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Are Car Shop Kinks Always Real Economy?

"NECESSITY is the mother of invention," but there have been a great many inventions for which it would be difficult to prove the necessity. Some shop foremen think they are not earning their salaries unless they are continually inventing something. Without any desire on our part to discourage ingenuity and progressiveness, it is nevertheless true that men with a leaning towards invention are apt to waste a lot of their own time and that of their employees as well as a great deal of money and energy in devising new "stunts," when there are commercial products already available for accomplishing the purpose desired, and doing it better and cheaper than it could be done by the proposed invention.

Anyone who has a problem of this kind before him would do much better to investigate the methods and apparatus which have already been devised for doing work of this kind rather than to attempt to manufacture something of his own. The manufacturing companies have engineering specialists whose services are at the disposal of their customers. These experts are always willing and eager to help in solving knotty problems in construction or maintenance, and a small customer will receive the same consideration as a large one. In addition, the ELECTRIC RAILWAY JOURNAL is always at the disposal of railway men and others who wish assistance in solving any particular problem. Of course, there are many opportunities for progressive master mechanics to render real service by introducing economical practices in their shops, but the real duties of such men should always be kept in mind. Anything that interferes with these duties, even if it is the invention of a shop device, involves the danger of not being in the line of real economy.

"Organize—Deputize—Supervise"—

A Formula for Administrative Success

E. P. RIPLEY is president of the Atchison, Topeka & Santa Fé Railroad system. The story of his rise from a dollar-a-week job to this presidency is told by a writer in the current number of the *American Magazine*. Mr. Ripley summarizes the experience of a long business career, in so far as it relates to administration, in stating that success on the part of executives consists in organizing, deputizing and supervising. Never was such a formula more urgently needed in our country than at the present moment, when we are struggling to throw off the shackles of inefficiency in preparation for winning the war. Of these three essential duties of every individual who is responsible for the work of others the one most neglected is the

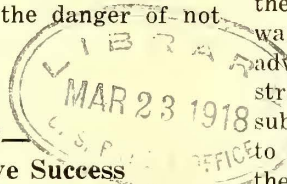
second. It is the height of folly at any time, and especially now, for any man not to be doing the thing that he can do best, that he can do better than anyone else. But this means turning over to others the responsibility and commensurate authority for doing other things that might at one time have been proper for him to do. Many a man wears himself out, fails to develop his subordinates, clogs the machinery of his organization—in short, fails of his full duty to his superiors by failure properly to deputize his work.

Scarcity of Common Track Labor—A Menace to Maintenance

TWO years ago, in commenting editorially upon the scarcity of track labor, we said that the high wages then being paid common labor in this country in munitions work and other fields where this class of labor could be used was having a demoralizing effect upon other industries and that the situation was becoming critical even then. Since that time the construction of the great military camps and the vast work now going forward in the shipbuilding field have made conditions many times worse. The government contractors, doing their work upon the cost and percentage basis, have bid against each other and have even revived the abominable padrone system in their efforts to obtain labor to such an extent that other industries, including the electric railways and even the big subway and sewer contracting firms, are being seriously handicapped in their efforts to secure and hold laborers.

The electric railway industry, as has frequently been pointed out in these columns, is tied to a fixed income, but the contractors mentioned above are now almost in the same fix, since their contracts were based on a pre-war labor cost base, while the present wage price has advanced by leaps and bounds until they can bear the strain but little longer. It is even predicted that the subway and sewer contractors in New York will have to stop soon unless some means is adopted to relieve the situation. With these powerful contracting firms in such a position, the situation of the electric railways must be worse, and it is safe to predict that they will not be able to undertake much reconstruction this year. In fact, they will be lucky if they are able to retain a sufficient supply of labor to carry on even ordinary maintenance work to the extent that this work should be done.

The Public Service Commission for the First District, State of New York, has recognized this critical condition in the labor market and has made certain suggestions for legislative enactments which may help the subway contractors to complete their new work without profit. As yet no similar relief from these conditions has been suggested for the electric railways,



although one would think that the maintenance in good condition of existing roads should be as important to the public as the completion of new lines. Yet it is quite apparent that the existing roads cannot be adequately maintained if the labor is not available.

Car Equipment Failures Should Be Carefully Analyzed

THE need for analysis is evident in all phases of railway service. In none is it more so than in the division of the subject which has to do with the failures of car equipment. It is the very essence of successful operation that cars be kept on the street with a minimum of interruption, and to this end it is imperative that the many detailed defects influencing this result shall be carefully recorded and diligently analyzed.

Too much stress can hardly be laid on the need for analysis, as without a thorough understanding of the failures and their underlying causes it is impossible to form any definite policy for their correction. This means either the replacement of the offending part with a duplicate of the original, bound sooner or later to repeat the breakdown of its predecessor, or the arrival at a "half-baked" conclusion as to the cause of the trouble and the adoption of a new and supposedly improved part. The latter may require considerable outlay yet be really of a nature which will not solve the problem because it does not touch the heart of it. Many a piece of apparatus has been thrown into the discard and replaced with another for which wonders have been prophesied, when the original one would have proved entirely satisfactory, with some slight detailed attention or maintenance. The expenditure was therefore incurred simply and solely as the result of a lack of proper analysis.

This is a function which, though not possessed by all in an equal degree, is like many others in that it is susceptible of development by use, and the commencement of its growth is the recognition of its necessity. A broader understanding of this fact and its intelligent application would go a long way toward raising the standard of operating methods.

Front-End Fare Collectors As Rear-End Accelerators

IT WILL BE recalled by our readers that the first Washington report recommended front-end fare collection at certain places in the congested zone of the Capital Traction Company. The latter company was not slow to try this plan of accelerating passenger movement. As worked out under J. H. Hanna, general manager, the front-end collector actually accelerates traffic at both ends of the car. After he has passed a reasonable number of people through the front entrance, he hastens to the rear to help the conductor. It is well known that the fellow who holds up a car longest at a stop is the late arrival who insists on boarding the car, regardless of the conductor's efforts to close the doors and clear the way for the next car. Here is where the gentle but firm arm and voice of the experienced street inspector prove very useful, both in saving time and avoiding accident.

Chicago Authorities Might Profitably Read the Beeler Report on Boston Traffic

PUTTING aside for a time all consideration of the legal and financial aspects of a proposed ordinance for unified operation of the surface and elevated lines in Chicago, the authorities have been debating some interesting features of service requirements. Speaking for the management of all companies, President Busby has been discussing the recommendations made last year by the Traction and Subway Commission and a few modifications proposed by the companies.

The discussions have had to do largely with rapid transit improvements. This is the all-important transportation topic in Chicago where the surface cars operate on nearly every section and half-section line throughout the city, while elevated construction has been at a standstill for years. Rapid transit facilities are costly, and Mr. Busby has made the point that subways should not be required where elevated lines will answer the purpose, and elevated construction should not be insisted on where the public can be accommodated by surface lines.

All the authorities have agreed that subways are needed in the downtown district of Chicago where the capacity of elevated and surface lines has long since reached the point of saturation. They may be required later on in other heavy centers of travel. Elevated construction, while more costly than surface tracks, is also under certain circumstances more desirable, but there is a limit fixed by good judgment to the distances for which such extensions should be built.

The Chicago aldermen on a trip to Boston last year were impressed by the combination of surface and rapid transit facilities in that city. If they have read the Beeler report to the Massachusetts Public Service Commission, however, they may discover a basis for serious reflection in the finding that the total cost of service for each 5-cents' worth of gross revenue is 7.23 cents on rapid transit lines, 4.86 cents on surface lines, and 8.10 cents on surface cars using subways, tunnels and viaducts.

In the long run the people must pay for what they get. If it is more convenient to have a rapid transit line within one block of everyone's home, it is also more costly. The 5-cent car fare is not made of rubber. It has been supposed that it would pay reasonable charges for labor and material and a fair return to the investor. But when labor and material costs increase as they have in recent years, these charges must be met in some way. Either the passenger must pay an extra fare or the public must agree to eliminate all non-transportation charges, such as paving right-of-way, maintaining such pavement and reconstructing tracks torn up for sewer construction and other city work. If the people not only refuse to make these concessions but insist on the most expensive type of construction for service in the least remunerative sections of their community, they must be prepared in some other way to reimburse the company for the service thus demanded.

The proposed plan for Chicago does not contemplate burdening the public with additional taxes. For this reason any system which is arranged for must be self-supporting. All charges for return on the investment as well as for operation must come out of the rate of

fare which is agreed upon. This means that the fare must either be increased or it must be relieved of all non-transportation charges.

Chicago seems well on the way toward a settlement of its transportation problem. This attitude must be encouraged. The city authorities and the people will do well to disregard the obstructive tactics and specious arguments of the small group of fanatics who have so long held up a settlement while other cities have been making fair arrangements designed to give the people better urban railway facilities.

Why Must We Waste

85 Per Cent of the Heat in Fuel?

IT IS RATHER unfortunate that, in general, we must depend upon such an elusive source of energy as heat for the propulsion of electric cars. A pound of good coal contains $3\frac{1}{2}$ kilowatt-hours of potential energy recoverable in heat form. Of this we are doing remarkably well if we deliver 15 per cent at the power-plant busbars. The fundamental reason for the difficulty in the uphill work of changing heat energy into electrical energy is that such transformation is opposed to the natural tendency of energy. In other words, all energy tends to degenerate into the form of heat. The various points at which energy shunts off into space, in heat form, during transformation upward are mentioned by B. H. Blaisdell in an article printed elsewhere in this issue. Some data pointing the way to heat saving were given in an abstract of an article by Eskil Berg last week.

It is loss, loss, all along the line, but there is no reason for discouragement in this if we consider what progress has been made in the last few years. A coal consumption of 4 or 5 lb. per kilowatt-hour is no longer respectable. Many plants are getting along with 2 lb. and the very best with $1\frac{1}{2}$ lb., high-grade coal being used in such cases, of course. When one considers the elusive nature of heat and the number of transformations and transmissions through which it must go between coal pile and busbar (to say nothing of the transmission system), the wonder is that more does not get away. There are losses in combustion (big ones), in steam production, in transformation to mechanical energy (enormous losses), in friction, in electric resistance and in radiation all along the line.

The very magnitude of the heat losses impels vigorous effort toward economy. The best equipment that can be afforded must be installed. Measuring instruments must be provided to indicate operating conditions. Someone qualified to do so must be studying operation constantly. Every effort must be exerted to stimulate intelligent co-operation on the part of those who ultimately control fuel consumption.

That such procedure will produce results is being proved in many plants. An example is the Manila (P. I.) plant where, under the bonus system outlined in the Feb. 16 issue of this paper, combined with station betterments, the fuel consumption has been reduced nearly 20 per cent in three years.

Even when doing our best, however, we shall still waste from 85 to 90 per cent of the energy theoretically available in the fuel, at least until some genius invents a radically new way to obtain it.

"Intelligent Economy"

Must Be the Slogan for 1918

A BUILDER of devices for facilitating track construction and repair recently said to the writer that it is much easier to sell such equipment to contractors than to railway men. The idea seemed to be that the contractor, through the nature of his work, looks at the ultimate saving due to the use of a given machine rather than to the first cost. The reverse, he thought, is true with the operating man due to his wholesome fear of swelling the capital account. Economy in the large sense may mean spending money as well as saving it, even if the money may at times be difficult to secure. Whether or not the diagnosis outlined above is correct, it is, nevertheless, extremely urgent that the railway business be conducted now with a view to ultimate economy rather than immediate expense reduction.

The present is no time for generalities; concentration of purpose—"getting down to hard tacks"—is the order of the day. For this reason the annual maintenance issue of the ELECTRIC RAILWAY JOURNAL is dedicated to the cause of true economy. A number of qualified men in different sections of the field have been asked to analyze the possibilities of energy, labor and material savings in lines of work with which they are particularly identified. It is not necessary for them to "qualify as experts" as each has established a reputation for thoroughness in his individual field.

As assistant manager of the railway department of a manufacturing company, Mr. Lambert occupies a vantage point from which he can command a wide survey of this field. Mr. Harte has work of a diversified character as construction engineer of one of the very large systems, particularly in electrical distribution. Mr. Litchfield is a specialist who has had unusual opportunity in analyzing car design problems and testing materials which enter into the construction of high-grade cars. Mr. Squier has had long experience in the rolling stock department of a large city railway system, and now, as engineer of a public service commission, can view railway work from another angle. Mr. Smith is in charge of the testing work of an important rapid-transit system where he comes in contact with a tremendous variety of investigation problems to handle. Mr. Hellmund is an experienced designer of electric railway equipment and has made a specialty of analyzing equipment problems in a large way, as well as in specific details. Mr. Cram is in a position to know "what is what" in way and structure, from his daily contact with the big questions in that line.

This group of seven experts has produced what must be considered a veritable treatise on means for saving everything that is savable in the power plant and on the track and line. They discuss not only the means available for saving but also the intelligent use of the means. Their work, however, is only a part of this issue, for it contains many short articles which bear on the central theme. If the whole thing taken together does not have a powerful influence in directing the thought of the industry to the fundamentals of economy, then nothing of this nature could do so. The editors take this opportunity cordially to acknowledge the splendid co-operation which they have had from the industry in preparing this summary for its benefit.

Certain Overhead Department Economies

Specifications Play an Important Part Particularly in This Field—The Author Lays Stress Especially Upon the Opportunity to Save Operating Costs by Doing Overhead Repair Work with Power Equipment

By Charles R. Harte

Construction Engineer The Connecticut Company,
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OCCASIONALLY, through slow development that has not been appreciated, or even from pure shiftlessness, there exist on a system poor material, bad construction, and inefficient methods which result in heavy losses annually. Such conditions are obvious except to those who have grown up with them, and their correction is only a question of treatment. These are exceptional cases, but there are many instances where leaks exist which in the aggregate cause serious loss without any clear indication of the trouble.

Sometimes the apparent waste is not a net loss because the cost of correction would be greater than the saving secured thereby, but there are comparatively few companies where careful study will not show an opportunity to save a few dollars. Such a study is best made jointly by an old-timer and a man comparatively new to the system. Working alone the latter fails to appreciate the real local peculiarities, although there is no form of excuse for freak ideas which approaches that stock expression of standpatters—"local condi-

ital locked up in patterns and the space and labor used in storing them. The larger the quantity of the device used the less extra charge per unit. As a rule, however, the demand is very limited, and the first cost unduly high, and because special designs are almost never kept in stock there is serious loss of time in making replacements.

In some instances the gain more than offsets these disadvantages, but far too often such material owes its existence to accident, to speak charitably, and its continued use to the fact that no test has been made to determine whether or not it is really worth while. If there is to be real efficiency and economy it is extremely important that all materials used should be put through tests carried out with thoroughness, of the sort fully to bring out the essential facts. The costliest mistakes are often those which approach success, for, while a really bad failure sticks up like a sore thumb, a "near success" frequently "gets by" to cause steady and long-continued waste, because such merit as it has is prominent and it is accepted on the strength of that without tests which would develop its bad points.

