unless relief is had in the lower courts. Joe A. Worsham, attorney for the Dallas Railway, is also preparing to take the case to the Supreme Court on a writ of error.

The case as originally brought by F. J. Geller et al. in the Forty-fourth District Court of Dallas County, sought to enjoin officials of the Dallas Railway from collecting a 6-cent fare, alleging that the city ordinance making the grant of the 1-cent increase in fare was not legally passed by the City Commission. Petitioners set forth that the franchise entered into between the city of Dallas and the Dallas Railway on Jan. 8, 1917, was a contract and bound the company to charge a 5-cent fare during the life of the franchise, unless said fare should be changed under the conditions of the sliding scale set forth in the franchise, and that therefore the city ordinance granting the fare increase was void, inasmuch as it had not been submitted to the qualified voters for indorsement at a referendum election.

John W. Pope, sitting as special judge in the Forty-fourth District Court, denied the injunction in sustaining a general demurrer filed by the attorney for the company.

The case was appealed to the Fifth Court of Civil Appeals at Dallas by attorneys for Geller et al. and on hearing before the Appellate Court the case was reversed and remanded to the District Court for hearing on its merits.

The Appellate Court held that the franchise entered into between the company and the city of Dallas was not a fixed contract, but was subject to constant regulation by the governing body of the municipality granting it; that the ordinance involved in this case was not one granting a franchise but one regulating the rate schedule; that such regulatory ordinance could not go into effect immediately because none of the exceptions creating an emergency existed; that the suspension of the prescribed method of passing ordinances was not required for the immediate preservation of the public peace, health or safety; that the declaration of the board of city commissioners declaring an emergency existed did not create such an emergency, was not binding and conclusive, but was subject to judicial ascertainment; that the emergency clause in the ordinance is void, but that the ordinance is not void, but merely

inoperative until it shall have been published for the thirty days required by law. And if within the thirty days a referendum shall be demanded by the electorate of the city of Dallas in the manner provided in the city charter, then such referendum must be held and the ordinance ratified by the people before it shall take effect.

Upon this decision Joe A. Worsham, attorney for the company, announced that he would seek to carry the case before the Supreme Court on a writ of error, and this proceeding served to halt the rehearing of the case in the Forty-fourth District Court.

In the meantime the city of Dallas, through J. J. Collins, city attorney, sought and was granted authority to enter the case as *amicus curiae*, declaring that although the city was not named in the original petition, the fare case was a matter of public interest and the city should be represented in the litigation. The city entered the case to attempt to aid the street railway in showing that the 6-cent fare increase was legally granted and should be continued in order that the traction company might earn a fair return on its invested capital.

Another development following the decision of the Fifth Court of Civil Appeals was the filing of a petition by attorneys for F. J. Geller et al. with the City Commission asking that the Dallas Railway be directed to issue a fare receipt to every person paying the 6-cent fare. The petition asked further that the company be directed to set aside the money collected by reason of the fare increase so that this money might be available for refund to patrons of the company in case the 6-cent fare ordinance is finally declared void.

The City Commission referred the petition to the city attorney without action.

Seeks Permission to Charge Seven Cents

The Shreveport (La.) Railways has filed a petition with the Public Service Commission of Louisiana asking permission to charge a 7-cent fare. The company based its application upon a belief that it was entitled to earn a fair return on the fair value of the property.

The appraised value of the property, based upon reproduction on present prices less a fair depreciation, is \$3,229,834. The company asks to be allowed to earn 7½ per cent on this amount above the cost of operation, taxes and depreciation. The commission now has public accountants preparing a statement of the historical value of the property.

In 1920 the people by a popular vote granted an increase from 5 cents to 6 cents. The Constitutional Convention of 1921 placed the public utilities of the state under the Public Service Commission and that commission promptly reduced the fare to 5 cents. Following this the company had the property appraised upon which it could base an application for an increase.

Personal Mention

Selling an Idea

W. B. Spencer, Assistant to President at Providence, Tells Public to Use Trolley for Business

To the general public of Providence, R. I., W. B. Spencer is just a name, like thousands of others in the telephone book or the city directory for instance. The public may not know Mr. Spencer, still all Providence is talking about him, or at least about his work, for it is he that is driving home to them by car dasher sign, newspaper ad and by pamphlet the philosophy of using the street car for business and saving the automobile for pleasure. He is getting his message across, or the public wouldn't be talking about him.



W. B. SPENCER

Mr. Spencer isn't new to the railway business in Providence. Indeed, not. He was, in point of fact, brought up in it. But he is comparatively new to that particular phase of the work he is now carrying on, for he has been at it actively only since Feb. 1, 1922, when he was appointed assistant to the president of the United Electric Railways and placed in charge of a newly organized department of publicity and public relations.

Mr. Spencer is twenty-nine years of age. He is a native of Providence. He joined the service of the trolley company in the summer of 1907, serving as office boy for the duration of the school vacation period, but liked his occupation so well that he retained his position when school reopened and attended an evening business school.

After serving several years in the electric railway business, Mr. Spencer decided in his own mind to see the business all the way through. He was then a junior clerk in the transportation department. Later, a position as night clerk in one of the carhouses was accepted, and the work here enabled him to become acquainted with the railroad man—his habits, his likes, his

dislikes, etc. After gaining considerable experience there, Mr. Spencer returned to the main office of the transportation department, working as a record clerk. Still desirous of gaining more experience, permission was granted him to work after office hours as a conductor, and he thus learned at first hand the many arduous tasks that confront the man on the rear platform in dealing with the public. Later, he operated the front end of a car as a motorman, also for the purpose of obtaining experience.

Not being satisfied with these attainments, Mr. Spencer peered into the inner workings of the transportation department, and began to experiment in schedule making, and gradually worked up in this department until he was appointed chief clerk, taking charge of the making of schedules, the chartering of special cars and the handling of the details in connection with the company's transfer system in the transportation department, and, in general, assisting the superintendent of transportation.

As stated previously, Mr. Spencer was next advanced, on Feb. 1, 1922, to the office of assistant to the president, in which capacity his duties consist of taking charge of the department of publicity and public relations, and such other matters as the president assigns to him.

Mr. Cullen Re-enters Newspaper Work

John E. Cullen, assistant to the president of the United Railways & Electric Company, Baltimore, Md., has accepted a post with the general staff of the Hearst newspapers and has gone to Milwaukee to take charge of two papers there. The announcement as made in the *Baltimore News* says that Mr. Cullen has been granted leave of absence for one year by the United. Mr. Cullen was appointed to the railway at Baltimore in 1918, in line with the policy of the company there to enlarge its staff so as to hasten the solution of the many problems created by the war. He directed his attention more particularly to the question of public regulations and publicity. He is a Baltimorean, well known as a special writer and former city editor of the *Evening Sun*. For three years before he accepted the appointment to the Baltimore company Mr. Cullen was engaged in newspaper work in New York City.

R. H. Horton, traffic engineer for the Philadelphia (Pa.) Rapid Transit Company, has been assigned to special duty in Buffalo for the International Railway and may be given a permanent position with the International, accord-

ing to announcement made by Herbert G. Tulley, president of the International Railway.

William J. Clark Dead

William J. Clark, advisory manager of the railway department, General Electric Company, died at his residence in New York Dec. 13. He leaves a widow and two sons. The funeral occurred Dec. 15.

Mr. Clark became interested in electric railways in 1888, when he was instrumental in obtaining a legislative charter authorizing the construction of an electric railway between Derby and Ansonia, Conn. Shortly after he joined the sales department of the Thomson-Houston Electric Company and had been connected with that company and its successor, the General Electric Company, ever since. For part of this time he was managing director of the British Thomson-Houston Electric Company, with headquarters in London, and the acquaintance then gained and later ex-



W. J. CLARK

panded of electric railway conditions abroad made him an authority on this subject.

Mr. Clark was a pioneer in electric railway matters in many ways besides manufacturing. He was a great student of the sociological and economic aspects of electric railroading, and in 1896, he made a valuation of the electric railway and lighting property in Milwaukee. This is said to have been the first extended physical valuation of a large electric public utility, and the general plan adopted by Mr. Clark has since been frequently followed by others. He was also greatly interested in the economic side of municipal vs. private ownership of public utilities. It was largely through his efforts that the National Civic Federation undertook its study of the subject in 1907 and he was chairman of its ways and means committee, as well as a member of the commission which made the investigation. In 1908 he acted as an expert on Cuban affairs for the War Department.

During recent years his attention had largely been given to collecting the materials for a comprehensive history on the electric railway industry.

Manufactures and the Markets

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

ROLLING STOCK PURCHASES

BUSINESS ANNOUNCEMENTS

Increase in Electric Locomotive Orders

A recent survey of the locomotive department of the Erie Works of the General Electric Company discloses the fact that at the present time there are a larger number of orders from different customers than has been the case at any time since 1914. Many of these customers have electrification projects under way in various parts of the world, and it is evident that interest in steam railroad electrification has been greatly stimulated by the high prices of fuel, labor and commodities.

Domestic orders include two 120-ton electric locomotives for handling increased business over the Baltimore & Ohio Belt Line, which was electrified by the General Electric Company in 1895. Another order has been received from the Sacramento Northern Railway in California for two freight locomotives to be used in heavy interurban freight service.

Among foreign orders are contracts for locomotives to be installed in Spain, France, Chile, Japan and Mexico. A Mexican order including ten 150-ton, 3,000-volt direct-current locomotives is the first electrification in that country. The equipment will be installed for the Mexican Railway on the Mexico City-Vera Cruz Line and is expected to effect sufficient economies to pay for the entire equipment in a period of five years.

The six locomotives for the Spanish Northern Railway, also to be operated at 3,000 volts direct current, are nearly completed and will be in operation early next year. These will be called upon to handle both freight and passenger service over a heavy grade section and will be the first installation of 3,000 volts direct current in Europe.