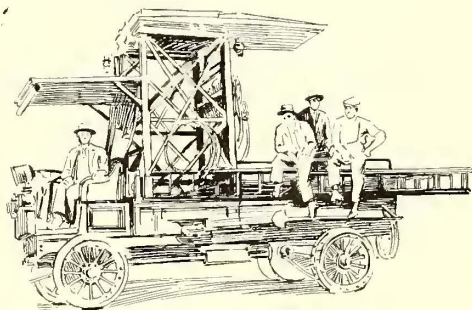
Lack of Standardization Makes Supplies Costlier

The American Electric Railway Engineering Association has approved as standard the specifications for overhead material and construction which were submitted by its power distribution committee after careful and extended study. The articles are regular stock patterns with all of the larger makers, and most if not all of the smaller ones, but as yet the association has not made that aggressive campaign which is necessary to establish any standard in an open field.

Here is an opportunity for a decided saving through the definite agreement by the majority of the company members to use one type of article only. This would enable the manufacturers very materially to reduce the capital now tied up in the many varieties which have to be carried, and in the much larger number of patterns which are used only once in a long time. A fair share of this saving should go to the user in the shape of reduced prices.

Until such concerted action is taken little reduction in ruling prices can be hoped for, but even so, as between special and stock designs, there will be found a considerable price difference which in many cases is not by any means paid for by difference in quality. It is greatly to be hoped that the day is not far distant when the term American Electric Railway Association material will be as specifically descriptive, and as universally accepted, as are American Society of Civil Engineers' rails or Master Car Builders' standards.

No less costly than the choice of out-and-out special devices is the specifying of what is apparently stock



The automobile tower wagon permits overhead repairs to be made with minimum interference with traffic

tions." On the other hand, the old-timer is apt to be "too sot in his ways" properly to realize the local faults.

The conditions of to-day demand that no penny be permitted to escape without "doing its bit." As an indication of lines for investigation there are here set down some of the possible sources of leakage in the overhead departments, and a few reminders of what has been done by others in increasing the efficiency of men and appliances.

Loss Through Unwise Specifications

Rigid adherence to fixed standards will naturally stifle improvement, but on the other hand until sufficient demand is established any new material varying from usual practice means increased cost. The manufacturer must be paid not only for the labor and materials which go into the devices, but for the idle cap-

material, but requiring it to meet special conditions. Here, too, the gain may offset the extra cost if the requirements are rational, but the insistence, for example, that hangers, pull-overs and wood strains, in which the weight except as fixed by dimensions has little relation to strength, shall weigh "not less than" a fixed value is little short of criminal. Not only must the extra material and the extra labor—and frequently special patterns—be paid for, but every extra ounce that goes into the overhead tends to decrease the life of the trolley wire. Unless this extra material is placed where it will materially increase the service life it is an actual detriment; and if the material already has a sufficiently large factor of safety, added strength is simply wasteful.

Sometimes what is a most desirable test for one class of material is merely a source of expense when applied to similar material having a different use. As yet, nothing has been developed that shows up as does the twisting test the flaws and cracks which do not appreciably affect the tensile strength of trolley wire, but which do constitute its most serious weakness. For similar wire employed as a conductor, but not also forced to act as a track as is the trolley wire, however, this torsion test is entirely unnecessary.

The material, special or otherwise, should be given such tests as will determine whether or not it complies with the requirements specified. If they are rational it is essential they be met; even if they are irrational, so long as they are specified the material ought to meet them. In checking there is always a chance that their undesirability may show up; besides, since good money must be paid for the privilege of imposing unusual conditions, it is well to get something for the outlay.

On the labor side it is equally desirable that the chief of overhead go carefully over the specifications to see that there are written into them no requirements which add largely to the cost and time without a corresponding gain. Special methods, like special material, are only warranted when their use shows a probable net gain, not alone for the immediate present but for a reasonable time in the future. In estimating on the result it is always well to bear in mind the dislike of the average man for anything "new-fangled," and the fact that such prejudice until overcome will prevent immediate realization of the efficiency and economy which may come later.

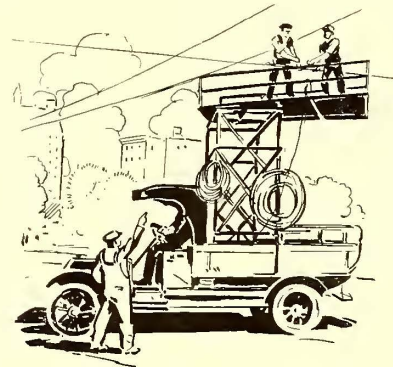
Labor Economy Does Not Mean Running Short-Handed

In general the economies which can be effected on the labor side are not in direct savings but instead result in the doing of more work by the same force. The tendency of most companies is towards short-handedness rather than the opposite; the payroll is always a shining mark for the axe. Clearly the ideal condition is to have just enough men in the gangs to insure that everyone will be reasonably busy all the time. On inter-urban and suburban lines this may be possible, but in the heavy service sections considerations of relations with the city as well as the cost of delay demand enough men to provide in the minimum of time for any contingency, particularly if due to fire. What constitutes the most efficient force for the purpose depends entirely upon the "local conditions" which in this instance are of the utmost importance.

In a very interesting article with a characteristic title ("Keep-Up Versus Pick-Up in Overhead Maintenance"—ELECTRIC RAILWAY JOURNAL, Aug. 4, 1917), S. L. Foster, chief electrician United Railroads of San Francisco, describes the prevention practice of his company. Mr. Foster modestly suggests that San Francisco's freedom from ice, snow, sleet and thunderstorms may account for the success of the plan, but he fails to mention the exceedingly corrosive salt fogs with which he has to contend and which nearly balance the score. Such a thorough and continuous "combing" as he describes, if applied on many of our Eastern systems, would unquestionably effect a reduction in overhead breakdown. It might not prevent a reduction in forces, particularly in the older, large cities, where the narrow and crooked streets prevent quick work with the wagons and compel a larger number of emergency crews than are necessary when the tower or repair wagon can really hustle. Advantage of this condition is sometimes taken by making the emergency crew really a wrecking crew to administer mechanical first aid to whatever goes wrong, the regular repair gangs following up if the trouble is too extensive for the emergency men to finish it themselves.

Watching the Repair Gang in Action

Watching a crew at work is about the best way to test the efficiency of its organization. Idle men, however, do not necessarily prove that a gang is too large. A poor arrangement of the men, of course, will overload some, while the others have little to do, a condition



"Watching a repair gang at work is the best way to test the efficiency of an organization."—Harte

showing that the foreman is not onto the job as a whole. Whether this is due to actual incompetency, the result of an endeavor of the foreman to do everything himself, or due to the use of a gang so small that he is obliged to work as one of the men, can be readily determined by watching the work for a time if a few questions do not bring out the facts.

It is true economy to have each gang so large and so well balanced that the foreman can give most of his attention to its work as a unit. If he is a good boss he will save his wages many times in the team work he can get. Further, by watching from the side lines, if he is at all ingenious, he can probably work out better methods or show why changes are inadvisable. Before any radical readjustments are made it is essential to good results that all the circumstances be understood. The fact that once or twice a gang has been working inefficiently calls for further investigation to determine

whether the trouble is chronic, and needs treatment, or whether the work at those particular times was unusual.

The Cost of Good Tools and Appliances Is Justified by the Results

Inefficient work by a crew may be due to man-trouble or it may be the result of poor or inadequate equipment. Good tools cost money and a mistaken idea of economy sometimes leads to the purchase of too few or, worse yet, of cheap makeshifts. Poor tools are costly at best. Even in the shop, where their inefficiency and breakdowns cause only delay, and that to the particular piece being worked on, the losses are large. In line work, where delay means not merely the loss of time of the gang, but the hold-up of traffic as well, and in addition an unexpected failure of a tool is apt to cause serious injury if not death to one or more of the men, the use of anything but the best is most unwise.

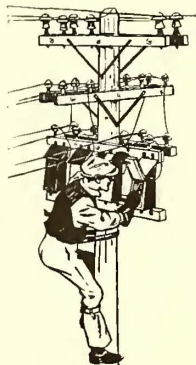
In the smaller line tools have been standardized to a large extent through the long experience of telegraph and telephone practice. Even here, however, helpful minor improvements are made from time to time. In the approach and attack, however, there are marked differences both of method and of appliances.

Power Lifts Should Be Provided on Tower Cars

The steadily increasing density of street and highway traffic is fast limiting the tower car to new construction and heavy repair work, where the track can be blocked for considerable stretches of time, and to work on open track which prevents the use of horse or auto wagon. On the other hand this limitation makes possible the use of heavy equipment with power devices, in fact, a traveling shop, the platform of which is almost as steady as the ground itself.

Power is required to raise this platform and various devices have been tried for the purpose. The use of a motor, taking current from the line permits, in conjunction with suitable clutches, its employment on winches, reeling devices and the like. An air cylinder, either in connection with an elevator-sheave-type rig, or better lifting directly, is probably the simplest arrangement. In some installations the platform has "danced" in service on account of the elasticity of the air, but the Washington Water Power Company, which has had an excellent example of this type of car in service since May, 1909, has had no such trouble, although safety chains are by this company used when the tower is to be long in service.

A combination system, having hydraulic lifting cylinders but obtaining the pressure by air fed to the top of the oil reservoir, has the rigidity of the hydraulic type and the simplicity of the air system. Straight hydraulic forms of lift require special pumps and seem particularly subject to trouble if power-operated. If hand-operated they are not enough better than the old-fashioned hand-winch rig to pay for the much higher cost.



Standardization of transmission line material tends to economy

Getting down to dollars and cents, it is difficult to measure the economy of power-operated lifts, but it is substantial. When the platform can be practically instantly shifted without effort it will naturally be adjusted to the most comfortable, which is the most efficient position, while under hand operation shifts are made only when absolutely necessary. The slowdown, and liability to slipshod work, when the men are tired from stretching or stooping, becomes quite an item if the work is at all continuous.

Modern Power-Operated Tower Cars Have "Men Under the Hood"

The early towers were light and easily raised. Changing conditions have steadily increased the weight, and this has been largely overlooked except in the case of the cars. So long as horses were used on the wagons there was a limit to the loading possible and no opportunity for power lifts. But the advent of the auto truck put an admirable power plant just where it could be utilized readily, and where it was completely overlooked. For many purposes this power plant furnished the equivalent of several men under the hood. It is surprising, therefore, that so little has been done to get the benefit of this circumstance.

It would be a poor "bunch" of linemen who could not raise a tower by hand and then do something on the overhead. But effort and time saved for the job itself means a corresponding reduction in the time an affected district is tied up. The cost of that effort and time is small as measured by the payroll, but measured by its effect on the tie-up it is quite another matter.

So important is speed in correcting troubles in the traffic centers, and they rarely occur except at rush hours, that at least one large company uses a light hurry-up wagon carrying ladders which are used in pairs, the feet placed so that when the ladder is vertical it just clears a car. For service the tops are leaned together, forming an "A," from which the lineman can quickly descend while the two parts are held vertical to permit cars to pass. The same result is aimed for in the use of overhang platforms, but if these are built sufficiently strong to swing with the men, the movement is apt to be slow. Presently, however, some one will remember the possibilities of the auto engine and effect another time economy.

Time-Savers Are Money-Savers as Well

The devices just described are time-savers rather than money-savers, at least directly. It is not always easy to persuade the "man higher up" that the two are the same. For this reason power winding devices, invaluable in handling feeder, are more apt to be found on systems having underground lines, where they serve as pulling rigs as well.

The economy of several types of pole-setting devices, however, is beyond question, if many poles are handled. For city work on the larger systems they are almost indispensable. The home-made gin-pole, on a truck with block-and-fall, worked by man power, shows a saving over piking. The more elaborate machines, on a property of any size, will soon pay for themselves if the time gained can be utilized. But here as in many other instances the economy which can be capitalized is often very different from the actual time saved. With

a new and well-constructed system advantage can be taken of every efficiency. As a rule, however, there are weak links which fix the size and number of repair crews, and time-saving devices, which otherwise would permit of a cut-down in force, are of value chiefly in shortening the time the crews are busy on the line.

This saving can be utilized to some extent in making up spans and brackets, cutting strand into convenient lengths, and salvaging partly used material. But with the best of management there is bound to be much lost time.

The high cost of copper, and unfortunately it is a "safe bet" that no marked reduction will be made in the immediate future, points to supplies made from it as a field where savings may be possible. Malleable iron has already proved a successful and materially cheaper substitute for bronze in frogs, crossings and mechanical ears, but whether a satisfactory iron clinch ear can be produced more cheaply than one of bronze remains to be seen.

Steel trolley wire has been employed fitfully for at least ten years, but there is almost as much uncertainty over it to-day as when the first experiments were made. Part of this is doubtless due to failure to appreciate its limitations. If the steel wire is subjected to heavy service the cost of the larger number of feed taps required equalizes the trolley wire cost. If not so fed it soon fails, as it also does in any case if there are hard spots to cause arcing. If left unprotected there is apt to be trouble from rust, not so much by weakening the wire as by streaking up the cars when rain falls.

Most of the installations of steel wire have been in solid round or grooved form, but some very interesting results have been secured in the use of common "seven-strand." In one case where there has been a total of several miles put up, largely on down grades of double-track, the chief troubles have come as the indirect result of sleet. The cars bunched and apparently started together, burning some of the strands. Whether the use of that portion of the span wires between the two trolley wires as an electrical equalizer would correct this difficulty, and if so, whether there would remain a saving, and for that matter, whether there is really any saving anyway, remains to be seen. However, as said before, the field at least holds out promise.

Three-Wire Distribution and the Automatic Substation

Two other interesting developments have to do largely with the substation. "Three-wire" distribution, one "wire" being the rail, with sections of the trolley wire alternately positive and negative, has been discussed more or less for several years. Installations have been made both in this country and abroad. As the rail serves only as an equalizer the tendency to electrolysis is reduced. In the past the complications of the system have resulted in its discontinuance after a short use. There are, however, at least two properties (Pacific Electric Railway at Los Angeles, installed about three years ago, and Omaha & Council Bluffs Street Railway, spring of 1917), which are to-day using it. The Springfield Street Railway is also arranging a new substation for three-wire operation.

As a means of reducing high-potential gradients the change to the three-wire system is much less costly than a new substation or additional insulated negative returns. There is, however, as yet not enough evidence available to say how much of the benefit is offset by the operating complications and to the fact that the potential difference between alternate sections and corresponding parts of the switchboard is double the operating voltage.

The automatic substation finds its chief economies through the large cut-down in station labor, about 60 per cent in several instances. By distributing the capacity of one or more substations with long feeder lines among more frequent and smaller automatic stations it may also be possible to take down very considerable amounts of copper. At the same time

power losses can be cut down in addition to saving labor and current by the use of the automatic operation itself.

But what can wisely be done in any case, as regards automatic substations, as well as all other possible means of saving, cannot be safely determined by theorizing on the part of the official concerned, let alone an outsider. All circumstances bearing upon the case must be brought together and considered. The conditions of to-day, and of to-morrow, as they now appear, call for far more such consideration than has been heretofore given to this matter.

Re-use of Line Insulators

IN the opinion of L. M. Klauber, San Diego Gas & Electric Company, companies having lines of various voltages are sometimes enabled to use old insulators on lower-voltage systems. This seldom pays, however, if the voltage steps are large, so that cumbersome insulators, subject to breakage and unnecessarily large pins, must be provided for use at the lower pressure. Some companies serving extensive territories in which a variety of service conditions are encountered find that insulators which have become inadequate in one district may be utilized for lines of similar voltage in sections where conditions are less severe. For instance, companies with lines along the seacoast may find that insulators which have proved to be inadequate under fog and spray conditions will give perfect service on the same lines in interior valleys.

On the whole, porcelain insulators, on account of their limited uses, offer a difficult problem when obsolete, and large numbers must be scrapped. It pays to have a few old types available for emergency connections and testing about any plant, for insulating stools and staging and for temporary service during construction work.

Strain insulators are more flexible devices, and if in good condition use may be found for most obsolete types. Glass "bobs," formerly used in large quantities in guys, are being abandoned for more dependable porcelain, but they will be found quite adequate for the house ends of service loops. They may also be used in the lighter types of guys, such as arm and bridle guys, and in dead-ending light secondaries. Two-bolt and small obsolete three-bolt guy chains should also be used up on these light guys.



"Believe me, this talk about 'local conditions' is greatly overdone"

Savings Attainable with Present-Day Car Design

This Article Shows How Each Element of the Car Design Affects Operating Economy Either Directly or Indirectly—Special Reference Is Made to Common-Sense Methods of Specifying and Testing Materials

By Norman Litchfield

IN his previous article introducing the subject of car studies the writer pointed out that a car is essentially a machine tool for the production of mileage. In any study of economies that can be effected in the operation of cars on an electric railway, therefore, there are three distinct general lines along which to pursue the possibilities, the first being an increase in production of mileage through reduction of the idle hours, the second an increased efficiency in the rate of production, and the third an improved quality of the product. It is readily seen that it is impossible to obtain results along these lines without co-operation of both the transportation officials and those responsible for the care of the cars, although in the first line, namely that of production, the transportation engineer stands more alone.

Getting More Revenue Miles from a Given Car

By the increase in production is meant the additional profitable mileage that can be produced with a given number of cars, by stimulation of travel through pleasure riding, special excursions, etc., or by other agencies which will permit the company's rolling stock to be used a greater number of hours per day than is now the case. On the average property this probably does not now exceed eight or ten hours.

This low figure, of course, is due to the fact that during the hours when people are going to and from their work there may be as many as sixty per cent more cars required than are needed during the remainder of the day, the latter number being determined largely by the interval necessary to be maintained between cars in order not to lose business. That is to say, during the middle of the day a prospective passenger will walk a reasonable distance rather than wait an undue time, or if the distance be too long to walk comfortably, he will complain either to his neighbors or to some regulating body, and if possible, withdraw his patronage altogether.

On the other hand, during the rush hour, the problem is chiefly that of transporting a maximum of passengers in a minimum of time, which often requires as many cars as can physically be operated over the tracks. This large number of cars, of course, is greatly in excess of the number required to maintain a reasonable interval in the middle of the day, and hence all operators have bent their efforts toward an increased use of these excess cars during the off hours.

By the efficiency in the rate of production is meant the increase in active mileage per car without the actual creation of new business, and the reduction of idle mileage. This phase of the subject has rather more angles

to it than that of increasing the amount of production, being more affected by details. Among the chief possibilities are the following:

The reduction of the idle or non-revenue-producing mileage through storage facilities at both ends of the line, and the short-routing of cars by a careful study of the origination and destination of travel.

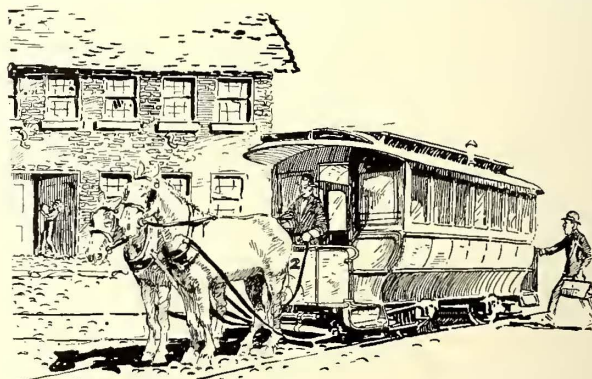
The increase of schedule speed through adoption of skip stops, higher rates of acceleration and braking, quicker interchange of passengers in loading and unloading through improvements in car design and fare collection facilities.

The reduction of platform charges through the use of one-man cars, two-car train operation, or double-deck cars.

The reduction of accident claims by providing conveniences for the motorman in the handling of his car, thus helping to prevent front-end accidents, and by improving the interchange arrangements so as to eliminate the boarding and alighting accident.

Last, but not least, the provision of all facilities possible to enable the large majority of honest conductors to obtain all the fares, and to restrain the small minority of dishonest employees from purloining fares. In this branch of the subject come also the use of devices to stimulate an increase in coasting, and of other devices and methods of saving power.

By the quality of the product is to be understood those features which tend to make the passenger satisfied, such as good lighting, heating, ventilation, and riding qualities, and freedom from delay or the discom-



The form of the platform didn't make much difference when this car was built

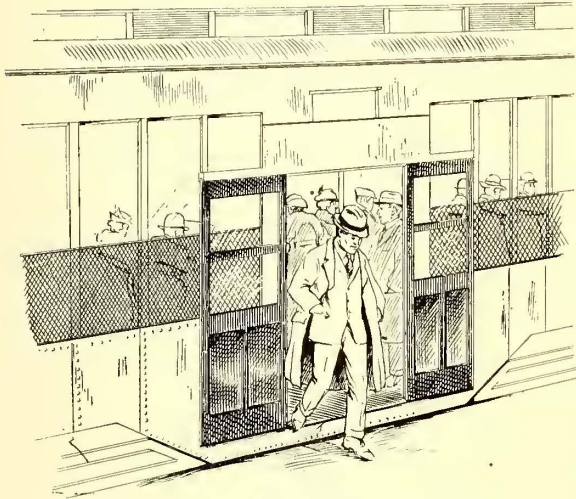
fort and exasperation induced by the request to "take the next car," due to failure of the car equipment.

As these studies have to do only with cars, we shall not dwell further on the subjects of short-routing and car storage other than to call attention in passing to the fact that an increased length of car means a larger house, and a heavier car, a stronger and more expensive building construction.

When we pass to the question of the increase in schedule speed, however, we find that the car itself becomes

a vital factor in many ways. Much attention has recently been given to the so-called skip-stop system, and special stress has been laid on the increased schedule speed and the saving in power through the reduction in the number of stops and starts. It is evident that if the number of stops is reduced more people must be handled per stop and consequently platform and fare collection arrangements must be adopted to take care of the increased number of passengers without congestion.

But in addition to this feature there enters one which



Make it as easy as possible for passengers to board and alight

has not received so much consideration, namely, the fact that in low-speed operation such as city service, the cost of car maintenance is very largely affected by the number of stops per mile.

The cost of maintenance of car equipment on a well-managed road will run from 2 to 2½ cents per car-mile. Taking an average of say eight stops per mile this would amount to a maintenance cost of about ¼ cent per stop. It cannot be claimed, of course, that the cost of maintenance increases or decreases in exact proportion to the number of stops, but on the other hand it is quite clear that if a car needed to make but one start during its whole trip, the wear and tear on the equipment would be tremendously less than under the actual conditions, where many stops per mile have to be made. Trolley poles, controllers, motors, doors, brakes, wheels and so on *ad infinitum* would bear eloquent testimony to the difference in operating conditions.

No car equipment man needs to have pointed out to him the difference in life of the same type of brake-shoe on different lines having unequal numbers of stops per mile and the humble brakeshoe may well serve as a measure of the severity of the service. Thus it is certain that the skip-stop has a marked effect on the cost of car equipment maintenance.

Proper Stepping of Resistors Permits High Rate of Acceleration

The possibilities through increased rates of acceleration and braking, use of proper gear ratio, and coasting devices, all have their influence on the schedule and the cost of power. They have received so much attention, however, that it seems unnecessary to dwell upon them here, further than to point out that a high average rate of acceleration can be maintained without danger of slipping the wheels and without discomfort to the pas-

sengers, provided the individual resistance steps are properly proportioned so as not to deliver a violent blow either to the passengers or to the wheels.

It must be borne in mind that any shock is the result of two things—the moving mass and the instantaneous rate of acceleration. That is to say, with an average rate or acceleration as low as 1 m.p.h.p.s. and an improperly graduated resistance, excessive instantaneous or momentary rates of acceleration are encountered—(possibly as high as 10 m.p.h.p.s.), which are exceedingly uncomfortable and which slip the wheels. On the other hand, if the resistance is properly graduated and the controller is skillfully manipulated a steady rate of 2 m.p.h.p.s. or even more can be maintained without difficulty. Similarly the rate of braking can be increased, either by an increase in the cylinder pressure or some slight change in the brake rigging so that the maximum force on the brakeshoes can be exerted which experience has shown to be desirable.

Making It Easy for Passengers to Board, Alight and Pay Fares

No phase of car design has perhaps received greater attention in the last few years than that of passenger interchange and fare collection, resulting in the development of a number of very interesting types of cars, and consequently in the formulation of certain fixed fundamentals. Among these are the carrying of the floor as close as possible to the ground, the reduction or elimination of steps, the provision of convenient means for operating doors, the use of fare boxes, and safety interlocks between doors and car control. All of these features contribute to the ease of operation of the car, increasing its schedule speed and reducing accidents. They are therefore classed as economies.

The one-man car, the double-deck car, and the two-car city train are in the same category in regard to economies to the extent that all are designed to provide transportation facilities of character equally as good as the more nearly standard types of car, and at a reduced platform cost. It would seem that the small one-man car of very light weight should prove increasingly popular in many classes of service, just as the two-car train is doing in others. While the double-deck car has not come into general use, it is probable that its capabilities and possibilities have not as yet been fully exhausted.

Passenger Comfort Features Can Be Improved at a Saving

When we come to consider the quality of the product which the car, considered as a tool, turns out, such comfort features as lighting, ventilation, heating, riding qualities, etc., would seem to be in the nature of luxuries, rather than economies. But inasmuch as they all form features of present-day car equipment that cannot be dispensed with, a little consideration will show that quite considerable economies can be effected by proper design and maintenance.

Take, for instance, the matter of lighting. The successful development of the tungsten lamp soon led to its general adoption for car lighting, and now the practical discontinuance of the manufacture of carbon lamps makes the use of the tungsten lamp imperative. It becomes important, therefore, to select very carefully the characteristics of the lamp which is to be used. The

old carbon lamp in general use was of 16 c.p., consuming about 60 watts. Where voltage conditions were reasonably good this was generally considered to provide adequate lighting.

In changing to the tungsten lamp, consideration should be given to the points on the line where low voltage occurs and to the importance of maintaining adequate lighting at these points. A question also is the amount of light which it is necessary or desirable to provide. For instance, it is generally agreed that from $1\frac{1}{2}$ to 2 foot-candles at a plane 36 in. from the floor give adequate illumination, but if very wide fluctuations of voltage occur, and the lighting is designed to give $1\frac{1}{2}$ foot-candles at the lowest point, then at the high-voltage points a very much greater degree of illumination is obtained. As the life of the tungsten lamp falls off very rapidly with increases in voltage, it is important that a lamp of proper characteristics be selected, so that a reasonable life will be obtained.

The photometric determination of illumination in a car is very simply made, and a check-up of this kind will often point the way to considerable operating economies. A step further, and one which in many cases is desirable, is to purchase the lamps to a specification requiring certain tests to be made in the presence of an inspector. Study of the operating and manufacturing conditions will finally dictate the selection of a lamp which will have the most desirable balance of life, power consumption and illumination.

A further point is that considerable increase in illumination can be obtained by a change in the color of the ceiling. These points, it is to be noted, are exclusive of any change in the arrangement of the lamps or of addition of reflectors, all of which may involve alterations to an extent not always justified.

With regard to heaters the most obvious possibility of economy is in some method of operation whereby no more than sufficient heat will be provided. Much can be done by proper co-operation with the transportation officials in the issuance of orders for the use of the heaters and the control of the doors, especially in cars



Facility of passenger interchange is an essential of quick transportation

having end doors. A simple test of heating any car to a given point, then turning off the heat and recording the temperature, say, every minute, with the car standing still, and then repeating the test with the car in actual service, will prove very instructive. It will show

how much heat is lost through opening doors, ventilation, etc.

Thermostatic regulators are also now receiving some attention, but inasmuch as they require an extra investment and add a hazard or element of failure and possible complaint, it is well to make a careful study of the actual total amount of heat used for power in an average year, and the actual amount of excess heat that is supplied by the existing graduations of heat control by the ordinary switches. These data, together with the cost of power (coal and water only if the company manufactures its own power) will give an indication as to whether regulators will prove desirable or not.

The conclusion will be influenced by the relation between the total numbers of cars owned and of car-hours operated. That is, sufficient regulators must be purchased to equip all cars, whereas only a certain proportion of these cars will be used enough hours each day to make the current saving profitable. The matter is also further influenced by the character of the climate, frequency of stops, kind of service, etc., so that it is essentially one in which the existing local conditions must be carefully studied. In studying this question it



Keep the cars out on the line—run-ins are expensive

should be understood that the difference between the power used in winter and that used in summer does not necessarily represent the heater load, as in winter season, more passengers are often carried, more stops are made per mile, vehicular congestion is greater, etc., these items sometimes in themselves causing a large increase of energy used per car-mile.

Heavy Trucks Not Essential to Easy Riding

Good riding qualities in a car are naturally desirable and are often thought to be obtainable only at the expense of excessive weight. It is very questionable whether even very high speeds require weight, in itself, to produce ease of riding, and it is certain that ordinary speeds, say up to 45 m.p.h., do not. The essentials are chiefly a proper side-swing motion adequately damped against excessive lurching, sufficient side-bearing and pedestal clearance, and correctly designed springs. Inasmuch as the cost of each additional pound has been estimated by various authorities to amount to as much as 5 cents per pound per year, it is evident that it is exceedingly wasteful to apply weight to a car simply with a view to improving its riding qualities, when this result can be accomplished otherwise. Instances have been met where it was possible by careful redesign to eliminate as much as 8000 lb. per car. For each lot of 100 cars this would amount therefore to \$40,000 per year, a very substantial saving.