As part of a large order for electrification equipment the Paris-Orleans Railway has under construction at the Erie Works of the General Electric Company a high-speed gearless passenger locomotive, which will be tried out on the initial electrification in France. In Chile, the Bethlehem Chile Iron Mines Company has purchased three 60-ton switching locomotives for hauling ore out of the Tofu mines. These will operate at the mines from a 600-volt trolley, but will haul ore to the port of Cruz Grande over the present 2,400-volt direct-current line. The Imperial Japanese Government had laid out an extensive program of electrification on the so-called Tokaido Railway using 1,500 volts direct current. Trial orders have been placed for locomotive equipment, and the Erie Works of the General Electric Company has recently shipped two 66-ton locomotives,

which will be temporarily operated on the present 1,200-volt electrification pending the purchase of additional equipment for the electrification of those lines which at present are steam operated.

There are numerous indications that a greater interest in electrification is being developed in the United States, and it is predicted that within the next few years extensive work will be done in electrifying the main-line roads of this country.

Largest Street Railway Adopts Meters

The Chicago Surface Lines has placed an order with the Economy Electric Devices Company for Economy watt-hour meters to equip the entire system of 3,000 or more active cars. The order is for immediate delivery. The meters will be complete with energy saving and car inspection dials.

Metal, Coal and Material Prices

Metals—New York		Dec. 12, 1922
Copper, electrolytic, cents per lb.		13.95
Copper wire base, cents per lb.		15.625
Lead, cents per lb.		7.10
Zinc, cents per lb.		7.35
Tin, Straits, cents per lb.		37.00
Bituminous Coal, f.o.b. Mines		
Smokeless mine run, f.o.b. vessel, Hampton Roads, gross tons		\$7.50
Somerset mine run, Boston, net tons		3.875
Pittsburgh mine run, Pittsburgh, net tons		2.625
Franklin, Ill., screenings, Chicago, net tons		2.375
Central, Ill., screenings, Chicago, net tons		1.675
Kansas screenings, Kansas City, net tons		2.50
Materials		
Rubber-covered wire, N. Y., No 14, per 1,000 ft.		6.50
Weatherproof wire base, N. Y., cents per lb.		16.00
Cement, Chicago net prices, without bsgs.		\$2.20
Linseed oil (5-bbl. lots), N. Y., cents per gal.		90.00
White lead, (100-lb. keg), N. Y., cents per lb.		12.125
Turpentine, (bbl. lots), N. Y., per gal.		\$1.395

Electrification Work Started

Work has been started by the Texas Interurban Company, Dallas, the corporate name of the company that will electrify the line of the Missouri, Kansas & Texas Railway from Dallas to Denton and operate it as an interurban line. The work of electrifying will go forward as rapidly as possible, according to Richard Meriwether, vice-president of the company and in charge of construction work. A crew of fifteen men has been put in the field digging holes for poles along the track of the steam railway. Mr. Meriwether said the entire electrification project, which is expected to cost approximately \$1,500,000 will be completed by August, 1923, and cars started.

The route of the new line from Love Field into Dallas has not been selected, and will not be selected before Dec. 14, Mr. Meriwether said. The traction company will build its own line from Love Field into Dallas, a distance of about 5 miles, and the new line will connect either with the Oak Lawn line on Cedar Springs Road or with the Lave Avenue line at Lake and Oak Lawn Avenue. The mileage in either case is approximately the same and one route is just about as direct in its entry to the business district as the other.

The company has also placed a crew of engineers in the field for surveys of the route of entry into the city of Denton. B. R. Brown and S. R. Fowler, in charge of engineering crews, have made all necessary surveys and have located a depot site in the heart of the business district at Denton. The Denton County Commissioners' Court has also granted a fifty-year franchise for the electrification of the line and the operation of interurban trains over any part of the lines of the Missouri, Kansas & Texas Railway, in Denton County from the Dallas County line to the corporate limits of the city of Denton. A similar franchise will be granted by the Commissioners' Court of Dallas County.



HERE ARE TWENTY LOCOMOTIVES IN THE WESTINGHOUSE WORKS IN VARIOUS STAGES OF COMPLETION. THEY COMPRISE MORE THAN HALF OF THE ORDER FOR THE CHILEAN STATE RAILWAYS AND WILL BE WORTH, COMPLETED, OVER \$2,000,000

Rolling Stock

Glendale & Montrose Railway, Glendale, Calif., expects to furnish new modern cars in line with its complete rehabilitation of the property.

International Railway, Buffalo, N. Y., lost thirty-one cars in a fire which destroyed the Cold Spring paint shop on the morning of Dec. 13. The cars destroyed consisted of nine Peter Witt type center exit cars; eleven double-end cars; three near-side pay-as-you-enter cars; four interurban cars and four converted one-man cars.

Public Service Company, San Antonio, Tex., has placed orders for fifteen new one-man cars to cost approximately \$100,000, according to announcement by E. H. Keifer, general manager. Contract for purchase of the equipment was signed Nov. 25 and calls for the first delivery on cars eight weeks from that date. The new cars will be put in service in speeding up traffic in carrying out the traction company's agreement with the city in connection with the city's curtailment of the operation of jitneys in competition with street cars.

Boston (Mass.) Elevated Railway has given an order to the Westinghouse Electric & Manufacturing Company to furnish thirty motor and control equipments for cars. Each equipment will include four Westinghouse Type 508-A motors with helical gearing and Type K-71 controllers. The cars, which are practically duplicates of those purchased by the railway last March, are being built by the Laconia Car Company and will be equipped for operation from either end. Work on the equipments has been started at the East Pittsburgh Works of the Westinghouse Company and shipment will be made about February, 1923.

Sandusky, Norwalk & Mansfield Electric Railway, Norwalk, Ohio, has purchased two gasoline rail cars from the American Railway Motor Car Company, Elyria, Ohio. These cars will be operated over the interurban tracks connecting Norwalk and Shelby, Ohio, a distance of 30 miles. The new cars will seat 40 passengers and weigh 13 tons. They are to be equipped with Midwest engines, and will have Timken roller bearings for the journals and a new type of transmission recently patented. The present owners of the railway bought it at a small fraction of its original cost, and are said therefore to have an opportunity to operate profitably.

Track and Roadway

Philadelphia (Pa.) Rapid Transit Company, through President Mitten, has submitted to the Council ordinances for three proposed new trolley routes connecting the Frankford section with Germantown and Nicetown.

Northwestern Ohio Railway & Power Company, Oak Harbor, Ohio, is constructing about 5 miles of new track

around the Kelley Island Lime & Stone Company's plant near Lakeside.

Gulfport & Mississippi Coast Traction Company, Gulfport, Miss., will extend its curves at Fourteenth Street and Twenty-first Avenue and Fifteenth Street and Twenty-first Avenue.

Public Service Railway Company, Newark, N. J., has begun the work of raising 1,000 feet of track on Lafayette Street, Riverside, N. J. The company and the Burlington County authorities planned to eliminate the Fairview Street and Pavilion Avenue crossings on both sides of the railroad by repairing Lafayette Street.

Pacific Electric Railway Company, Los Angeles, Calif., was given permission by the commission to make track changes in the City of Long Beach. The company plans to relocate its crossing across the tracks of the Los Angeles & Salt Lake Railroad at Alamitos Avenue and Broadway, to construct an additional track, and to relocate tracks across Alamitos Avenue and across the intersection of Olive Avenue and Broadway.

Power Houses, Shops and Buildings

United Electric Railways, Providence, R. I., is taking figures for the construction of its new carhouse on North Broadway, East Providence. The structure is to be one and two stories high, 535x170 ft., of brick and steel. C. R. Makepiece & Company, Providence, are the engineers.

British Columbia Electric Railway, Vancouver, B. C., is preparing to build a new substation on Bodwell Road to cost about \$65,000. It will probably be ready in six months. This station will be of the latest type. It will supply direct-current for railway purposes in the South Vancouver district.

Louisville (Ky.) Railway is planning the erection of a large new office building and interurban station, work on which will probably start within three or four months. This station will house the offices of the company and its subsidiary, the Louisville & Interurban Railway, as well as the interurban lines operating out of Louisville, including those into southern Indiana operated by the Interstate Public Service Company.

Trade Notes

A. A. Heller has taken over the management of the International Oxygen Company, in place of L. W. Hench, secretary and general manager, resigned.

Locke Insulator Company, Victor, N. Y., has been awarded the order for insulators on the Paris-Orleans (France) Railroad 150,000-volt electrification. It is understood that this is the largest insulator order that has been made in ten years.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces a change in the addresses of the St. Louis and Los Angeles offices. The former office is now located at 717 South Twelfth Street, St. Louis, and the latter at 420 South San Pedro Street, Los Angeles.

Monroe Brass & Wire Company, Cincinnati, Ohio, announces the death of its manager, J. Sumner Monroe. The business conducted by the late J. Sumner Monroe was incorporated under the laws of the State of Ohio Oct. 6 as the Monroe Brass & Wire Company with L. D. Whitcomb as president and general manager.

H-E Supply Company, Chicago, Ill., has been organized with offices at 945 Monadnock Building by J. W. Himmelsbach. The company will handle the products of the United Boiler, Heating & Foundry Company of Hammond, Ind., which manufactures steel tanks, steel stacks, breeching, light structural steel work, United traveling grate stokers and accessories and repair parts for all types of automatic and hand-fired stokers. Mr. Himmelsbach is known to the electric railway field for his connections with the Green Engineering Company, of which he was formerly district manager in Chicago, and with the Johnson Fare Box Company.

New Advertising Literature

Locke Insulator Corporation, Victor, N. Y., has issued an eleven-page booklet entitled "Strain Insulators for Guy, Dead End and Anchor Service."