In the elimination or reduction of run-ins caused by car equipment failures we strike a mine whose depths

cannot be plumbed in the limits of such an article as this. There are, however, certain outstanding features to which attention may be called, the chief of which is the constant recording and analyzing of recurrent failures.

From the analysis comes the knowledge making possible the redesign of the offending part, or the formula-



Some people are naturally in a hurry—Utilize this trait by providing suitable entrances and exits

tion or adoption of a specification or practice which will prevent the repetition of the failure. The word "specification" should be taken in its broadest sense, not necessarily a detailed statement, but possibly simply the adoption of some one make of article which has proved satisfactory. The chief thing is not to keep on replacing the very thing which has proved a failure.

Instances of the above will immediately suggest themselves to all familiar with car equipment, one of the most striking being that of gearing, where improvements in materials and their proper selection for the service have resulted in an increase in life from a former figure of 50,000 miles to one of more than 200,000 miles.

Each Road Needs at Least One Defect Analyst

Two questions naturally arise for the average road, one being how to make use of the scientific knowledge available from different sources, the other how much use should be made of specifications and inspection services. Should each road have its own force, however small, for the scientific analysis of problems, should it go for information to other and larger roads, or is it desirable to employ outside consulting engineers? Similarly, should the road attempt to inspect its own materials, or employ the services of inspection bureaus? This is a problem which can, of course, be settled only by each individual management. Roughly speaking, it may be said that in each organization the attempt should be made to include at least one man whose duty shall be to attend to the recording and analysis of failures and to keep in touch with those roads and engineering associations which are developing or recording methods and materials which have proved satisfactory.

As to detailed specifications, their uses are twofold: first, to insure obtaining the material desired, and second, to yield the advantages of competition which could not be made use of if but one definite make of material were named to the exclusion of all others.

In connection with both of these points, however, two things must be borne in mind. The first and more important of these is that if the user does not understand the specification it will often be wiser for him not to use it at all but depend rather on the word and experience of some reputable manufacturer. It is self-evident that no specification, however carefully drawn, can supply a lack of experience or integrity on the part of the manufacturer. There are extant a number of specifica-

tions which are a "hodge podge" of extracts from various originals combined by inexperienced hands into a heterogeneous mess. The various provisions of these are absolutely contradictory, and hence make them the laughing stock of reputable manufacturers and tend to make the latter "gun-shy" of any specification not prepared by themselves. Faulty specifications, and their incorrect use, therefore, do not tend to economy.

The second point has to do with inspection of materials. Here an attempt should be made to analyze requirements so as to determine fully just what materials are most vital to have properly inspected and tested, and what others can be purchased from ordinary merchantable stock, for the tendency in inspection, as in many other things, is to degenerate into red tape. Such inspection as can conveniently be made by the company's own employees should be so handled, and the balance should be turned over to reliable inspection bureaus.

Don't Hesitate to Conduct Tests and Inspections

Conditions vary considerably with the size of the property and its local situation, but the following would seem to be a reasonable procedure in connection with miscellaneous materials. Taking first the materials themselves, the chief supplies used for car equipment are gray iron and malleable iron castings, bar iron, steel shapes and plates, steel castings, copper cable, insulating materials, brass castings, bar copper and lumber.

Cast iron, being generally used in places where there is little tensile or bending stress, will usually be found satisfactory provided it is of good, soft, gray quality. This is easily ascertained by fracture. So with malleable iron, which is used in places where some degree of flexibility is necessary, the quality of the product can gen-



Heater regulation will avoid this

erally be determined by bending. When it comes to bar iron and steel, we enter the region wherein it may be well to resort to more elaborate tests. But here again the engineer need not sacrifice his judgment to the fetish that "everything must be tested."

If the material is for a piece the failure of which does not affect safety, and little trouble has been experienced with the part, ordinary stock material may be used at less cost than if rigid specification were required.

To insure reasonably good open-hearth steel, two simple tests can be made. In one the piece is bent cold around a 1-in. radius, and in the other a chemical determination of the percentage of phosphorus which it contains is made. The phosphorus content should not exceed 0.07 per cent. As the importance of the piece grows the specifications may be made more complete until the full tests required in the standard specifi-

Betterments Available in Car Equipment

Why and Where It Will Pay to Use the Newer Motors and Control, Large - Unit Lighting, Thermostatic Regulation, Car Checking Devices, Etc.

By C. W. Squier
Electrical Engineer.

THE spirit of the day is "economy" and "efficiency." Never before in our history have these two essentials been so impressed upon us. We have learned to retrench in fuel, food and all things connected with our daily needs as individuals, and we are learning to make what we have to do twice the work we previously expected it would perform.

The cost of transportation is subject to the same rules as the cost of other commodities. Its cost of production must be restricted and reduced, and our car equipment so readjusted and operated that increased efficiency will result. In the past great strides have been made in rendering better service with lower costs of operation. Now any methods by which the capacities of our transportation system can be increased or their costs of operation reduced are of paramount importance.

Up to approximately five years ago safety and reliability in electric-car equipments were considered the first requisites. Heavy construction was considered necessary in order to meet the extremely trying operat-

(Concluded from page 499)

cations are made. The above often holds also for steel castings, as in many cases a piece has only to withstand stresses which are but slightly in excess of these which could be met by the use of cast iron.

The copper parts and insulating materials are very generally put to use where safety and durability are prime features and hence should receive the maximum degree of care in selection that the user feels justified in applying. As the manufacturers are fitted to make the necessary tests at their own plants it is comparatively simple to have an inspector witness the necessary tests.

The requirements for lumber on the average car are not severe enough to necessitate elaborate tests, simple inspection being usually sufficient. Completely fabricated parts of special nature such as gearing, brushes, lamps, brakeshoes, buses, etc., can be effectively checked up as to their relative cost and efficiency by simple tests in the shops, and by recording the life and the mileage, at a cost the sum total of which is insignificant compared with the possible economy.

In all these matters it should be borne in mind that there are "acid tests" of the desirability of any specification or requirement. Will it make the article (1) safe, (2) more durable, (3) cheaper? The purchaser must be convinced that every requirement of the specification tends to one or more of these ends, and if he cannot be so convinced, it is often better to omit the requirement.

ing conditions of railway service and to decrease the troubles of operation and the resulting maintenance costs. The life of all wearing parts was increased and operating engineers bent all their energies toward keeping maintenance costs as low as possible. As the limit in this direction was approached the fertile mind of railway engineers cast about for some other means of reducing costs of operation. Saving power appeared to offer the largest field for economy, as this constituted one of the largest operating cost items.

A demand for the reduction in weight of all car and equipment parts was the first that occupied attention. Articles were written by many engineers who figured the costs resulting from carrying around the dead weight of the car and its equipment. These figures varied from 3 to 10 cents per pound per year as the conditions and service varied. The results were, however, that all manufacturers of railway equipment were forced to redesign their apparatus. By the use of high-grade metals, pressed-steel shapes and better insulation, the weight was reduced and at the same time other vital characteristics received careful study to reduce power consumption wherever possible. The results that have been obtained are astonishing and the limit has not yet been reached.

Let us consider the various groups of apparatus comprising a car equipment and see what improvements have been made that are conducive to energy and labor saving.

Making Better and Lighter Motors

As the motors are used for propelling the cars we naturally expect to find the greatest saving in energy through improvement in their design.

The saving in power, the greater electrical efficiency produced and the decreases effected in maintenance costs have resulted primarily from the following improvements:

1. Better mechanical and electrical construction.
2. More efficient methods of lubrication.
3. Slotted commutators and high-grade brushes.
4. Interpole field windings.
5. Self and forced ventilation.
6. Reduction in weight.
7. Higher grade insulation.
8. Choice of correct gear ratio.
9. Lower armature speed.
10. Tapped field windings.

After the experimental and early development stages of railway motor construction had passed, there followed the period, already referred to, when the energies of railway engineers were directed toward reliability and increased life in operation. This resulted in the development of the magnificent motor equipments that are now found on our electric roads.

The first two groups of improvements enumerated above belong to this period and need not be described here, as they are a matter of history which has been fully treated in many articles in the *ELECTRIC RAILWAY JOURNAL* and elsewhere.

Present 1500-Volt Motors Less Troublesome Than Old 500-Volt Types

The development of the interpole or commutating-pole motors was brought about in an endeavor to reduce operating troubles and maintenance costs. This design was introduced and perfected during the period from 1907 to 1911. Previously one of the greatest troubles with direct-current motors was in commutation. The introduction of commutating poles, together with undercutting the mica of commutators and the use of high-grade carbon brushes which occurred about the same time, overcame this last serious objection.

Those who have had experience with older types of motors, especially before these improvements were adopted, will remember the frequency with which the commutators ran black and developed flat spots. The lathes in the maintenance and overhauling shops were kept in constant use turning down and sandpapering commutators. As a result commutator wear was very rapid and it was necessary for manufacturers to make the segments very deep to provide for this wear. Now the wear of commutators is so slight that it can hardly be detected after a year of service, and the depth of segments is made only sufficient for proper insulation and mechanical strength. The wear of the brushes was also very rapid, due to the excessive sparking at the commutator, and it was necessary also to use a brush with high abrasive properties to cut the mica. With the slotting of commutators hard brushes were no longer necessary and brushes with greater conductivity came into general use.

Another great advantage that has resulted from these improvements is in the use of higher voltage circuits, which has increased reliability of service. Now motors are made to operate on 1500 volts and have less commutator trouble and operate better than did the old motors on 500 volts.

The principal saving that has resulted from these improvements is in the reduced maintenance and repair costs which have been given by some reliable authorities as from 50 to 75 per cent. These improvements have also made possible the carrying of heavy overloads on the motors, permitting higher rates of acceleration and therefore more economical operation. They have also made possible the use of field control with its resulting economy.

The first railway motor did not have an enclosing frame. All parts were exposed and consequently well ventilated. Vital parts were easily damaged, however, and due to the exposed location of the motors it was found necessary to inclose all parts by the frame. This

added greatly to the reliability of the motor, but prevented proper ventilation.

As service conditions grew more severe it became evident that much could be gained by ventilating the interior parts and forcing air through the windings. The first step in this direction was to ventilate the armature and depend on its fan effect to keep the air circulating. This was a step in the right direction, but all heat had still to pass through the frame by conduction. By providing openings in the frame and additional ducts and channels in both frame and armature the present ventilated motor has been developed.

The various stages in the development in motor ventilation were shown very clearly by a series of diagrams in the *ELECTRIC RAILWAY JOURNAL* of May 15, 1915. On some locomotives air is forced through the motors by motor-driven blowers, but the construction most used provides a fan on the armature which draws air in and

drives it through the armature and fields and by shields and ducts deflects it and again expels it to the outside of the motor. The effect that this has in reducing the temperature and increasing the capacity of the motors is simply tremendous, and it has resulted in increasing the continuous capacity of motors, which ordinarily is not more than 45 to 50 per cent of the one-hour rating, to 65 to 80 per cent of this rating.

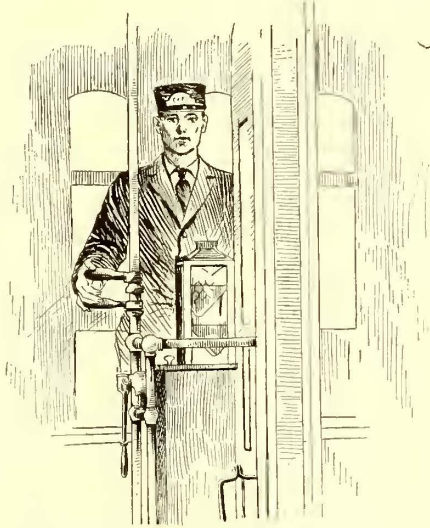
The benefit that can be derived from self-ventilation depends upon the schedule speed that is to be maintained and the gear ratio used, since the amount of ventilation obtained is a function of the armature speed rather than the car speed. Thus in city service much

of the operation is at low speed, with the fan practically inactive, and the benefit derived will be comparatively small. In high-speed interurban service, with long runs, great benefit is obtained. With a separate blower for circulating the air the ventilation is, of course, independent of the speed.

Motor Weight Reduction Alone Can Save \$42 per Car per Annum

The weight of motors has been reduced by careful designing and proper proportioning of parts so as to eliminate all useless material. High-grade metals have been used to a greater degree, and many parts formerly made of cast iron are now made of malleable iron or steel. Great improvements have been accomplished in making these steel castings so as to permit the use of thinner sections than had been possible to cast theretofore. This has reduced the amount of useless material and resulted in a corresponding saving in weight.

Pressed-steel shapes have been used more extensively also, and heat treating of steel has been perfected to bring about other savings in weight. These improvements, together with the latest ventilating practice have resulted in a saving of from 15 to 40 per cent in weight, as compared with the old-style, totally-inclosed motor. The exact percentage depends upon the commercial sizes and speeds available.



The conductor has a lot to think about—
Make his labors as light as possible

To take a concrete example, suppose we consider a two-motor equipment with old motors weighing 2700 lb. each replaced by motors weighing 2000 lb. each. This gives a saving in weight of 1400 lb. per car. At an assumed operating cost of 3 cents per pound per year there would result an annual saving of \$42 per car per year. Now consider a road that is in the market for 200 new equipments. The reduction in the weight of the motors which this road could now purchase will represent a saving of \$8400 per year.

Better Insulation Is Equivalent to Increase of Motor Capacity

By employing a higher grade of insulation, with greater heat-resisting qualities, the capacity of motors has been increased through the raising of the safe temperature limit.

Soldering material with a higher melting point has also been used. This is important since heavy and sudden overloads of such short duration that they do not



Better lubrication is a factor in conservation

cause excessive heating of the armature coils, often last long enough to melt the soldered connections or to cause them to soften sufficiently to permit the solder to be thrown out by centrifugal action.

This increase in the capacity of motors will enable a lighter motor to be used for a given service and also will permit a higher rate of acceleration in operation, thus reducing the average power consumed.

Re-Gearing Costs Less Than 5 to 10 per Cent Power Waste

The use of incorrect gear ratios for railway motor equipments has caused great losses to operating companies. Gearing that was suitable for operating conditions when the motor equipments were purchased will likely prove unsuitable as the service becomes more exacting. When we consider that in city and suburban service a majority of the work done by the motors is at speeds less than 10 m. p. h., we begin to realize how important it is to be able to accelerate rapidly.