Gould Coupler Company, New York, N. Y., has issued a descriptive booklet describing its type B and C slack adjusters. Drawings are given of the applications of these brake slack adjusters to late designs of cars, including one-man types.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a twenty-page booklet, folder 4506, entitled "Salient Facts on Silent Gears." This is issued in order to acquaint the industrial gear user with the advantages of Micarta gears. The booklet describes the advantages of the use of Micarta gears and pinions and gives photographs and data describing some of their applications, tables of gear data, etc., enabling the gear user to judge whether or not they are applicable to his machinery.

Economy Electric Devices Company has recently published an interesting circular which is available for electric railway men, setting forth what may be accomplished by the substitution of aluminum field coils for copper. In this circular it is pointed out that as much as 1,500 lb. can be saved on some interurban equipment and up to 1,000 lb. on some city equipment by using aluminum coils. The technical aspects of the aluminum coil are quite clearly and fully set forth. Quite a considerable number of these coils are now in use on some forty electric railways.



PEACOCK STAFFLESS BRAKES

**Safety First—
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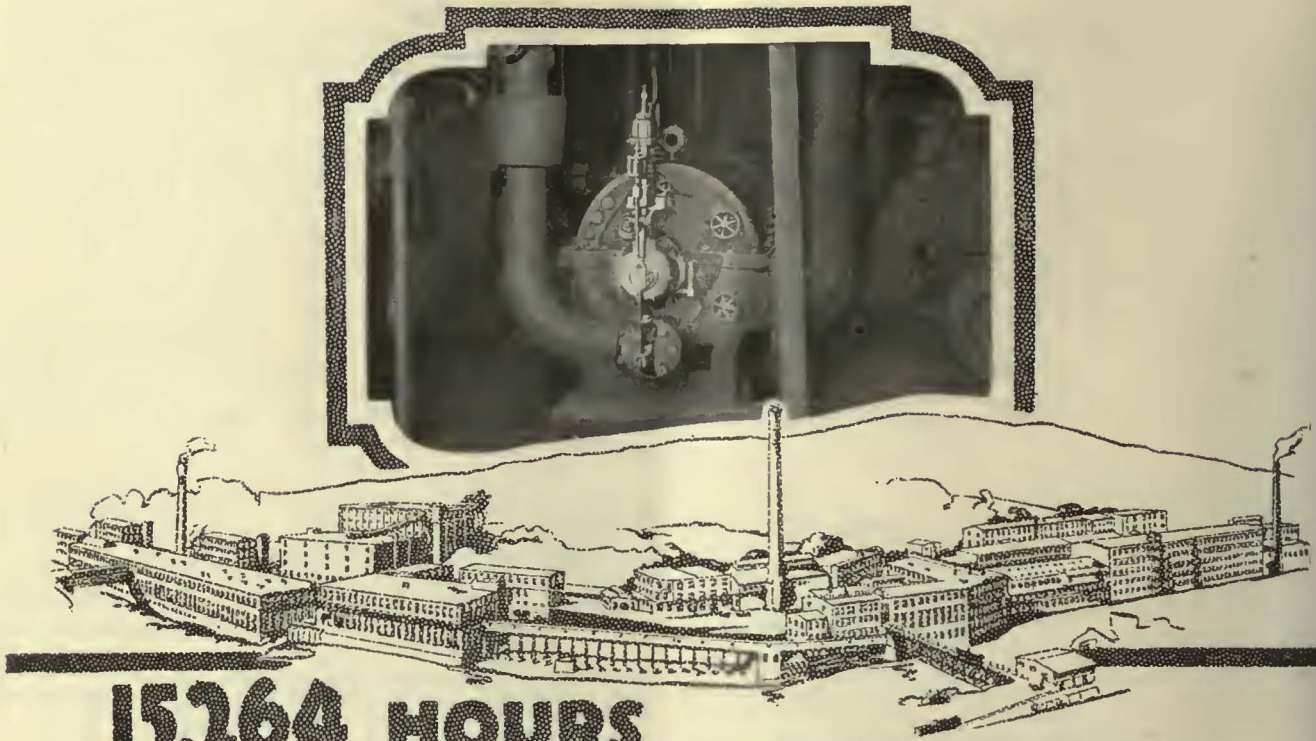
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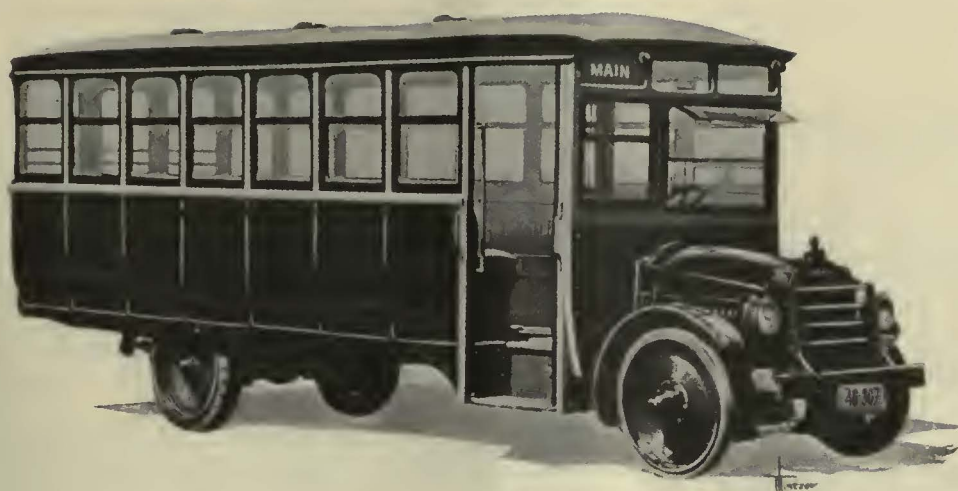
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They will want to know just where the industry is headed before they plunge with their newly developed net profits.