In checking over the service conditions of a large railway system operating city and suburban service, I find that 37 per cent of the total mileage made is in congested sections where a schedule speed of 7 m. p. h. is as high as can be obtained. Thirty-eight per cent of the mileage is in sections where from 8 to 9 m. p. h. is the highest speed practicable, and only the remaining 25 per cent is in sections where the cars can maintain a schedule speed of more than 10 m. p. h. The maximum speed for such sections is less than 11 1-2 m. p. h. It is thus seen that the period during which cars can operate at maximum speed is very short, and a grave error is made by providing gearing for high speed when there is no opportunity to obtain it. A typical cycle for

such service is rapid acceleration, short coasting period and rapid braking. Consequently the most efficient operation is with the lowest-speed gearing that will give the required schedule speed, with a reasonable margin for congested conditions and the making up of lost time.

Few outside of those who have made a special study of this question realize its importance and at the present time there are a great many motors operating in service which are so geared as to cause a continual loss to the operating company. Without doubt 5 to 10 per cent of all the power used for propelling electric cars and trains could be saved by the use of correct gearing.

In order that a motor may be economical in power consumption it must have a low armature speed, with as high a gear ratio as the service will permit. In comparing the power consumption of two motors, with the same gear ratio but different armature speeds, the one with the armature of lower speed will show a decreased power consumption in one of the following two ways, namely, it can produce the same rate of acceleration with less current, or with the same current it will give a higher rate of acceleration.

This saving will be found much more pronounced in a service with frequent stops. In comparing two equipments in a city service with nine stops per mile and a schedule speed of 9.2 m.p.h., it was found that the slow-speed motor used 0.46 kw.-hr. per car-mile less than the high-speed motor, or a saving of 10.9 per cent in its favor. This was due to the more rapid acceleration of the car with the slow-speed motor, so that the accelerating current did not continue so long, and with the same amount of coasting the brakes were applied at a lower speed. Part of this saving is, therefore, due to lower rheostatic losses and the remainder to the smaller amount of stored energy wasted in braking.

How Field Control Saves \$100 per 35,000 Miles

The first designs of double-reduction motors provided for controlling their speed by varying the effective turns in the field winding. This was known as the "loop" system and was quite familiar on our first electric roads. This method of speed control proved a failure at that time, due principally to the difficulties encountered in commutation as the fields were weakened.

Improvements in motor design, together with the use of interpole field windings, slotted commutators and high-grade carbon brushes, so improved commutation that railway motor designers have again taken up this method of control, with surprising success. The first method of field control consisted of shunting portions of the field windings through a resistance. The latest method differs from this in that, instead of shunting the field, approximately 40 per cent of the full field winding is cut out. The advantages gained by this latter method are that the use of a non-inductive shunt around the field is avoided. This, with solid-frame motors, produced flashing.

Let us consider how a tapped-field motor saves power, and what saving can be expected by the use of tap-field control. This saving in power is the result of more efficient acceleration. By comparing the characteristic curves of the motors, one a slow-speed motor without field control and the other the corresponding motor with field control, we find that the speed of the field-control motor, when operating on normal or tapped

field is about the same as that of the other motor, while the speed of the field control motor when operating with full field is much lower.

In accelerating the full field is used and the rheostatic losses will be less, as the grid resistors have less resistance and are not in circuit for as long as is necessary when using a motor without field control. The tapped field is used for running, so that the same speed is obtained as with the non-field-control motor and the braking losses remain the same. A further advantage is also obtained by use of the field-control motors when the same car is required to operate in service of different character. Thus for combined city and suburban service field control provides more economical operation over the slow-speed city sections in that it permits the use of a gear ratio most economical for this service, and with the same gear ratio provides the higher speed necessary for suburban service.

As an illustration of the saving that may be expected from the use of tapped-field motors consider a two-motor equipment where the tractive effort per motor necessary to produce the desired acceleration is 2000 lb. The relative values of current necessary to give this tractive effort are 83 amp. with the non-field-control motor as compared with 76 amp. with field control, and the corresponding rheostatic losses are 1.4 watt-hr. per ton as against 0.7 watt-hr. with field control. The tapped-field motor, then, saves 0.7 watt-hr. per ton every time the car starts. With a car weighing 30 tons and making eight stops per mile the saving in rheostatic losses alone will amount to 0.168 kw.-hr. per car-mile. The total saving from employing field-control motors in the service will amount to 0.38 kw.-hr. per car-mile. Considering that energy costs $\frac{3}{4}$ cent per kilowatt-hour at the car, and assuming that the car makes 35,000 miles per year, this saving would amount to approximately \$100 per car per year.

Concentrating Control Saves Weight, Wire and Conduit

At the same time that new motors were being developed, the old ones were receiving much attention from operating engineers and master mechanics with a view to cutting down maintenance costs. Wonders have been performed in this field, and now it is essential as never before to introduce still further economies if profits are to be made by the average road.

The design of railway control apparatus has kept pace with the improvements in motor construction and many operating economies have been made possible by the advance made in control equipments. The following are some of the improvements in control that have aided in producing high service efficiency and operating economies:

1. Simplicity of construction.
2. Greater reliability.
3. Consolidation of parts into single units.
4. Reduced weight.
5. Improved materials.
6. Automatic acceleration.
7. Selective acceleration.
8. More efficient use of resistance.
9. Arrangement for field control.

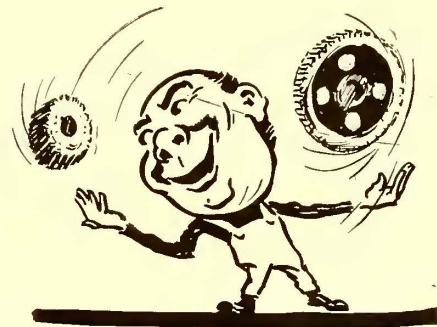
One of the most notable advances has been the tendency to seek simplicity and reliability and to combine various small pieces of apparatus into larger units. In

the equipment for surface cars a return has been made to more general use of the shunting method of transition from series to parallel, instead of using the bridging feature, which required a greater number of contacts or switches. These changes are producing lower maintenance costs and reduced cost for replacement parts.

The combining of various pieces of control apparatus and assembling them in a single box, which applies particularly to switch-group control, simplifies the control connections, reduces the labor and time of inspection and provides a lighter equipment.

Switch Group of World's Biggest Rapid-Transit Car Weighs Only 900 lb.

The effort to reduce weight has not been confined to car bodies, trucks and motors, but has been extended to control equipment in a marked degree. The consolidation of various parts comprising an equipment into single units, just referred to, has produced astonishing



Skill in the selection of gearing conduces to economy

results in weight reduction. In the control equipments used by the New York Municipal Railway on their new subway cars, the switch group which is designed to handle two 200-hp. motors weighs but 900 lb., scarcely more than half the weight of the former control outfit of similar capacity.

By combining all the main-circuit apparatus in a single box a further reduction in weight has resulted, due to the decrease in the amount of cable and conduit required and in the labor and consequent cost of installation.

Another marked saving in weight has been effected by a special design of grid resistor, whereby the weight of a set has been reduced approximately 40 per cent without loss in continuous capacity.

Not only has the weight of resistors for a given capacity been decreased by better ventilation and increased radiation, but control connections, also, have been rearranged so that the same section of resistance is used several times in increasing the voltage on the motors, by using it in series and again in parallel with other sections. Previously when a section was cut out it remained inactive during the remainder of the period of acceleration. This improvement gives a more efficient use of the resistors.

Smaller Control Accelerates Passenger Interchange

A large part of the equipments now being supplied are of the switch-group or multiple-unit type of control. Some of the many advantages possessed by this type of control are:

1. Better location of apparatus.
2. Less platform space occupied.
3. Less liability of accident.
4. Greater flexibility for operation.
5. Decreased maintenance.
6. Automatic acceleration.

The removal of the controller from the platform is important because the greater the space that can be used for boarding and alighting the less will be the resulting congestion and the shorter will be the stops. This produces a saving in time that is at once apparent in the increase that results in schedule speed, while the saving in platform wages and passenger time is well worth considering.

This effect of the length of stop on operating results and costs is very clearly illustrated in the article by J. F. Layng in the *ELECTRIC RAILWAY JOURNAL* for Jan. 5, 1918. This shows an increase of one-third in the cost of platform wages alone by increasing the duration of stop from five to fifteen seconds with nine stops per mile.

The removing of the main circuit apparatus from the car platform reduces the liability of accidents from controller explosions and burnouts, with consequent reduction in accident damage suits.

Automatic Acceleration Promotes Faster Schedules

Another great saving is possessed by switch-group control arranged for automatic acceleration in that it eliminates the energy waste in the first or accelerating part of the operating cycle by removing the personal element in operation.

Designing engineers make very careful calculations for the values of the various resistance steps in order to obtain smooth acceleration and prevent abnormal current peaks. They assume a certain definite rate of notching for cutting out these resistance steps. With hand-operated controllers this is seldom obtained.

The effect that the rate of notching has on current values and power consumption is very clearly shown by the curves given in my article on "Resistance Standards" in the issue of the *ELECTRIC RAILWAY JOURNAL* for May 11, 1912. A saving of from 5 to 7 per cent in the total power used could be obtained on most roads if the controllers were operated according to the methods assumed in the design of the apparatus. Automatic acceleration does away with the personal element and assures the engineer that the equipment will be operated as desired.

Another saving with automatic acceleration is in obtaining at all times the maximum rate of acceleration for which the equipment is designed. It is frequently found that where a line is operating under a fairly easy schedule the motorman will accelerate slowly and, no doubt, operate with the motors in series a large part of the time. A study of the energy required for different rates of acceleration is very interesting. With a specific equipment operating in city service the following results were obtained:

| Rate of Acceleration M.p.h.p.s. | Watt-Hours per Ton Mile | Per Cent Saving from $\frac{3}{4}$ m.p.h.p.s. |
|------------------------------------|----------------------------|--|
| $\frac{3}{4}$ | 110 | |
| 1 | 90 | 18.2 |
| $1\frac{1}{4}$ | 83 | 24.5 |
| $1\frac{1}{2}$ | 78 | 28.2 |
| 2 | 76 | 30.9 |

The difference in energy saving is considerably less between the high rates of acceleration than it is between the low rates. Thus the difference between accelerating at $1\frac{1}{2}$ and 2 m.p.h.p.s. is only 2.7 per cent, while between $\frac{3}{4}$ and $1\frac{1}{4}$ m.p.h.p.s. it is 24.5 per cent.

Selective Acceleration Is Another Refinement

In order to obtain the same rate of acceleration for all loads between maximum and minimum, what has been termed selective acceleration has been developed. On the subway cars of the New York Municipal Railway this is accomplished by having two windings on the limit switch. One coil is in series with the main motor circuit, while the other is wound so as to oppose the first and is connected to a storage battery through a variable resistance. This resistance is cut out automatically as the load on the car increases, so that it will take more current through the series winding to counteract the current in the battery circuit and therefore to cause the "limit" to operate.

This feature not only produces economy at the car but permits trains to get away from stations faster and makes them respond more rapidly at signals, thereby increasing the capacity of the road.

Another great advantage accomplished by this improvement is in connection with field control. In changing from full to short field with tapped-field motors there is a sudden increase in current. This current swing mounts very rapidly as the lower current value, from which the change is made, is increased. Thus if the change from full to tapped field is made at 200 amp. the current will increase to 340 amp., and if it is made at 275 amp. it would swing to 450 amp. By the use of the double winding on the limit switch, just described, this change is always made at the lowest setting of the limit switch, which is 200 amp., and this current swing is constant and moderate.

Faster Braking Results in Energy Saving

Time saved while stopping a train is just as valuable as time saved during any other part of the operating cycle. Improvements in air brakes have made it possible to use a higher rate of retardation for stopping and also they have reduced the time necessary to apply the brakes so as materially to reduce the stopping distance and time necessary for bringing a train to rest.

Conditions remaining the same, any increase in the braking rate produces a decrease in power consumption, since the car or train can be allowed to coast longer and the brakes can be applied at a lower speed. Thus less of the stored energy of the car will be consumed during the braking period. This saving is shown directly in the decreased time that power must be used in order to maintain the required schedule speed.

Electro-Pneumatic Brakes Stop a Train in 330 ft. Instead of 580 ft.

By using electricity to actuate the air valves of the compressed air brake, the following advantages have been obtained:

1. The difference in time, at which brakes are applied on the front and rear cars of a train is eliminated.
2. The probability of rough handling is reduced.
3. The difference in time, between the movement

of the brake valve and the application of the brakes is reduced.

4. Brake-cylinder pressure and the resulting retarding force is developed more rapidly.

5. Higher rates of retardation can be employed.

6. The limits in the length of trains are removed.

The largest saving that has been accomplished by the use of electro-pneumatic brakes has been obtained by increasing the braking rate. Previously it was not possible to use a rate of retardation anywhere near approaching the holding power between the wheels and the rail. This was due to the fact that in applying the brakes pneumatically the application began first at the front end of the train, and this interval between brake application at the front and rear prevented using the maximum rate of retardation at the front end or shocks would occur so severe as to damage the car equipment and be injurious to passengers. By the use of the electro-pneumatic features a rate of initial retardation has been made possible at least ten times that formerly used without damage or inconvenience, since the brakes are applied on the rear of the train at nearly the same instant, as at the front.

It is also practicable to use a maximum rate of retardation approaching very closely to the holding power of the rail. Compared on this basis, brakes applied electro-pneumatically will give 100 lb. brake cylinder

pressure in two seconds, with a braking ratio of 150 per cent, and will stop a train from 40 m.p.h. in 330 ft., while when applied pneumatically they produced 60 lb. cylinder pressure in 6.6 seconds, a braking ratio of 120 per cent and at 40 m.p.h. required 580 ft. to stop the train. A saving in distance of 250 ft. is obtained in this instance by the use of electro-pneumatic brakes. This means a great deal on lines where it is necessary to operate to the full capacity of the tracks, as the length of the blocks used in signaling depends on the distance that is necessary to bring a train to a stop. With shorter blocks trains can follow each other more closely and so the capacity of the line is increased.

The stopping distance with the pneumatic brake will increase as the length of train is increased, while that with the electro-pneumatic brake is independent of train length. The length of train that can be operated is thus limited by the use of the pneumatic brake while with electro-pneumatic brakes any length trains are feasible as far as the brakes are concerned.

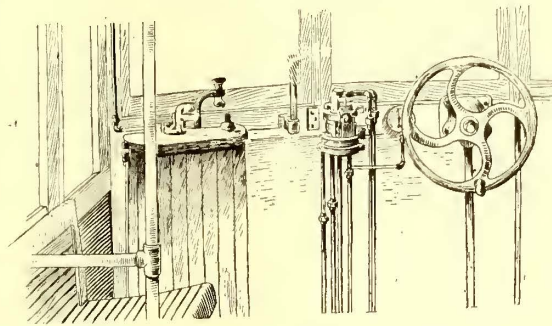
The value of increased braking rates on electric cars or trains makes itself manifest in a decreased power consumption if the same schedule speed is maintained or in an increase in schedule speed with the same power consumption. This follows since, with the same schedule speed, an increased rate of retardation will allow an additional amount of coasting and enable current to be cut off the motors sooner. The energy saved in average city service by increasing the rate of retardation from 1 to 1½ and 2 m.p.h.p.s. will average about 8 and 11 per cent respectively.

Since a high rate of retardation produces the greatest economy it is desirable to maintain the maximum rate

with a loaded car or train as well as with a light one. A braking power sufficient for a light car is inadequate for one loaded, and if the braking power is designed so as to use the adhesion of the loaded car it would obviously produce sliding wheels when the car is empty. The variable-load brake, which has had its first installation in passenger service on the cars of the New York Municipal Railway, fulfills this requirement.

On these cars a full passenger load represents 45 per cent of the light weight of the car. The increase in train weight if the same braking pressure were used would mean practically a proportional increase in braking distance. It will be readily appreciated that the improvement prevents a serious waste of time and decreases the distance between trains at limiting points so as to increase the capacity of the lines.

Briefly, this automatically provides an increase in brake-cylinder pressure as the load increases, by increasing the volume of the auxiliary reservoir. This change in reservoir capacity is accomplished by the use of an additional reservoir divided into compartments of various sizes, and connected to the auxiliary and supplementary reservoirs through ports controlled by a slide valve. The movement and position of this slide valve is automatically adjusted by the variations in weight on the truck springs due to changes in passenger load. An accurate adjustment



These are the tools that the motorman works with. Give him the best

of braking power in ratio to load is thus obtained.

In some tests made under operating conditions with a view to determining what saving was effected by the use of this improvement in stopping loaded trains, it was found, with the brake-cylinder pressure adjusted to give the maximum safe rate of retardation for a light train, that in making a stop with a fully loaded train from 40 m.p.h. an additional five seconds per stop and an average of 150 ft. in stopping distance was required over that obtained with the empty-and-load device supplying a brake cylinder pressure in proportion to the load. This means that with a brake adjustment and pressure for producing an average rate of retardation of 2 m.p.h.p.s. with a light train, there would be obtained but 1.6 m.p.h.p.s. with a fully loaded train. By the use of the empty-and-load brake device 2 m.p.h.p.s. could be obtained.

This device also improves operation in that a motorman can judge his stopping distance more accurately, for the stopping distance with the same reduction in train line pressure will be nearly constant while otherwise motormen frequently have to make a second reduction and sometimes an emergency application.

Slack Adjusters for Safe Saving—Automatic Couplers for Quick Train Make-Up

Slack adjusters also decrease power consumption. In making an application of the brakes, the first movement of the brake-cylinder piston takes up the slack in the brake rigging and brings the brake shoes in contact with the wheels. The more slack there is in the brake rigging the greater is the distance that the piston will have to travel before braking pressure is

applied to the wheels, and the greater will be the volume of air used in applying the brakes. By taking up any excessive slack in the brake rigging the slack adjuster aids in giving more efficient braking. Slack adjusters also lengthen the period between brake adjustments.

The most important recent developments in coupler design include provision for automatically making the air and electrical connections between cars as well as providing the mechanical coupling of the cars. These improvements effect a great saving in time in adding and cutting off cars and they also do away with the extra men formerly necessary to assist the motorman in making these connections. Accidents are also reduced to a minimum. Automatic couplers also make it easy to add and cut off cars at points before the end of the line is reached, so that trains of maximum length can be operated through the congested service sections and then cars can be cut off and the remainder of the run made with just enough cars to take care of the service requirements.



Better braking results in energy saving

Pneumatic Door and Step Control— Better Lighting with Large Units

With power operation of doors and steps, many advantages have been made use of to reduce costs that were not considered at first. These include:

1. Reduced number of accidents.
2. Shorter duration of stops.
3. Better car heating.
4. The use of labor more suitable for personal contact with the traveling public.

When the rear platforms of earlier cars were open no door-operating mechanism was necessary, but with the introduction of closed vestibules on cars it became evident that the value of such cars would be greatly increased by a faster operation of door and step mechanisms. The earning power and attractiveness of a car are also greatly increased by the use of automatic equipment.

The hard service which manual door operation requires of a conductor can be appreciated from the fact that on some lines a round trip requires opening and closing the doors as many as 200 times. Is it any wonder then that with hand-operated doors the conductor slows up his operation after a few trips?

I have already discussed the advantage in power saving that is gained by keeping the stops as short as possible. There is an additional advantage obtained by closing the doors quickly in the saving of heat in cold weather. In addition to these savings in time and labor, power operation of doors and steps permits the use of a different class of platform labor and assists in obtaining it more readily, as the duties are made more attractive and desirable. Labor with greater mental capacity rather than physical agility can be used, and as the duties require close and continual contact with the traveling public better relations are fostered and complaints are reduced in number.

The changes and improvements that have been made in car lighting have resulted not only in better lighting but in cheaper lighting as well. The lamps in use on

cars on nearly all the lines today are of the improved tungsten-filament type. Up to approximately five years ago the carbon-filament lamp was in general use. Due to the fact that nearly all roads using direct current arrange their lamps in circuits of five lamps in series, and as these circuits are subjected to a considerable fluctuation in voltage, the carbon lamps used were burned at low efficiency. Tungsten-filament lamps outclass carbon lamps in efficiency and in the color of the light produced and, with the improvements in manufacture that have been made, they now give as long life as the carbon lamps.

The first use of tungsten-filament lamps was in replacing carbon lamps and as most of these installations had been arranged for use of 16-candle power lamps these were replaced with 23-watt tungsten lamps to give approximately the same illumination. In rearranging lighting circuits for remodelled cars and installations of new equipment an endeavor has been made to use a lamp of larger candle power with fewer units per car, in order to get the durability of a larger filament. The results of some tests extending over a period of several years after carbon lamps had been replaced with tungsten-filament lamps show a net saving in the cost of energy after the additional cost of tungsten lamps reinstalled had been deducted of 25 cents per 1000 car-miles.

The advantages of the electric heater result from light weight, smaller fire risk, low maintenance, reliability, possibility of accurate regulation, cleanliness and small space required. The operating cost of electric heating is a serious one and this fact has been especially emphasized during the past winter.

Thermostatic Control Saves Money

The use of thermostatic control for regulating the electric heaters of cars has produced a large saving. Careful observations taken in actual service have shown that this saving amounts to 30 to 40 per cent of the total power used for heating in some cases. The heat

from the passengers' bodies aids in heating the cars more than is usually supposed. A crowded car is many degrees warmer than an empty one consuming the same current.



High-grade maintenance will assure savings expected from new equipment

During the rush hours cars traveling in one direction are usually crowded while those going in the opposite direction are comparatively empty. These varied conditions can be met successfully only by having an accurate automatic control of the heaters. The heating current load, occurring as it does during the winter months when both the lighting load and the power load are increased considerably, is worth more than its proportion of the total cost of power. The "top of the peak costs most" and any reduction in heating current decreases the peak load.

Ventilated Motors During a Strenuous Winter

Neglected Commutator Covers of Old Motors Gave More Trouble Than Clogged Drain Holes of Ventilated Type—The Latter Motors Can Be Protected by Snow Shields, Better Insulation, Etc.

By R. E. Hellmund.

Engineer Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

THE great amount of troubles and breakdowns experienced during the very severe winter season of this year, in connection with car equipments, naturally suggests the following questions with regard to the motors:

1. To what extent is the introduction of the ventilated type of railway motors responsible for breakdowns?

2. What can be done with regard to operation and maintenance to avoid a recurrence of the recent experiences in connection with the motors?

3. Is the ventilated motor a practical proposition and is it destined to survive?

To get an answer to the first of these questions, a number of the writer's associates visited a great many electric railway properties during, or soon after, the severe snow storms of this season and also while the exceptional water conditions existed when large amounts of snow were thawing within a few days. Unfortunately, a good deal of confusion existed in most places, due to the fact that the troubles to be taken

care of were usually far in excess of the shop capacities for handling them. The records, therefore, were not fully kept, and this led often to confusing and contradictory information with regard to the number of failures, their location and their probable cause. Nevertheless, it was possible to reach the following conclusions with a fair degree of certainty:

Snow and Water Proved Even Worse for So-Called Closed Motors

A certain amount of damage is done every year to the motor equipment on account of the dampness within the motor caused by snow and water conditions. These troubles were more numerous than usual during this year's winter season, but, except on a few properties where special conditions prevail, they were hardly more numerous than should be expected if the greater severity and the more continued snow condition are taken into account. Actually the older so-called inclosed motors suffered more than the ventilated motors. This difference, however, can be accounted for by the difference in the age of the motors, and the quantity of the trouble which develops does not seem to be a question of the type.

(Concluded from page 506)

Another improvement that is worthy of consideration in these times of earnest effort to effect economies is the use of the heat from the resistors and main motors to help heat the cars. Several schemes for using this waste heat have been developed, but so far, I believe, have never been tried in actual service. On one particular installation of new equipment I recall that the registers were located so as to be available for such use, but an actual trial was never made.

On closed vestibule cars, one-man cars, and centre-entrance cars, the use of some type of trolley catcher or retriever has come to be considered as a necessity. On these cars when the trolley wheel leaves the wire the car must be brought to a stop before the pole can be pulled down and the wheel replaced on the wire. Much of the popularity of these modern cars is no doubt due to the effective service given by trolley retrievers.

This Is the Day of Car-Checking Devices

A large part of the electric car equipment in operation is not of the latest type and does not possess many of the improvements to which I have called attention. The attainment of the highest efficiencies possible with such equipment lies in its correct operation. Electric railway service contains many waste factors. To keep these at a minimum requires constant investigation and checking. Any automatic checking

device intelligently used will pay for itself many times over. The mere installation of coasting recorders or power recording instruments on the cars of a company will not effect economies. They must be properly and intelligently used to insure the desired results.

Neither is it sufficient to instruct the men responsible for the operation of the cars as to how and why economies are produced. An incentive must be offered the men in order to get them to practice and put into effect the knowledge and instruction which is given them. They should be paid something for saving energy and time. Their work should be checked carefully and earnestness shown in preventing waste of power.

A great deal can be accomplished by personal follow-up work. The average motormen are bound to appreciate this man-to-man policy and, aside from the saving in time, power and wear of equipment parts, it will make thinking men of them. They will thus become better and more efficient in other ways.

There are many pieces of equipment on our modern cars, other than those specifically mentioned, that are being continually improved and their use is producing savings in labor, time and maintenance costs. Such are sanders, fenders, wheel guards, buzzers and other signals, headlights, signal-lights and markers, anti-climbers, storage-batteries, fuses, trolley parts, fare boxes and registers. It will be unnecessary to indicate here how these contribute to the desired end, but they should be kept in mind in any study of the subject of economy.

This fact seems at first somewhat surprising, but it is easily explained. Much of the damage in both ventilated and non-ventilated motors was caused by faulty conditions of the motor covers and drain holes. This was especially the case in parts of the country where severe snow and water conditions are not usually experienced. Thus, it was found that on certain northern railway systems, where the operators are accustomed to taking care of severe snow and water conditions, very little trouble was experienced, although an appreciable amount was reported from some systems farther south.

Melted Snow Refrozen and Drain Holes Clogged with Snow

Much of the snow which caused damage to the motors entered through the top commutator opening on account of missing or badly fitting commutator covers. On some properties the motors are purposely operated without commutator covers during the summer season in order to keep the motor temperature low, and these covers were not replaced at the beginning of the winter season, as would have been advisable. In other cases commutator covers were not properly tightened and were therefore lost during the summer. In still other cases the commutator covers had been adjusted, for convenience, so that they could be easily removed, and this caused bad fits and large spaces between the motor and the cover for snow to enter. It was observed that with such conditions snow was pushed into the motors in very large quantities when the cars bucked snow banks.

A good deal of trouble also was caused by snow blowing in through the top openings during a storm. In such cases, if the motors have been operated and are fairly warm and the car then stands still a considerable length of time, either while the service is intentionally suspended during the night or because the car is stalled in a snowdrift, it is especially bad to have the snow drift into the motor at the top. Such snow will naturally settle partly on top of the commutator and armature and partly on the brush holders. In the beginning these parts are warm and partly melt the snow. Later these parts cool off and get below the freezing point, so that the partly-melted snow refreezes into a solid mass of ice. It is easy to imagine the result when an attempt is subsequently made to start the motors. In quite a number of cases the brush holders were frozen stiff, making it impossible for the carbons to move up or down, while, at the same time, irregularities caused by ice on the commutator make such a movement very desirable. Whenever a motor starts at all under this condition, flashing and burnouts follow.

Another cause for many failures was found in the faulty conditions of the drain holes at the bottom of the motor. In many cases carelessness in oiling without gaging and consequent flooding of the bearings had caused the collection of oil inside of the motor near the drain holes, and this oil, with the dirt which collected in it, had blocked up the drain holes. In other cases it was found that the drain holes had been purposely blocked up to prevent water from entering the motor. In still other cases the drain holes were frozen shut either because the motors ran very cool or they became frozen while the car was standing still, and the motors were allowed to operate before the ice was removed from the drain holes. In all such cases the water from the melting snow or otherwise collected

was retained long enough in the motor to soak the lower field coils thoroughly and cause them to break down.

Another fact which was brought out by the investigations is that motors on low-floor cars give more trouble than other motors, on account of the small clearance of these motors above the track. This is especially true where severe water conditions prevail. It is to be expected, also, because it is evident that water collects on the track in a good many cases high enough to enter a motor with 2-in. to 3-in. clearance but not high enough to enter motors with a considerably larger clearance.

A study of the failures caused during the snow and water periods showed that a good many of them occurred in definite weak points in the motor and that these weaknesses were caused by a great many circumstances, such as defective workmanship brought about by the difficulty of securing skilled labor, severe overloads which had caused roasting some time in the past, etc. These weaknesses would have resulted in breakdowns at some time or other even without special conditions, but the severe snow and water conditions simply served to hasten the breakdown. This in itself would not be very serious if it had not been for the fact that all such breakdowns occurred at a time when the shops were already overtaxed.

Ventilated Motor Lighter, So Absorbs Less Heat

In this connection it is worth while to discuss one point in which the ventilated type of motors is liable to give slightly more trouble than the non-ventilated motor unless the motor is properly applied. Ventilating motors have for a given continuous rating considerably less weight than non-ventilated motors. Under ordinary operating conditions this is of little consequence, but under emergency conditions such as obtain while cars are bucking snowdrifts, pulling disabled cars home, etc., the ventilated motor, if applied to the limit of its continuous rating under normal operating conditions, is more liable to roast out than the old non-ventilated motors. The extra weight of the latter and the larger masses can temporarily absorb during heavy overloads of short duration a certain amount of heat and thereby prevent overheating. This has always been realized by the designing engineers, but the strong tendency of the last years towards reduction in weight has led to a number of rather close applications of the ventilated motors. In such cases the severe service conditions of the past season have roasted out a number of motors, causing poor insulation conditions. Snow and water which get inside of the motor in such cases constitute then only a contributory cause for trouble, in so far as they hasten the failure of roasted parts.