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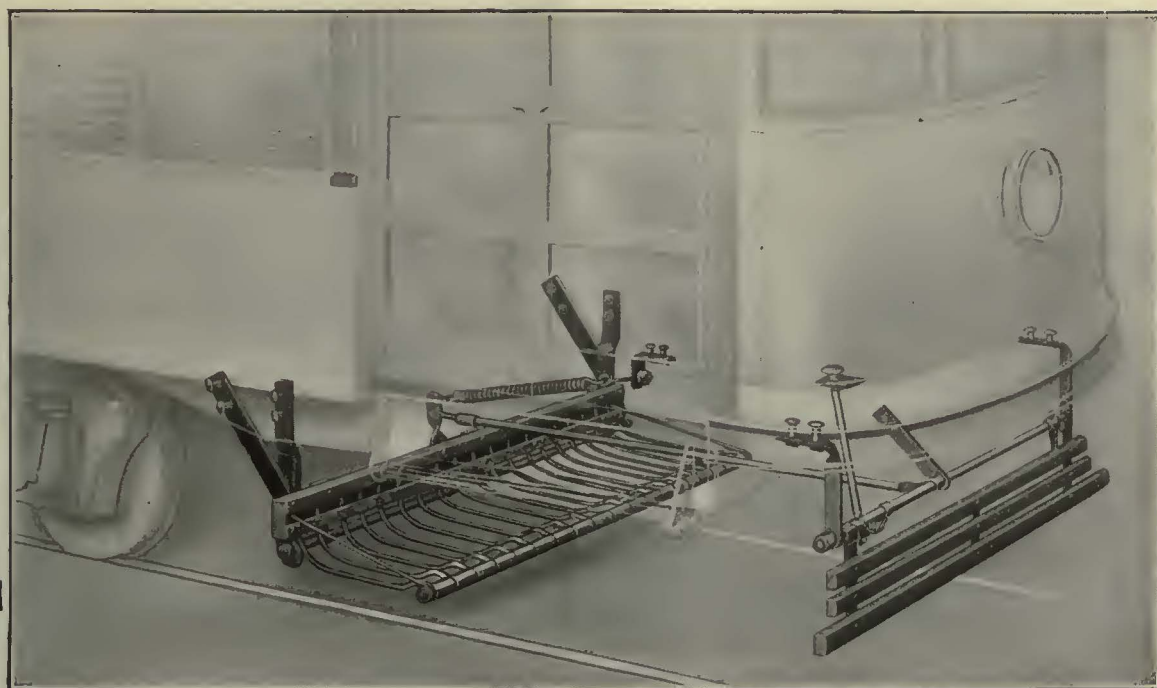
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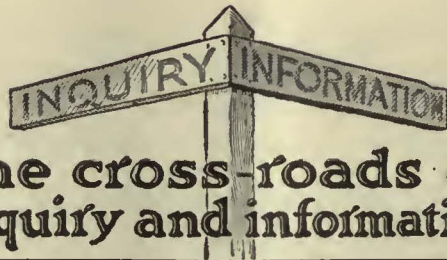
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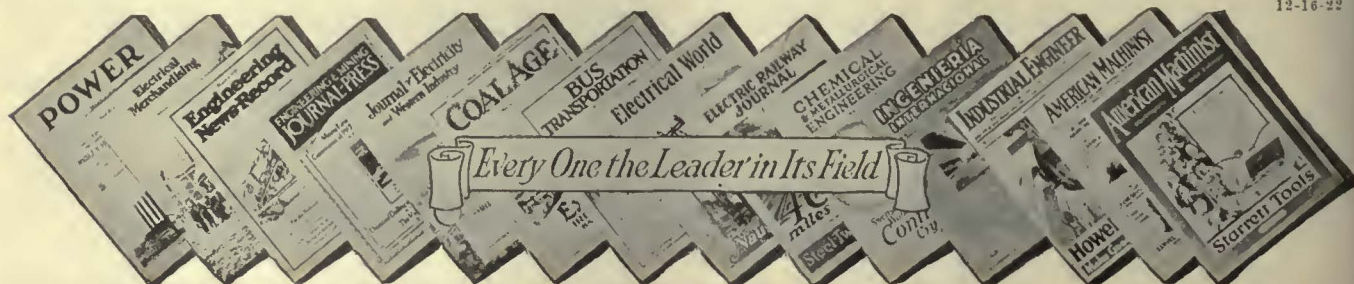
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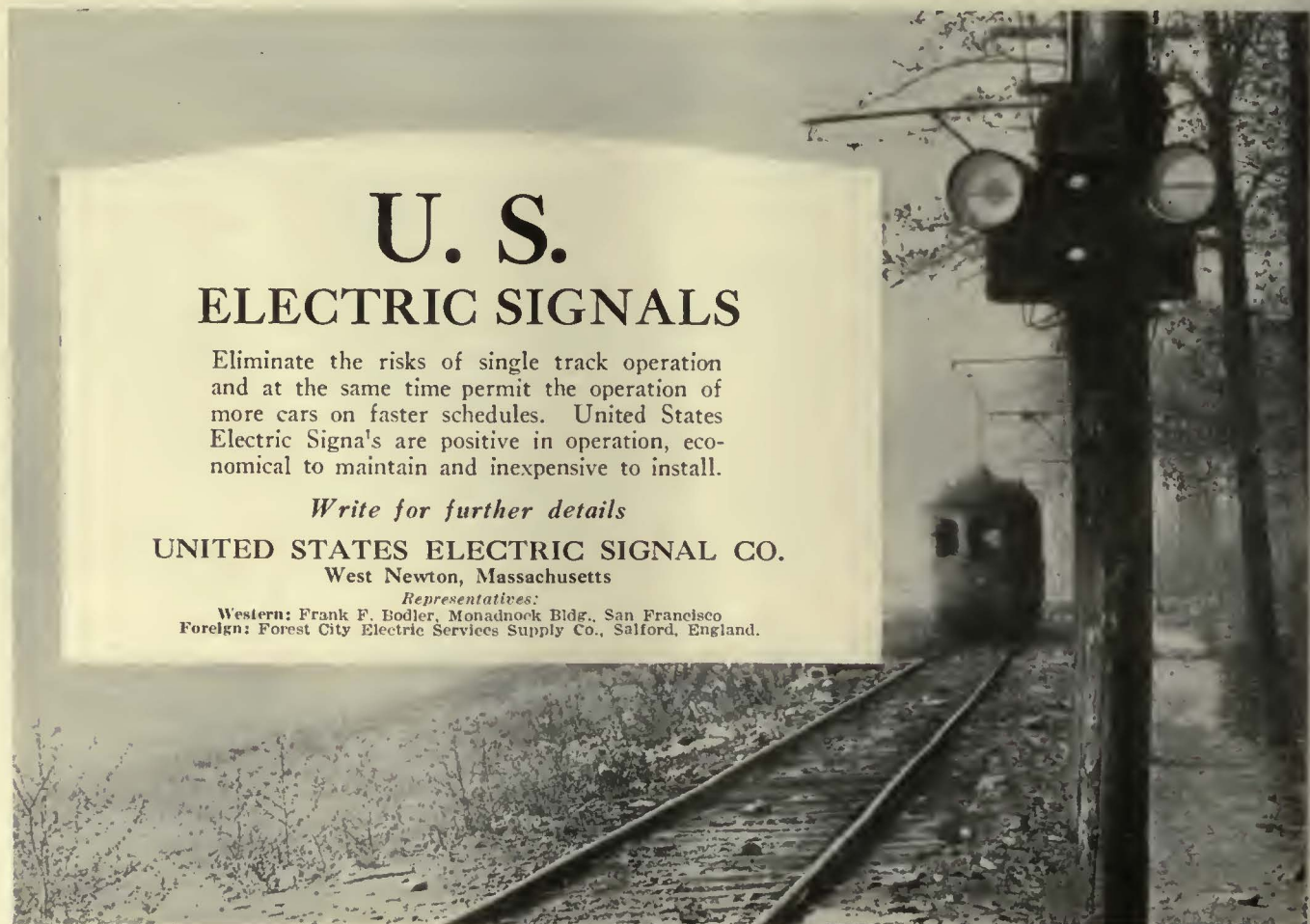
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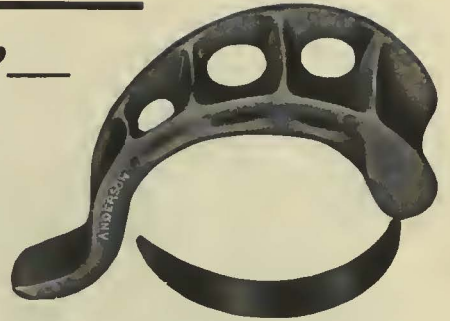
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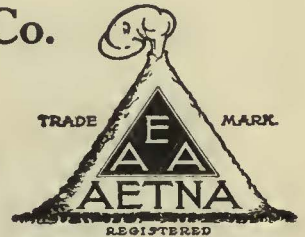
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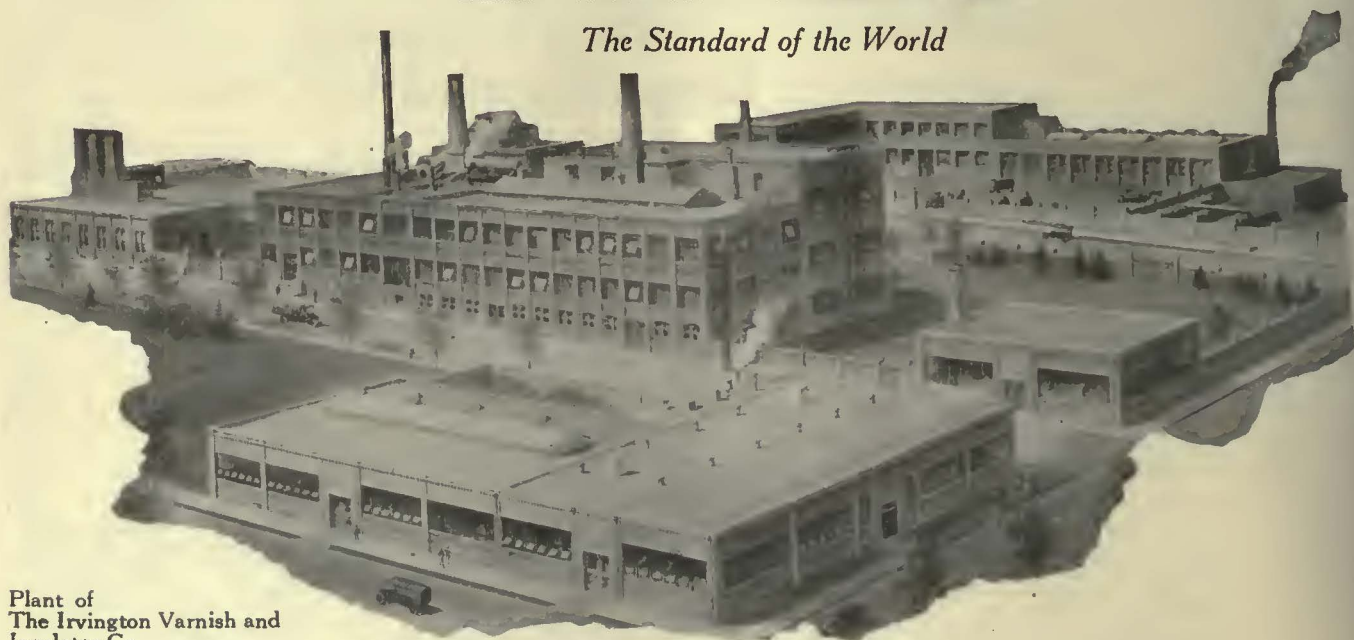
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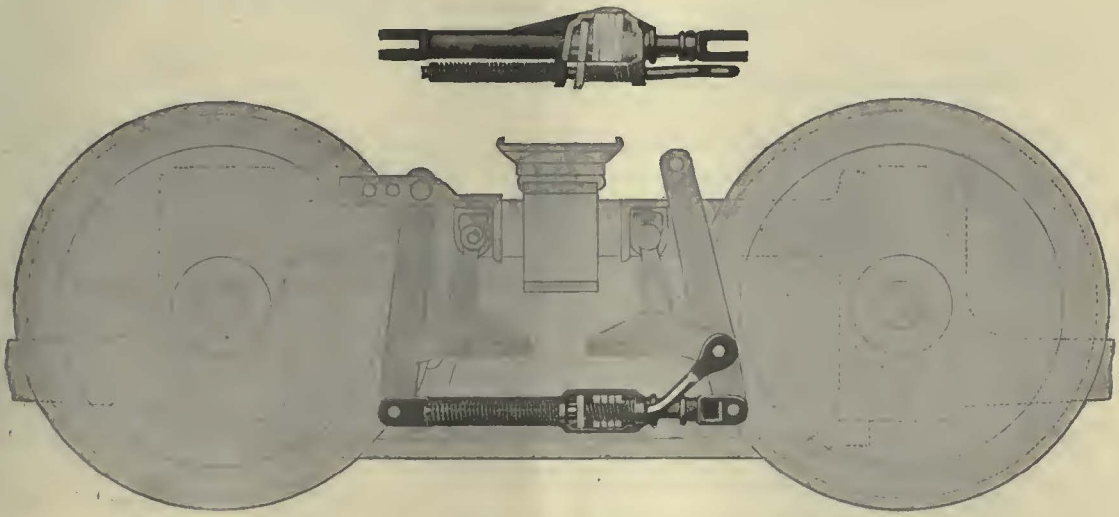
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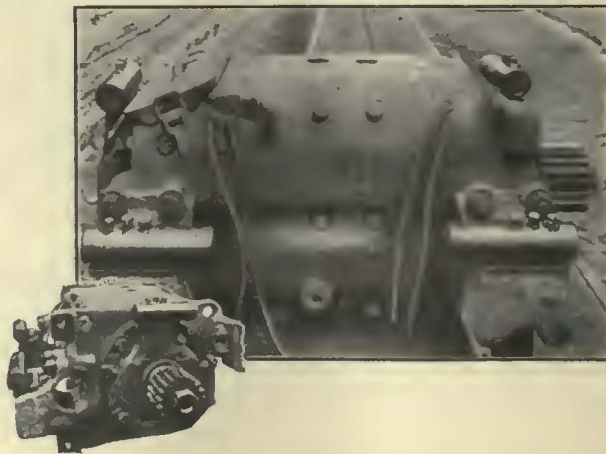
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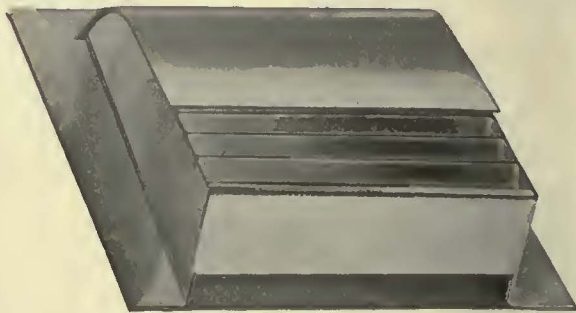
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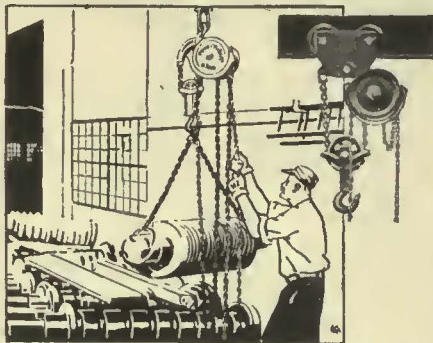


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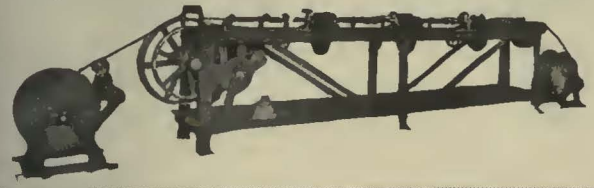
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We solicit a test of TULC
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Micanite armature and commutator insulation, commutator segments and rings, plate, tubes, etc., Empire oiled insulating materials; Linotape; Kablak; Mico; and other products—for the electrical insulating requirements of the railway.

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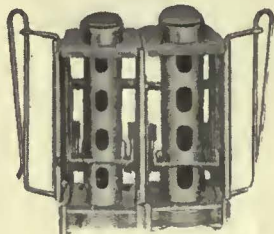
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Exclusive selling agents for HEEREN ENAMEL BADGES.

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is one of the winter problems that you must settle without delay. We can show you how to take care of both, with one equipment. Now is the time to get your cars ready for next winter. Write for details.

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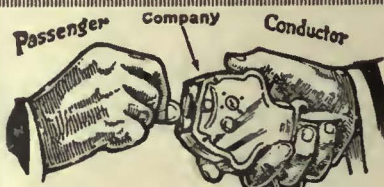
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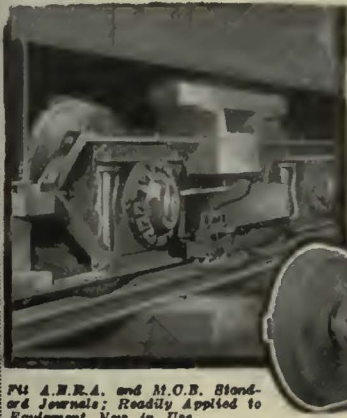
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They Eliminate
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**REDUCE YOUR POWER
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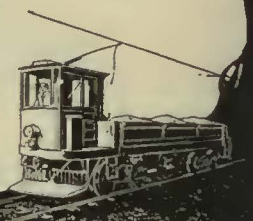
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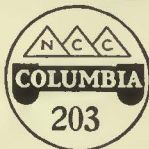
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Grade 203, produced by research and proved by test, the most satisfactory and lowest cost-per-car-mile brush obtainable for A. C. commutator type railway motors. One of a series of standard railway motor brushes.

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AUDITOR, broad experience as chief accounting officer with representative utility interests, now engaged on important work for federal government, desires connection with progressive utility as auditor, secretary or treasurer. PW-488, Electric Railway Journal, Real Estate Trust Bldg., Philadelphia, Pa.

CIVIL engineer, technical; married; member American Society Civil Engineers; six years' miscellaneous engineering experience, twelve with street and interurban railways; present, engineer maintenance of way and structures, large property; engineer of recognized ability; excellent references; interview solicited. PW-489, Elec. Ry. Journal, Old Colony Bldg., Chicago, Ill.

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Send your orders to us and deduct 25 per cent from the current quotations.

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FOR SALE

20—Peter Witt Cars

Weight Complete, 33,000 lbs.

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Think
"SEARCHLIGHT"
 First!

0099

The "Searchlight" Advertising in This Paper

is read by men whose success depends upon thorough knowledge of means to an end—whether it be the securing of a good second-hand piece of apparatus at a moderate price, or an expert employee.

THE BEST PROOF

of this is the variety of this journal's Searchlight ads. Without a constant and appreciable demand for such machinery or services, by its readers, the market place which these advertisements represent could not exist for any length of time.

Are you using the Searchlight Section?

0318

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used by the Electric Railway Industry with
Names of Manufacturers and Distributors Advertising in this Issue