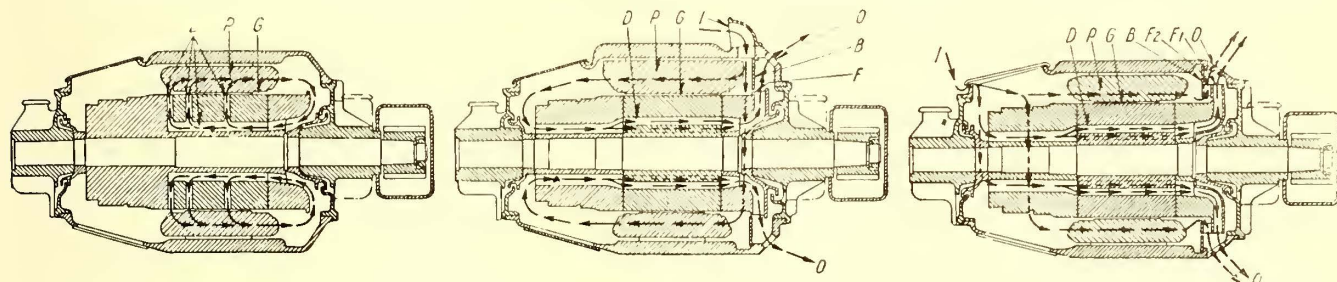
A number of failures of ventilated motors have also resulted from the opposite extreme of practice, namely, where cars have been over-motored. Particularly during the early days of the ventilated motors, a number of installations were made where ventilated motors of the same weight and size were applied in places where inclosed motors were previously used. This plan results in exceedingly cool running motors, but with not sufficient heat to dry out and evaporate whatever dampness gets into the ventilated motors, although the inclosed motors previously used were always warm enough properly to take care of this dampness. In such

cases there have been a few more breakdowns with the ventilated motors than with the old inclosed motors.

It is evident from these facts that the great amount of trouble experienced this winter can hardly be blamed on the ventilated motors but is principally due to the more severe weather conditions, insufficient maintenance, rather close and too liberal applications, or the like. It is logical, therefore, to consider ways and means for remedying the real causes of the trouble; especially so in view of the fact that the expenses and losses caused this winter to many properties, both in the form of shop labor and lost revenues, exceed the \$100,000 mark in many cases. This fact clearly indicates the wisdom of expending some money during the summer and fall seasons to prevent a recurrence of the recent winter troubles.

Care of Commutator Covers and Drain Holes Is Essential

It is at once evident, from what has been said, that steps should be taken properly to maintain all motor covers, especially to replace all missing commutator top covers and properly tighten them if necessary, by



THREE TYPES OF MOTOR VENTILATION—FIG. 1—INCLOSED RADIAL-DUCT TYPE MOTOR; FIG. 2—SERIES VENTILATED FAN-TYPE MOTOR; FIG. 3—PARALLEL-VENTILATED FAN-TYPE MOTOR

While Fig. 3 shows the air intake on top, most recent motors of this type have them lower down, the advisability of which has been borne out by the experience of the last few months

applying felt linings before the winter season begins. Especially in interurban service, perfectly fitting covers are of great importance during snow storms. Furthermore, the drain holes of the motors should be kept open in all motors all the time. It is true enough that once in a while closed drain holes may keep water out of a motor and prevent a breakdown when the car runs through a deep pool of water over a considerable distance. Much more frequently, however, closed drain holes will hold water, which cannot be entirely prevented from entering the motor and remaining long enough around the bottom field coil to soak it completely and cause its certain breakdown. Even in an entirely inclosed motor there are always air openings to let water-saturated air enter the motor at times. If this air subsequently cools off while the car in standing idle during the night, for instance, the cooling air will deposit dampness either in the form of condensed water or, when it is very cold, in the form of frost on the motor parts. If such water, after running toward the bottom of the motor, is allowed to drain out promptly but little harm will be caused, but if it is kept within the motor it usually will cause damage. For this reason drain holes kept open all the time by proper inspection and maintenance are usually less of an evil than blocked drain holes. If, in case of flood conditions, it seems desirable temporarily to block the drain holes, great care should be taken that all other motor openings

whether such conditions are fulfilled it is advisable for properties operating ventilating motors to take sufficient temperature readings under actual operating conditions to determine how the motors are loaded. If it is found that the motors run relatively cool, that is, if they have a temperature rise of not more than 40 to 50 deg. C. over the surrounding air under the most severe service conditions, it may be advisable to replace the ventilating covers partly or entirely by closed covers during the winter season; it may also be advisable, for similar reasons, to cover up some or all of the air outlet openings. But if the motors while fully ventilated run hotter than the temperature mentioned, it may be dangerous to reduce the amount of ventilation, and if from the experience of the past season an improvement is desirable besides that which can be accomplished by proper maintenance of covers and drain holes, other steps may be necessary.

Snow Shield Protection Possible for Ventilating Motors

In certain localities the use of shields in front of the motors, preventing large quantities of snow getting near the motor, has given very satisfactory results. Such shields should preferably be of substantial steel construction, since canvas covers which have been tried can hardly be maintained in proper condition more than a few days. In fact, it would seem advisable to pro-

vide, wherever possible, shields so substantial that they can serve at the same time as snowplows and so set that they will keep the snow level lower than the bottom of the motor and the gear cases. This would have the additional advantage of eliminating troubles caused when the motors and gear cases ride on the snow. In a great many localities, especially inside of towns, such a condition is not unusual in winter. The result is that considerable snow, mixed with sand and dirt, is scraped into the motors. Furthermore, gear cases have been worn through so that sand and snow have got into the gears. It is estimated that the damage thus done this winter to the gears and gear cases amounts to many thousands of dollars.

Fill Up the Cracks in the Insulation

While the previous suggestions for keeping snow and water out of the motors will undoubtedly give better results, some dampness will frequently get into the motors in spite of all possible precautions, as already explained in connection with condensation. This dampness will cause breakdowns wherever the insulation is not in perfect condition. It is, therefore, most desirable to keep up the quality of the insulation.

The best and cheapest way in which this can be accomplished with motors which have been in service is by the dipping and baking processes, applied to the armatures and field coils. Any insulation now known will when heated and cooled continuously and when subjected to the unavoidable vibrations of railway service develop certain cracks and small openings. This is particularly the case in motors which have been subjected to severe overloads and which have been roasted because of them. After the insulation has thus developed cracks, it is only a question of time when dampness entering such cracks will cause insulation breakdowns, and the only means for preventing such failure consists in the refilling of these cracks with insulating material before it is too late. This can be very easily accomplished if the armature and field coils are properly dried in a simple baking oven and dipped while hot in Sterling varnish or some equivalent insulating material, then dried in the oven. The varnish will fill up all little crevices and cracks, and, if the process is repeated from time to time, it will prolong the life of the insulation considerably. It is believed that the expense for the equipment and work necessary for this process could have been saved ten times over during the last season on a great many properties.

The Ventilated Motor Is Best but Requires Good Maintenance

Our third question as to whether the ventilated type of motor is destined to survive can now easily be answered with an emphatic "Yes." The evidence so far collected, under actual operating conditions, shows that if properly applied and handled, the ventilated motor will give no more trouble than an inclosed motor. This also follows from the following simple consideration.

It may be true that snow and dampness, at times, get into a ventilated motor in larger quantities than into a non-ventilated motor with well maintained covers. On the other hand, it must also be remembered that the constant air stream going through a ventilated motor will dry out damp insulation rather quickly, while even

a small amount of dampness getting into the insulation of an inclosed motor will not dry out for considerable time. Since it takes some time for dampness completely to penetrate insulation, a small amount of dampness present for a long time is liable to do more harm than a larger amount for a shorter time. Even if it should prove necessary on some properties to change the type of covers twice a year and to adopt some improved methods of maintenance, the use of the ventilated motor is justified because the expense incurred is only a small percentage of the economies that can be accomplished with the ventilated motors.

It must be realized in this connection that the use of ventilated motors and attendant changes have reduced the weight of the motors alone on quadruple-equipment city cars between 2000 lb. and 5000 lb., not counting the reduction in the weight of the trucks made possible by the smaller motors. Assuming, therefore, the customary figure of three cents to five cents per pound extra weight in operating expenses, the introduction of the ventilating motor has made possible an annual saving of \$75 to \$300 per car. This being the case, it is good economy to spend a small percentage of this money in extra maintenance which may possibly be required with ventilated motors. The argument often advanced that it is impracticable to change covers a couple of times a year or properly maintain insulation must simply be discarded as long as a marked resulting economy with the ventilated motor is possible.

It should further be kept in mind that the ventilated motor is a rather new piece of apparatus and that not only its maintenance can be improved along lines suggested in this article but that it will also be possible to accomplish improvements with regard to its design and to its proper application. Recent experience has shown that such improvements are desirable even if they have to be accomplished by means of a slightly increased first cost of motors.

Streaking of Railway Motor Brushes

JOHN SWIFT DEAN, of the railway engineering department Westinghouse Electric & Manufacturing Company, has recently investigated the causes of the peculiar streaks or grooves which run along the front and back surfaces of brushes that have been in service for some time. Study of the streaking on a number of samples led to the hypothesis that it was due to particles of sand and dirt working their way down between the carbon and the carbon box. These, by constant vibration, movement of the carbon and the action of gravity, cut small grooves in the sides of the carbon.

This conclusion was confirmed by tests with and without current between brushes and boxes, the following test results being noted: (1) Pronounced streaking of carbon exists. (2) Streaking was produced when electric current was not present. (3) Considerable dust and dirt were in evidence. (4) When dust and dirt chutes were provided no streaking was produced. (5) When the dust and dirt were removed streaking was eliminated. (6) Sand particles were found lodged in groove.

From these results Mr. Dean was convinced that the grooving or streaking of railway motor carbons is due to the abrasive action of the grit, as he had surmised from his preliminary studies.

The Testing Organization of Electric Railways

This Analysis Shows How Useful Such a Department Can Be and How Diversified Its Work Becomes in a Large Electric Railway Organization, Affecting All Phases of Construction and Operation

By *Hartley LeH. Smith*

Chief of Testing Bureau
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IN CONSIDERING the work of a testing department the first question which merits discussion is whether or not such a department is worth while and economical. To justify itself it must result in the more systematic and efficient handling of certain things which are indubitably worth while.

The tendency of the times is to make tests. When it is decided that necessary or desirable tests shall be made with frequency, a testing department is created; until then, such tests as are made are handled by outside laboratories.

Electric railway tests, like all others, may be classified as those which are necessary and those which are desirable. Of necessary tests, practically all electric companies, railway or otherwise, are agreed that watt-hour-meter calibrations shall be so classed. The division line between necessary tests and desirable tests is an extremely elastic one.

If a testing department exists the tests which are considered either necessary or desirable, and, being so considered, are made, depend really very intimately upon the relationship of the testing force to the departmental organization of the corporation. Tests might, for instance, be very closely associated with purchases. Where this was true the testing organization would be intimately connected with the purchasing organization. On the other hand, tests made on materials purchased are much more likely than not to be made on materials bought under technical specifications: *i.e.*, engineering specifications. Such specifications are naturally prepared by the engineering department or departments. Thus a natural link is at once found between the testing organization and the engineering organization.

Modern testing, of course, is an engineering matter. As a matter of fact, it is now fairly established as a branch of engineering. I need only point out that one of the great national engineering societies, the American Society for Testing Materials, is one devoted specifically to testing. So a testing organization is almost sure to be an engineering organization, manned by engineers. In an overwhelming majority of cases the testing organization of any corporation constitutes a part or branch of one or more of the engineering departments of the corporation. It might be thought that if there are more or less separated engineering departments in

a large organization the testing force would in some way be equally associated with or related to them all. Such would, indeed, be the logical arrangement.

Tests may deal with materials or machines. The distinction is quite real. There is, for instance, the American Society for Testing Materials, cited above, but as yet there is no national society concerned particularly with the making of tests on machines, and perhaps there never will be. There are, instead, the codes of several national engineering societies dealing with the methods of making tests on some of the important classes of engineering apparatus. For instance,

there are "the power-test code," adopted by the American Society of Mechanical Engineers, and the "standardization rules" of the American Institute of Electrical Engineers.

Among other broad divisions into which the work of a testing organization of an electric railway may be classed, so far as new material and apparatus are concerned, these three seem pertinent; first, continuous supplies; second, apparatus installed for extensions and betterments, purchased under guaranteed - performance specifica-

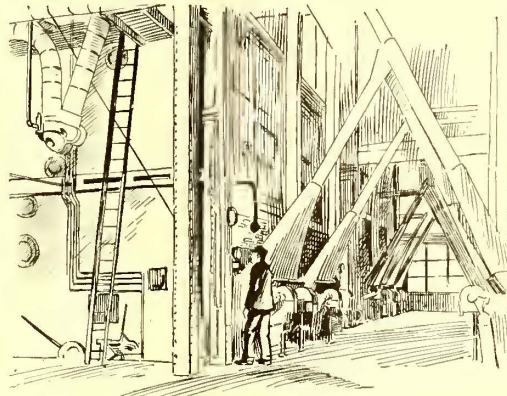
tions, and tested for acceptance; third, materials and apparatus on trial.

Of the first class a long list might be written, but some very common illustrations are coal, oil, condenser tubes, boiler tubes, incandescent lamps, trolley-line material, car wheels, axles, bolts, cement, paint, etc. In the second class a partial list including turbines, condensers, boilers, automatic stokers, centrifugal pumps, blowers, static transformers, rotary transformers, circuit breakers, high-tension cables, etc., might do. Of the third class, coals and oils other than those which have been customarily used, all sorts of steam specialties, lightning arresters, rail bonds, and many other things, might be mentioned as illustrative.

Deterioration Tests Another Function of the Testing Department

Another large field of work for the testing force is in inspecting material and apparatus during manufacture. In some of the most advanced organizations this work receives great prominence. As an important contribution along this line I would cite the paper entitled "Testing Is Not Inspection," by W. A. Aiken, read at the annual meeting of the A. S. T. M. in 1908.