- Advertising, Street Car
Collier, Inc., Barron G.
Air Receivers & Aftercoolers
Ingersoll-Rand Co.
Anchors, Guy
Elec. Service Supplies Co.
Ohio Brass Co.
Western Electric Co.
Westinghouse E. & M. Co.
Anti-Climbers
Railway Improvement Co.
Armature Shop Tools
Armature Coil Equip. Co.
Elec. Service Supplies Co.
Automatic Return Switch
Stands
Ramapo Ajax Corp.
Automatic Safety Switch
Stands
Ramapo Ajax Corp.
Axles
Bemis Car Truck Co.
Axle Straighteners
Columbia M. W. & M. I. Co.
Axles, Car Wheel
Bemis Car Truck Co.
Brill Co., The J. G.
Westinghouse E. & M. Co.
Babbitt Metal
More-Jones B. & M. Co.
Babbitting Devices
Columbia M. W. & M. I. Co.
Badges and Buttons
Elec. Service Sup. Co.
Int. Register Co., The
Batteries, Dry
National Carbon Co.
Bearings and Bearing Metals
Bemis Car Truck Co.
Columbia M. W. & M. I. Co.
General Electric Co.
Gilbert & Sons B. F. Co., A.
Le Grand, Nic
More-Jones Br. & Metal Co.
Westinghouse E. & M. Co.
Bearings, Center and Roller
Side
Burry Railway Supply Co.
Stucki Co., A.
Bearings, Roller
Stafford Roller Bearing Car
Truck Corp.
Bells and Gongs
Brill Co., The J. G.
Columbia M. W. & M. I. Co.
Consolidated Car Heat'g Co.
Elec. Service Sup. Co.
Western Electric Co.
Bollers
Babecock & Wilcox Co.
Bond Testers
Amer. Steel & Wire Co.
Elec. Service Sup. Co.
Bonding Apparatus
Amer. Steel & Wire Co.
Electric Railway Improvement
Co.
Elec. Service Sup. Co.
Indianapolis Switch & Frog
Co.
Ohio Brass Co.
Railway Track-Work Co.
Rail Welding & Bonding Co.
Western Electric Co.
Bonds, Rail
Amer. Steel & Wire Co.
Electric Railway Improvement
Co.
Elec. Service Sup. Co.
General Electric Co.
Indianapolis Switch & Frog
Co.
Ohio Brass Co.
Rail Welding & Bonding Co.
Western Electric Co.
Boxes, Switches
Johns-Pratt Co.
Brackets and Cross Arms
(See also Poles, Ties,
Posts, Etc.)
American Bridge Co.
Bates Exp., Steel Tr. Co.
Electric Ry. Equipment Co.
Elec. Service Sup. Co.
Hubbard & Co.
Ohio Brass Co.
Western Electric Co.
Brake Adjusters
Gould Coupler Co.
Nations' Ry. Appliance Co.
Westinghouse Tr. Br. Co.
Brake Shoes
Amer. Br. Shoe & Fdy. Co.
Barbour-Stockwell Co.
Bemis Car Truck Co.
Brill Co., The J. G.
Columbia M. W. & M. I. Co.
Brakes, Brake Systems and
Brake Parts
Allis-Chalmers Mfg. Co.
Bemis Car Truck Co.
Brill Co., The J. G.
Columbia M. W. & M. I. Co.
Safety Car Devices Co.
General Electric Co.
National Brake Co.
Westinghouse Tr. Br. Co.
Bridges and Buildings
American Bridge Co.
Brooms, Brushes, Etc.
Worcester Brush & Scraper
Co.
Brooms, Track, Steel and
Rattan
Amer. Rattan & Reed Mfg.
Co.
Worcester Brush & Scraper
Co.
Brushes, Carbon
General Electric Co.
Jeandron, W. J.
Le Carbone Co.
Morganite Brush Co., Inc.
National Carbon Co.
Westinghouse E. & M. Co.
Brushes, Graphite
Morganite Brush Co., Inc.
National Carbon Co.
Brushes, Wire, Pneumatic
Ingersoll-Rand Co.
Brush Holders
Anderson Mfg. Co., A. &
J. M.
Columbia M. W. & M. I. Co.
Bunkers, Coal
American Bridge Co.
Buses, Motor
Brill Co., The J. G.
Mitten-Traylor, Incorporated
Bushings
Nat'l Fibre & Insulation Co.
Bushings, Case Hardened and
Manganese
Bemis Car Truck Co.
Brill Co., The J. G.
Bus Seats
Hale & Kilburn Corp.
Cables, (See Wires and
Cables)
Cambic Tapes, yellow and
black varnished
Irvington Varnish & Ins. Co.
Mica Insulator Co.
Carbon Brushes (See Brushes,
Carbon)
Car Panel Safety Switches
Westinghouse E. & M. Co.
Cars, Pump
Differential Steel Car Co.
Car Lighting Fixtures
Elec. Service Sup. Co.
Car Panel Safety Switches
Consolidated Car Heat'g Co.
Cars, Passenger, Freight, Ex-
press, etc.
Amer. Car Co.
Brill Co., The J. G.
Kuhlman Car Co., G. C.
National Ry. Appliance Co.
Wagon Mfg. Co.
Cars, Second Hand
Electric Equipment Co.
Transit Equipment Co.
Cars, Self-Propelled
General Electric Co.
Castings, Brass, Composition
or Copper
Anderson Mfg. Co., A. &
J. M.
Columbia M. W. & M. I. Co.
More-Jones Br. & Metal Co.
Castings, Gray Iron and Steel
American Bridge Co.
Bemis Car Truck Co.
Columbia M. W. & M. I. Co.
Castings, Malleable and Brass
Archbold-Brady Co.
Bemis Car Truck Co.
Columbia M. W. & M. I. Co.
Le Grand, Nic
Catchers and Retrievers,
Trolley
Earll, Chas. I.
Elec. Service Sup. Co.
Ohio Brass Co.
Wood Co., Chas. N.
Catenary Construction
Archbold-Brady Co.
Western Electric Co.
Centrifugal Machinery
De Laval Separator Co.
Circuit-Breakers
General Electric Co.
Westinghouse E. & M. Co.
Clamps and Connectors for
Wires and Cables
Anderson Mfg. Co., A. &
J. M.
Elec. Ry. Equipment Co.
Elec. Service Sup. Co.
General Electric Co.
Hubbard & Co.
Ohio Brass Co.
Westinghouse E. & M. Co.
Cleaners and Scrapers, Track
(See also Snow-Plows,
Sweepers and Brooms)
Brill Co., The J. G.
Clusters and Sockets
General Electric Co.
Coal and Ash Handling (See
Conveying and Hoisting
Machinery)
Coasting Recorders
Railway Improvement Co.
Coil Banding and Winding
Machines
Armature Coil Equip. Co.
Columbia M. W. & M. I. Co.
Elec. Service Sup. Co.
Colls, Armature and Field
Columbia M. W. & M. I. Co.
General Electric Co.
Westinghouse E. & M. Co.
Colls, Choke and Kicking
Elec. Service Sup. Co.
General Electric Co.
Westinghouse E. & M. Co.
Coin Counting Machines
Intern'l Register Co.
Johnson Fare Box Co.
Commutator Slotters
Elec. Service Sup. Co.
General Electric Co.
Westinghouse E. & M. Co.
Commutator Truing Devices
General Electric Co.
Commutators or Parts
Cameron Elec. Mfg. Co.
Cleveland Armature Works
Columbia M. W. & M. I. Co.
General Electric Co.
Mica Insulator Co.
Westinghouse E. & M. Co.
Compressors, Air
General Electric Co.
Ingersoll-Rand Co.
Western Electric Co.
Westinghouse Tr. Br. Co.
Compressors, Air Portable
Ingersoll-Rand Co.
Condensers
Allis-Chalmers Mfg. Co.
General Electric Co.
Ingersoll-Rand Co.
Westinghouse E. & M. Co.
Condensor Papers
Irvington Varnish & Ins. Co.
Connectors, Solderless
Westinghouse E. & M. Co.
Connectors, Trailer Car
Consolidated Car Heat'g Co.
Elec. Service Sup. Co.
Ohio Brass Co.
Controllers or Parts
Columbia M. W. & M. I. Co.
General Electric Co.
Westinghouse E. & M. Co.
Controlling Regulators
Elec. Service Sup. Co.
Controlling Systems
General Electric Co.
Westinghouse E. & M. Co.
Converters, Rotary
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse E. & M. Co.
Conveying and Hoisting Ma-
chinery
American Bridge Co.
Columbia M. W. & M. I. Co.
Cooling Systems
Spray Engineering Co.
Copper Wire
Anaconda Copper Mining Co.
Cord Adjusters
Nat'l Fibre & Insulation Co.
etc.
Cord, Bell, Trolley, Register,
Brill Co., The J. G.
Elec. Service Sup. Co.
Internatl Register Co., The
Roebling's Sons Co., John A.
Samson Cordage Works
Silver Lake Co.
Cord Connectors and Couplers
Elec. Service Sup. Co.
Samson Cordage Works
Wood Co., Chas. N.
Couplers, Car
Brill Co., The J. G.
Gould Coupler Co.
Ohio Brass Co.
Westinghouse Tr. Br. Co.
Cranes
Allis-Chalmers Mfg. Co.
Cross Arms (See Brackets)
Crossing Foundations
International Steel Tie Co.
Crossings
Ramapo Ajax Corp.
Crossing Signals (See Sig-
nals, Crossing)
Crossing, Frog & Switch
Wharton, Jr., & Co., Wm.
Ramapo Ajax Corp.
Crossing Manganese
Indianapolis Switch & Frog
Co.
Ramapo Ajax Corp.
Crossings, Track (See Track,
Special Work)
Crossings, Trolley
Ohio Brass Co.
Curtains and Curtain Fixtures
Brill Co., The J. G.
Edwards Co., Inc., The O. M.
Elec. Service Sup. Co.
Motors Mfg. Co.
Cutouts
Johns-Pratt Co.
Dealer's Machinery
Elec. Equipment Co.
Foster Co., H. M.
Derailing Devices (See also
Track Work)
Wharton, Jr., & Co., Wm.
Derailing Switches, Tee Rail
Ramapo Ajax Corp.
Detective Service
Wish-Service, P. Edward
Dogs, Lathe
Williams & Co., J. H.
Doors & Door Fixtures
Edwards Co., Inc., The O. M.
Door Operating Devices
Brill Co., The J. G.
Consolidated Car Heat'g Co.
General Electric Co.
Nat'l Pneumatic Co., Inc.
Doors, Folding Vestibule
Nat'l Pneumatic Co., Inc.
Drills, Rock
Ingersoll-Rand Co.
Drills, Track
Amer. Steel & Wire Co.
Elec. Service Sup. Co.
Ingersoll-Rand Co.
Ohio Brass Co.
Dryers, Sand
Elec. Service Sup. Co.
Ears
Ohio Brass Co.
Electrical Wires and Cables
Amer. Electrical Works
Roebling's Sons & Co., J. A.
Western Electric Co.
Electric Grinders
Railway Track-Work Co.
Electrodes, Carbon
Indianapolis Switch & Frog
Co.
Railway Track-Work Co.
Electrodes, Steel
Indianapolis Switch & Frog
Co.
Railway Track-Work Co.
Engineers, Consulting, Con-
tracting and Operating
Allison & Co., J. S.
Archbold-Brady Co.
Arnold Co., The
Beeler, John A.
Byllesby & Co., H. M.
Day & Zimmerman, Inc.
Dodd, J. N.
Drum & Co., A. L.
Fenstall, Robert M.
Ford, Bacon & Davils
Gould, L. E.
Hemphill & Wells
Hols, Engelhardt W.
Jackson, Walter
Kelly, Cooke & Co.
Ong, Joe R.
Richey, Albert S.
Robinson & Co., Dwight P.
Sanderson & Porter
Sangster & Mathews
Smith & Co., C. E.
Stone & Webster
White Eng. Corp., The J. G.
Witt, Peter
Engines, Gas, Oil or Steam
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Westinghouse E. & M. Co.
Extension Platform Trap
Doors
Edwards Co., Inc., The O. M.
Fare Boxes
Cleveland Fare Box Co.
Johnson Fare Box Co.
Economy Elec. Devices Co.
Nat'l Ry. Appliance Co.
Ohmer Fare Register Co.
Fences, Woven Wire and
Fence Posts
Amer. Steel & Wire Co.
Fences and Wheel Guards
Brill Co., The J. G.
Cleveland Fare Box Co.
Consolidated Car Fender Co.
Elec. Service Sup. Co.
Le Grand, Nic
Star Brass Works
Fibre and Fibre Tubing
Nat'l Fibre & Insulation Co.
Westinghouse E. & M. Co.
Field Coils (See Coils)
Flatiron Insulation
Nat'l Ry. Appliance Co.
Floodlights
Elec. Service Sup. Co.
Flooring Composition
Amer. Mason Safety Tread
Co.
Forgings
Columbia M. W. & M. I. Co.
Williams & Co., J. H.
Frogs & Crossing, Tee Rail
Ramapo Ajax Corp.
Frogs, Track (See Track
Work)
Frogs, Trolley
Ohio Brass Co.
Funnel Castings
Wharton, Jr., Inc., & Co.,
Wm.
Furniture, Metal Office
Edwarda Co., Inc., The O. M.
Fuses and Fuse Boxes
Columbia M. W. & M. I. Co.
Consolidated Car Heat'g Co.
General Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.
Williams & Co., J. H.
Fuses, Cartridge, Non-
Refillable
Johns-Pratt Co.
Fuses, Refillable
Columbia M. W. & M. I. Co.
General Electric Co.
Johns-Pratt Co.
Fuses, High Voltage
Johns-Pratt Co.
Gaskets
Westinghouse Tr. Br. Co.
Gasoline Torches
Economy Elec. Devices Co.
Gas-Electric Cans
General Electric Co.
Gas Producers
Westinghouse E. & M. Co.
Gates, Car
Brill Co., The J. G.
Gear Cases
Chillingworth Mfg. Co.
Columbia M. W. & M. I. Co.
Elec. Service Sup. Co.
Westinghouse E. & M. Co.
Gears and Pinions
Bemis Car Truck Co.
Columbia M. W. & M. I. Co.
Elec. Service Sup. Co.
General Electric Co.
Nat'l Ry. Appliance Co.
Nuttall Co., R. D.
Tool Steel Gear & Pinion
Co.
Generating Sets, Gas-Electric
General Electric Co.
Generators
Allis-Chalmers Mfg. Co.
General Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.
Goggles—Eye
Indianapolis Switch & Frog
Co.
Gong (See Bells and Gongs)
Greases (See Lubricants)
Grinders and Grind, Snipples,
Metal & Thermit Corp.
Indianapolis Switch & Frog
Co.
Railway Track-work Co.
Grinders, Portable
Railway Track-Work Co.
Grinders, Portable Electric
Railway Track-Work Co.
Grinding Blocks and Wheels
Railway Track-work Co.
Guard Rail Clamps
Ramapo Ajax Corp.
Guard Rails, Tee Rail &
Manganese
Ramapo Ajax Corp.
Guards, Cattle
American Bridge Co.
Guards, Trolley
Elec. Service Sup. Co.
Ohio Brass Co.
Hamme Pneumatic
Ingersoll-Rand Co.
Harps, Trolley
Anderson Mfg. Co., A. &
J. M.
Bayonet Trolley Harp Co.
Elec. Service Sup. Co.
More-Jones Br. & Metal Co.
Nuttall Co., R. D.
Star Brass Works
Western Electric Co.
Headlights
Elec. Service Sup. Co.
General Electric Co.
Ohio Brass Co.
Heaters, Car (Electric)
Consolidated Car Heat'g Co.
Economy Elec. Devices Co.
Gold Car Heat. & Light Co.
Nat'l Ry. Appliance Co., P.
Smith Heater Co., Peter
Helmets—Welding
Indianapolis Switch & Frog
Co.
Heaters, Car, Hot Air and
Water
Elec. Service Sup. Co.
Smith Heater Co., Peter
Holds and Lifts
Columbia M. W. & M. I. Co.
Ford Chain Block Co.
Holds, Portable
Ingersoll-Rand Co.
Hydraulic Machinery
Allis-Chalmers Mfg. Co.
Instruments Measuring, Test-
ing and Recording
Economy Elec. Devices Co.
Elec. Service Sup. Co.
General Electric Co.
Western Electric Co.
Westinghouse E. & M. Co.



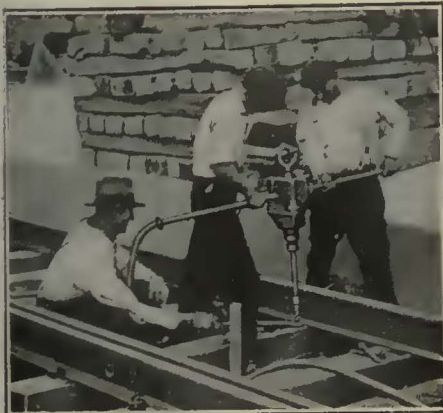
The Imperial Tamper Car is a handy portable compressor for many kinds of work.



Imperial Tampers enable small gangs to equal the work output of large ones.



Paving Breakers operated from the Tamper Car show savings up to 75% over handwork.



Other machines such as the screw spike driver can be used with a Tamper Car to reduce track work costs.

Further Savings in Track Work

Four men with "Imperial" Pneumatic Tamping Tools will tamp more track than 12 to 16 men working with picks and bars, and do a better and more lasting job.

Besides quartering the cost of tamping ties, "Imperial" Outfits make possible the use of labor-saving methods on other kinds of work. For instance, in breaking out paving of any character, the Portable Tamper Car supplies air to the pneumatic Paving Breakers, which show savings of 60% to 75% over hand methods.

Other tools used with the outfit are air-operated spike drivers, tie borers, track drills, portable grinders, riveters and chipping hammers, etc.

The sum total of all the savings possible with "Imperial" Tamping Outfits makes them the greatest labor-saving machines for general track work.

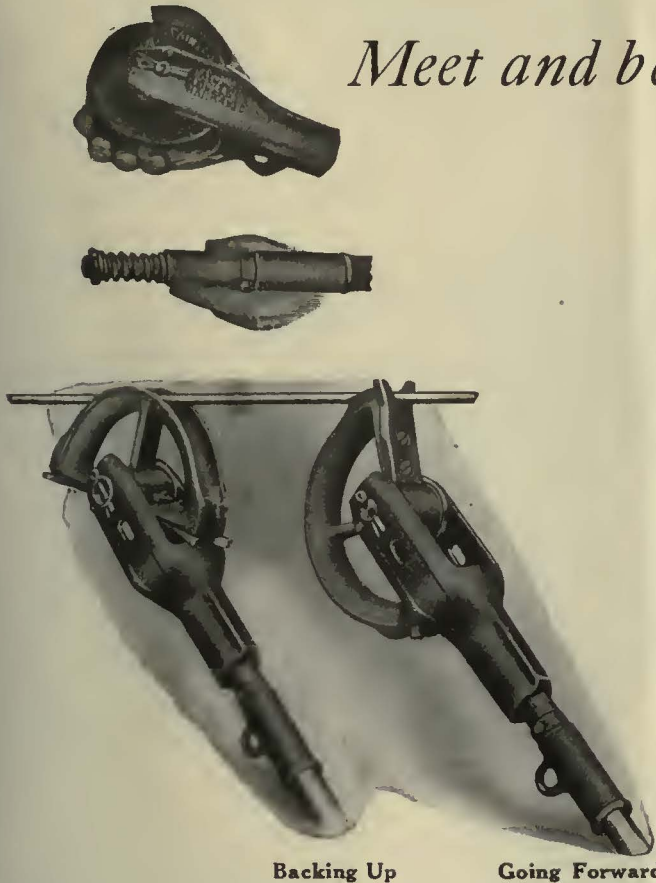
Let us tell you how "Imperials' are reducing track costs on other electric railways.

INGERSOLL-RAND COMPANY
 General Offices: 11 Broadway, New York .
 Offices Everywhere

- Insulating Cloth, Paper and Tape
Anchor-Webbing Co.
General Electric Co.
Irvington Varnish & Ins. Co.
Mica Insulator Co.
National Fibre & Insulation Stand. Underground Cable Co.
Westinghouse E. & M. Co.
Insulating Compounds & Varnishes
Sterling Varnish Co.
Insulating Silk
Irvington Varnish & Ins. Co.
Insulating Varnishes
Irvington Varnish & Ins. Co.
Sterling Varnish Co. The Insulation (See also Paints)
Anderson, M. Co., A. & J. M.
Electric Ry. Equipmt. Co.
Electric Service Sup. Co.
General Electric Co.
Irvington Varnish & Ins. Co.
Mica Insulator Co.
Sterling Varnish Co. The
Westinghouse E. & M. Co.
Insulators (see also Line Material)
American Porcelain Co.
Anderson, M. Co., A. & J. M.
Electric Ry. Equipmt. Co.
Electric Service Sup. Co.
General Electric Co.
Hemingray Glass Co.
Irvington Varnish & Ins. Co.
Ohio Brass Co.
Western Electric Co.
Westinghouse E. & M. Co.
Insulators, Combination Strain
American Porcelain Co.
Insulator Pins
Elec. Service Sup. Co.
Hubbard & Co.
Insurance, Fire
Marsh & McLennan
Jacks (See also Cranes, Hoists and Lifts)
Buckeye Jack Mfg. Co.
Elec. Service Sup. Co.
Joints, Rail
(See Rail Joints)
Journal Boxes
Remis Car Truck Co.
Brill Co., J. G.
Junction Boxes
Std. Underground Cable Co.
Labor Adjusters
Corpn. Service Bureau, The
Lamps, Guards and Fixtures
Anderson, M. Co., A. & J. M.
Elec. Service Sup. Co.
General Electric Co.
Westinghouse E. & M. Co.
Lamps, Arc & Incandescent
(See also Headlights)
Anderson, M. Co., A. & J. M.
General Electric Co.
Westinghouse E. & M. Co.
Lamps, Signal and Marker
Nichols-Lintern Co.
Lanterns, Classification
Nichols-Lintern Co.
Lathe Attachments
Williams & Co., J. H.
Lightning Protection
Anderson, M. Co., A. & J. M.
Elec. Service Sup. Co.
General Electric Co.
Ohio Brass Co.
Westinghouse E. & M. Co.
Line Material (See also Brackets, Insulators, Wires, etc.)
Anderson, M. Co., A. & J. M.
Archbold-Brady Co.
Columbia M. W. & M. I. Co.
Electric Ry. Equipmt. Co.
Elec. Service Sup. Co.
General Electric Co.
Hubbard & Co.
More-Jones Br. & Metal Co.
Ohio Brass Co.
Western Electric Co.
Westinghouse E. & M. Co.
Lockers, Metal
Edwards Co., Inc. The O. M.
Locking Spring Boxes
Wharton, Jr., & Co., Wm.
Locomotives, Electric
General Electric Co.
Westinghouse E. & M. Co.
Lubricating Engineers
Galena Signal Oil Co.
Texas Co.
Universal Lubricating Co.
Lubricants, Oil and Grease
Galena Signal Co.
Texas Co.
Universal Lubricating Co.
Machine Tools
Columbia M. W. & M. I. Co.
Machete Work
Columbia M. W. & M. I. Co.
Machinery, Insulating
Amer. Insulating Mach. Co.
- Manganese Steel Castings
Wharton, Jr., & Co., Wm.
Manganese Steel Guard Rails
Ramapo Ajax Corp.
Manganese Steel Switches
Frogs & Crossings
Ramapo Ajax Corp.
Manganese Steel Special Track Work
Wharton, Jr., & Co., Wm.
Manganese Track-work
Indianapolis Switch & Frog Co.
Meter Car, Watt Hour
Economy Elec. Devices Co.
Meters (See Instruments)
Elec. Service Sup. Co.
Mica
Mica Insulator Co.
Molding, Metal
Allis-Chalmers Mfg. Co.
Motor Buses (See Buses, Motor)
Motormen's Seats
Allis-Chalmers Mfg. Co.
Brill Co., J. G.
Elec. Service Sup. Co.
Wood Co., Chas. N.
Motors, Electric
Westinghouse E. & M. Co.
Motors and Generators, Sets
General Electric Co.
Nuts and Bolts
Barbour-Stockwell Co.
Remis Car Truck Co.
Columbia M. W. & M. I. Co.
Hubbard & Co.
Oils (See Lubricants),
Omnibuses (See Buses, Motor)
Oxy-Acetylene (See Cutting Apparatus Oxy)
Paints and Varnishes (Insulating)
Beckwith-Chandler Co.
Mica Insulator Co.
Sterling Varnish Co., The
Paints and Varnishes for Woodwork
Beckwith-Chandler Co.
National Ry. Appliance Co.
Pavement Breakers
Ingersoll-Rand Co.
Paving Material
Amer. Br. Shop & Fdy. Co.
Pickups, Trolley Wire
Elec. Service Sup. Co.
Ohio Brass Co.
Pintol Pullers
Columbia M. W. & M. I. Co.
Elec. Service Sup. Co.
General Electric Co.
Wood Co., Chas. N.
Pinions (See Gears)
Pins, Case Hardened, Wood and Iron
Remis Car Truck Co.
Elec. Service Sup. Co.
Ohio Brass Co.
Westinghouse Tr. Brake Co.
Pipe Fittings
Westinghouse Tr. Brake Co.
Pliers (See Machine Tools)
Plates for Tee Rail Switches
Ramapo Ajax Corp.
Pliers, Rubber Insulated
Elec. Service Sup. Co.
Pneumatic Tools
Ingersoll-Rand Co.
Pole Line Hardware
Ohio Brass Co.
Poles, Metal Street
Bates Exp. Steel Truss Co.
Elec. Ry. Equipmt. Co.
Hubbard & Co.
Western Electric Co.
Pole Reinforcing
Hubbard & Co.
Poles & Ties Treated
International Crossting & Construction Co.
Poles, Ties, Posts, Piling & Lumber
International Crossting & Construction Co.
Le Grand, Inc., Nlc
Nashville Tie Co.
Poles, Trolley
Anderson Mfg. Co., A. & J. M.
Bayonet Trolley Harp Co.
Columbia M. W. & M. I. Co.
Elec. Service Supplies Co.
Nuttall Co., R. D.
Poles, Tubular Steel
Elec. Ry. Equipmt. Co.
Elec. Service Sup. Co.
Power Saving Devices
Economy Elec. Devices Co.
National Ry. Appliance Co.
Railway Improvement Co.
Pressure Regulators
General Electric Co.
Westinghouse E. & M. Co.
Pumps
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Pumps, Vacuum
Ingersoll-Rand Co.
Punches, Tleket
Bonney-Vehslage Tool Co.
Intern'l Register Co., The
Wood Co., Chas. N.
Rail Braces & Fastenings
Ramapo Ajax Corp.
Rail Grinders (See Grinders)
- Rail Joints
Rail Joint Co., The
Rail Joints—Welded
Indianapolis Switch & Frog Co.
Railway Safety Switches
Consolidated Car Heat. Co.
Westinghouse E. & M. Co.
Rail Welding
Metal & Thermit Corp.
Rail Welding & Bonding Co.
Rattan
Amer. Rattan & Reed Mfg. Co.
Brill Co., The J. G.
Elec. Service Sup. Co.
Heywood-Wakefield Co.
Registers and Fittings
Brill Co., The J. G.
Elec. Service Sup. Co.
Intern'l Register Co., The
Ohmer Fare Register Co.
Rooke Automatic Rg. Co.
Reinforcement, Concrete
Amer. Steel & Wire Co.
Repair Shop Appliances (See also Coil Banding and Winding Machines)
Columbia M. W. & M. I. Co.
Elec. Service Sup. Co.
Repair Work (See also Cots)
Columbia M. W. & M. I. Co.
General Electric Co.
Westinghouse E. & M. Co.
Replacers, Car
Columbia M. W. & M. I. Co.
Elec. Service Sup. Co.
Resistances
Consolidated Car Heat. Co.
Resistance, Grid
Columbia M. W. & M. I. Co.
Resistance, Wire and Tube
General Electric Co.
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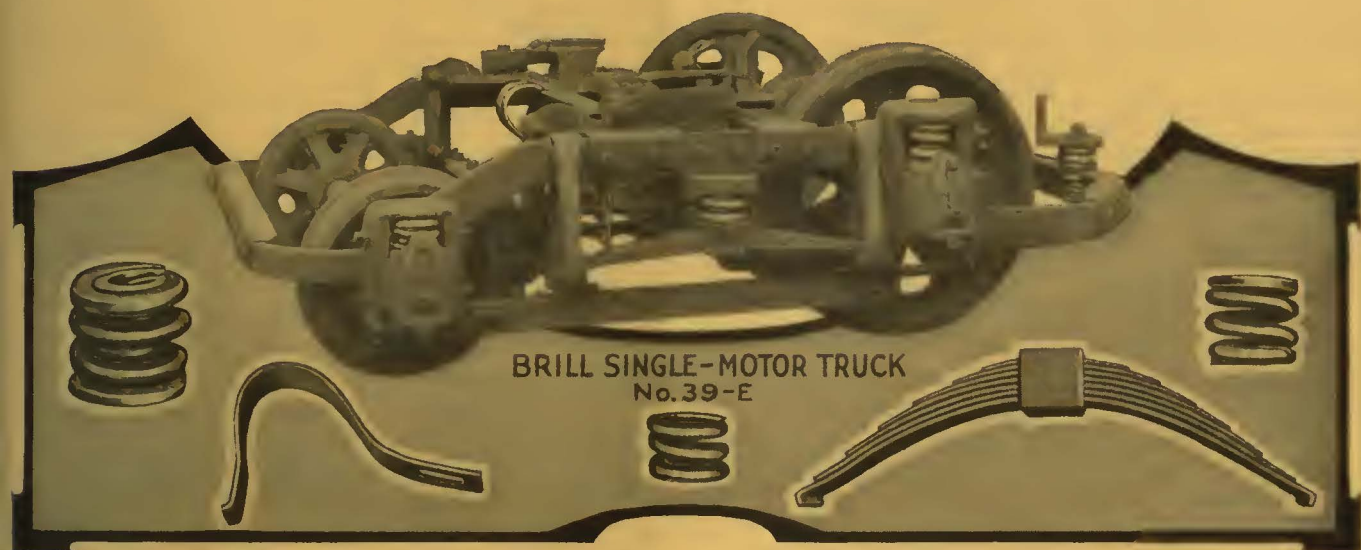
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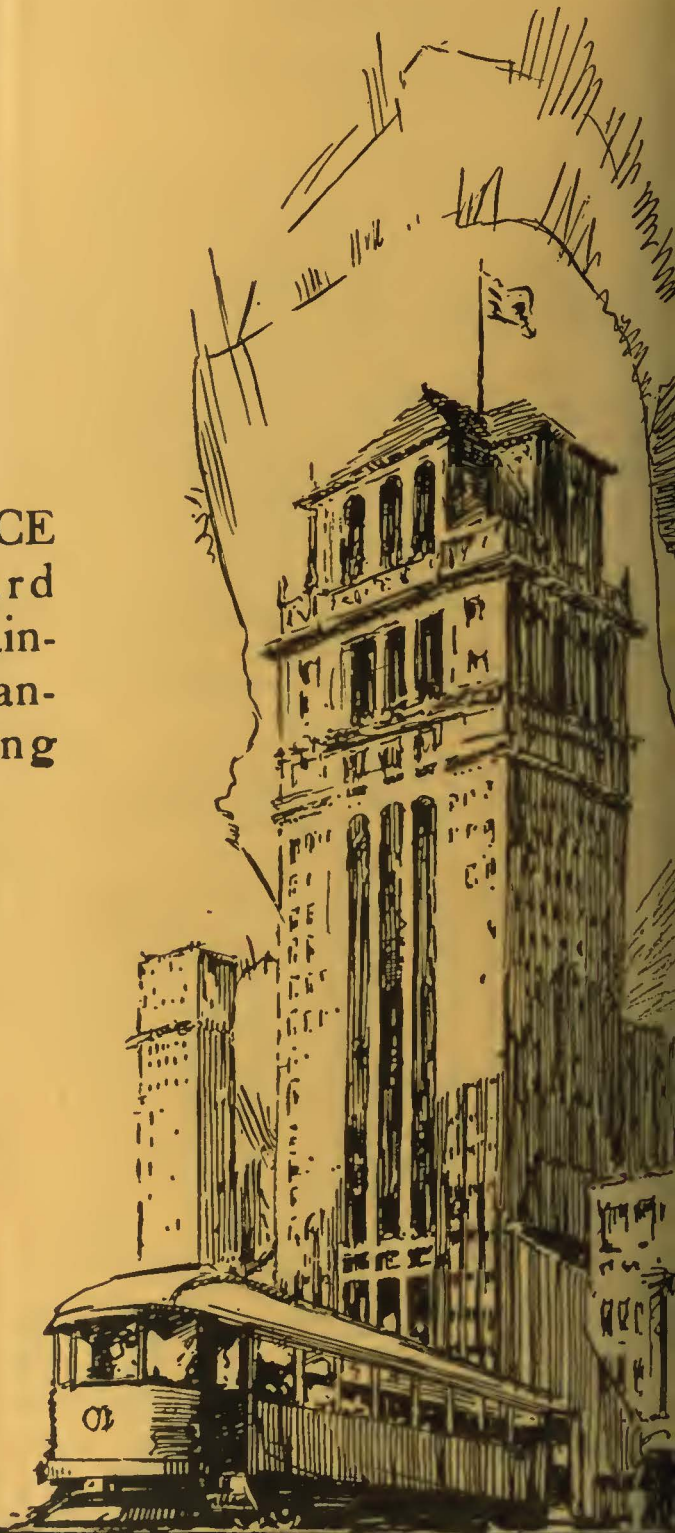
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