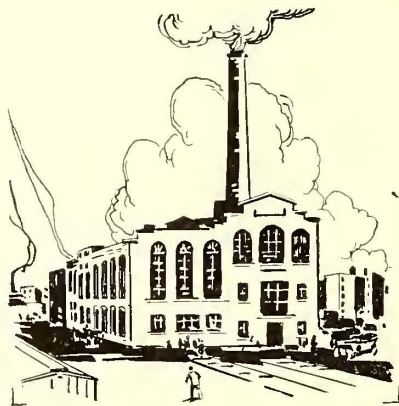
Another class of work for the testing organization is in making tests to detect deterioration of the efficiency



Steam gages need calibration now and then

of apparatus which has seen considerable service. Such tests are of much aid in securing reasonable maintenance of the original efficiency of the apparatus throughout its life. Such tests, for instance, might show that the blade clearance of a turbine has increased and turbine castings become warped, both contributing to higher steam consumption; that pump impellers and casings have suffered erosion, with resulting falling off of efficiency; or that engines have developed valve and piston-ring leakage, clearly evident in indicator cards systematically taken and analyzed.

A still further field for the department is in tests made on apparatus for the detection of developing obso-



From foundation to chimney the testing department can find something to do

lescence. This is intimately related to the evolution of more highly efficient forms of apparatus designed for the same work. As illustration, the ageing of transformer iron may be cited, with its effect on substation efficiency, or as measured by uneconomical iron losses where potential is continuously maintained regardless of load. Still another illustration is in the detection of increasing current transformer errors due to aging of iron, with its effect on watt-hour-meter registration.

Tests Related to Improvement of Operating Conditions

Among the lines of work for the testing department which are of importance are those which deal with studies of operating methods. For instance, in power-station work there are tests made for the purpose of revealing those operating methods which will yield high efficiency under fundamentally controlling conditions of operation; that is load factor, extreme range between maximum and minimum loads, etc. Take, for example, the matter of banking boilers. This operation involves losses, but, depending upon the furnace equipment, some boilers will give astonishingly high over-all efficiency when steaming at low rates. These same boilers may show a falling off in efficiency to disappointingly low, but nevertheless legitimate, values in hours of heavy peak loads.

Merging closely with the above are studies which attempt to show the operating conditions and methods which will bring about the ultimate desideratum of power-plant economy; that is, such operation as will cause the summation of the fixed capital charges and the operating charges to be a minimum.

For instance, it does not at all follow that a turbine should be operated at its most economical water rate. Important papers on power-plant operation, based upon

a realization of all these general principles, have been read before some of the national engineering societies, and certainly in the future this subject will receive a great deal more detailed attention than formerly.

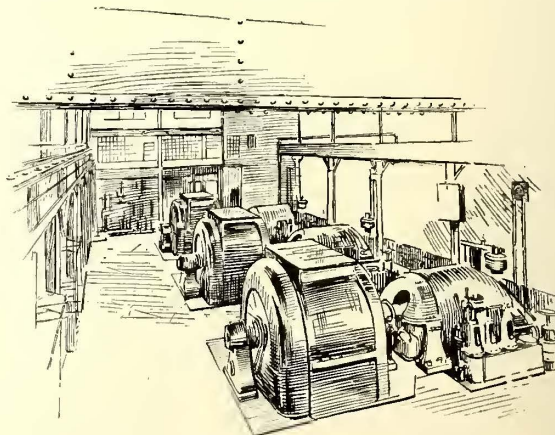
Another set of general tests includes those designed to give clear-cut information as to the methods of operation and maintenance which will favorably affect the heat balance of the station as a whole. For instance, there is the important problem of exhaust steam from auxiliaries; that is, as to the excess or deficiency of it, and the action taken regarding such excess or deficiency. In many stations to-day provision has been made for the connection of the auxiliary piping system, not only to the feed-water heaters but also to the low stages of one or more turbines, thus allowing considerable practical control of the heat balance.

Certain variations in operating procedure are dictated by seasonal variations throughout the year. Two sources of heat supply (when the heat balance is rigorously considered) fluctuate very greatly with respect to entrance temperature throughout the year, namely, the feed water as taken from the city mains, or other outside source, and the intake circulating water. The feed water, in so far as it comes from an outside source, is able to absorb a far greater quantity of exhaust steam in the winter than in the summer; and similarly the seasonal variation in intake circulating water is so great as to make large changes in the quantity of circulating water which are most economical in winter, on the one hand, and in summer on the other.

Routine Testing of Water and Other Power Plant Elements

Apart from tests and studies which have classifications such as outlined above, there are in the modern power station certain tests which do, or should, constitute essential parts of daily operating routine.

Foremost among these are tests which deal with water treatment. Where turbines are used, it is only under rather extreme circumstances that surface condensers are not used. The only justification for surface con-



Here is a fertile field for the testing engineer

densers is the use of the condensate as feed water. Where feed water has to be purchased from a municipality, the potential saving in the use of the condensate from surface condensers becomes enormous; so large that to forego it is prohibitive.

The use of condensate from surface condensers, however, involves many a problem. Except where the power station is so fortunately situated as to have unusually

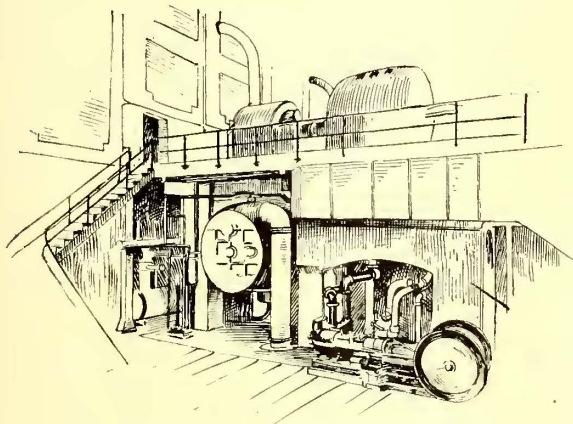
good condenser circulating water, I do not think it is possible to continue long the use of water from the hot wells of the condensers as feed water unless such use of it is controlled throughout by daily laboratory tests. Condenser tubes will develop leaks, and, as such leaks are the result of attack of the circulating water on the tubes, water so leaking becomes a contaminating influence in the feed water, and will cause trouble if not controlled.

Tests for Impurities in Condensate and of Conditions in Condenser

The sort of tests which in the aggregate constitute a system of adequate control is an extensive subject in itself. Certain fundamentals, however, can here be set down. When the tube leakage in any one condenser has become too great the entire hot-well water from that condenser must be thrown away until such time as the condenser can be shut down and repairs made. While it continues in operation with its water so contaminated by condenser-tube leakage as to prohibit its use as feed water an equivalent feed-water supply must be obtained from the alternative source, in general from a municipality, at a rather high cost per cubic foot.

The water from the mains of a municipality seldom constitutes an ideal boiler feed water; in other words, it compares unfavorably with the hot-well water from a condenser in which the leakage is slight, or even negligible. Therefore, it becomes a problem of correctly establishing the standard of allowable leakage through the condenser tubes into the hot well, after which the hot-well water will be temporarily thrown away.

Next in the order of these problems is that of scale prevention. The hot-well water will normally come to the feed-water heaters with certain amounts of condenser leakage water in it, as outlined above, and will consequently, in practically every case, be a scale-forming water. So also, in general, will be the water taken from the municipal mains or other outside source.



Tests of condensate are essential to safe operation

Prevention of objectionable scale is a necessity, and laboratory tests of some sort are essential to control the water treatment, whatever the treatment may be. After the water has been treated with reasonable satisfaction in this respect, it may, as a result, be of such nature as to induce priming. Hence, water tests for the specific purpose of avoiding priming difficulties become quite as essential as those which deal with the scale-prevention treatment.

Among the tests which are practically essential parts of daily operating routine are those connected with the maintenance work involved in maintaining first-class vacuum on large turbines. The last quarter-inch of vacuum obtainable in turbine practice is of the most urgent importance. The items which should have daily watching and control by tests are the adequacy of flow of circulating water, the air leakage, and the efficiency of air removal.

The adequacy of flow of circulating water is affected by the obstructing material which may have accumulated in the water boxes because it was not entirely caught at the intake screen. Daily tests should therefore be



Where there is enough work for him an expert chemist should be a part of the testing organization

made to determine the temperature rise of the circulating water, which data in connection with simultaneous turbo-generator load data suffice for calculating closely enough for the purpose the quantity of water circulating. This will be found to undergo quite marked reduction between intervals of water-box cleaning or condenser-tube scraping. A fixed schedule for such work is not satisfactory because obstruction due to accumulating trash is itself irregular, due very largely to the effect of weather conditions on the source of condensing-water supply, usually a river.

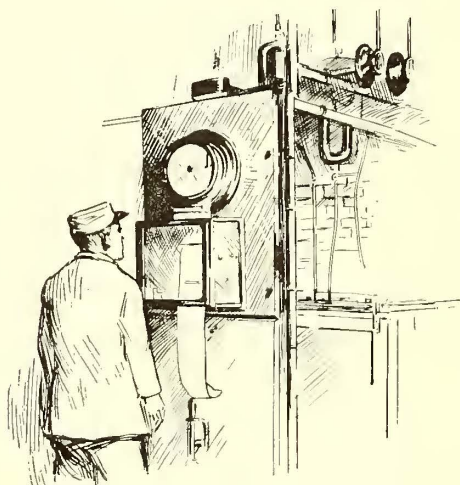
The air leakage into a condenser due to obscure causes is variable, and quantitative measurements are an aid in the general work of vacuum maintenance. Some years ago, in large power stations, the practice of using the following simple device became rather general. It embodies the principle of a gas holder or tank. The air, leaking into a condenser and withdrawn by a reciprocating dry-vacuum pump, is discharged into the device, causing its movable element to rise as the air accumulates in it above a water surface. The time of rise is measured with a stop-watch, and the quantity of air is calculated in cubic feet per minute, or other convenient unit. The power stations which have adopted this practice look upon it as well-nigh revolutionizing the problem of insuring that their condensers are free from objectionable air leakage. Such a device can be used immediately to render large air leakage evident.

There is, however, another aspect which perhaps has not had quite such general recognition, namely, the effectiveness or efficiency of air removal. All of the air which leaks into any condenser is removed by the air pump, otherwise there would be an accumulation of air in the condenser, and the unit would soon go to high pressure. To show what is involved in effective air removal it is only necessary to name the means used to measure it. To this end the valve in the air suction line between the air pump and the condenser is closed, and a reading is taken of the vacuum which

the pump is able to "pull down" against the closed valve. If the pump is in proper operating condition it will naturally "pull down" a very high vacuum. Often enough, however, it will do nothing of the sort, and maintenance or repair work is accordingly at once indicated as urgently necessary on the pump parts themselves.

Some Factors in Maintaining High Vacuum

Some very interesting relationships exist, indeed, between the effectiveness of air removal, the quantity of air leaking into a condenser (and hence removed actually by the pump), the vacuum accordingly maintained in the condenser, and the type of air pump. There are on the market several kinds of air pumps embodying the ejector principle, and so constituting a radical departure from the old-line reciprocating pumps. Among these types great differences exist, as can be seen from curves plotted to show the vacuum possible to maintain in a condenser under given conditions of turbine



Graphic meters are of great help in testing

load, circulating-water temperature and quantity of flow, in terms of the quantity of air leaking, and accordingly removed by the pumps.

Most reciprocating pump equipments in actual service are really of greater capacity than is ordinarily recognized. When such pumps are so maintained as to give effective air removal they will take out of a condenser the quantity of air leaking into it with such relative ease as to make the extent of air leakage of rather secondary importance. That is to say, if a reciprocating air pump is kept in fine mechanical condition one need not worry greatly over the quantity of air getting into the condenser.

With certain ejector pumps, however, the operating characteristics seem quite different. The vacuum which can be maintained in the condenser itself is not only a definite but one might say that it is a considerable function of the quantity of air leaking into a condenser. In such cases great care needs be taken to keep the condenser air leakage down to a low minimum if the pump has small capacity. If it has large air-removing capacity it is apt to make considerable power demand.

Attention may also properly be called to the fact that it is with just this sort of equipment that no effective device has as yet been developed which will permit of measurement of the air leakage in absolute terms. This,

however, is not such a great disadvantage as might be supposed, because it is still possible to judge the condition of such an ejector pump by measuring its vacuum-pulling ability against a closed suction valve, and immediately afterward the vacuum which it can maintain when actually removing air from the condenser.

The rather steep line, previously referred to, connecting its vacuum-pulling ability with the quantity of air removed, suffices to determine whether the air leakage into the condenser is moderate or whether it is large, and thus needs work to bring it down again to moderate values.

Tests of Boiler Operation

An extremely simple matter which can be controlled by daily testing and which relates to one of the most fundamental and by no means negligible sources of loss of power station efficiency is the determination of the combustible matter in the ashes. Undoubtedly many power stations are following this matter up, as the relationships between true ash in the coal, combustible in the ashes as dumped, and resulting loss of potential heat are well understood.

Of great importance, also, although not so obviously connected with testing, is insuring the cleanliness of the heat-absorbing surfaces across which the gases from the furnace flow and through which the heat is transmitted to the boiler water. As, however, the fluctuations in gas temperatures leaving the boiler are given more attention than formerly, and very frequently are recorded automatically, it generally follows that a testing force becomes considerably involved in such studies.

In this connection it certainly would not do to omit some mention of the determination of the composition of flue gases. A few years ago the writing of papers on this subject amounted to nothing less than an epidemic. If we could gather statistics showing what young men in testing work in power stations really are doing probably the time spent analyzing flue gas or adjusting apparatus which itself automatically analyzes flue gas would appear high up on the list.

Calibration of the Watt-Hour Meter May Produce Large Cash Savings

Turning attention to the tests which may really be called essential for power station operation, we are confronted first by watt-hour-meter calibrations as mentioned earlier. In many cases, increasing in number, the corporations owning power stations are dependent for their fundamental income upon the accuracy of watt-hour-meter registration. In most electric railway power stations watt-hour-meter registration accuracy still affects only the accuracy of certain statistics, such as the economy figures of the power station itself, the energy consumption of the rolling-stock per ton-mile, figured from the power station switchboard, etc. But more and more every year the registration of watt-hour meters measuring energy supply for railway use is intimately related to cash payments, as the generating end bills the railway for energy as if it were a separate organization.

Probably accuracy of registration of railway watt-hour meters in service averages lower than in lighting or industrial power service because of the more vio-

lently swinging character of railway loads. Large railway power systems naturally suffer less from this handicap than small ones, but large systems are in general worked with substations, and the substation load is usually marked by severe fluctuation. Naturally this is true in a special degree where subway or elevated train loads are carried. The testing force of a railway power company therefore finds itself concerned with the problem of overcoming the handicap and attaining high accuracy in watt-hour-meter calibration. Quite special instrumental means and methods have accordingly resulted.

Insuring Accuracy of Switchboard Instrument Measurements

In a more general way the electric plant tests, which may be considered in the strictly necessary class in that they are either taken care of by an organized testing force or at less frequent intervals through the agency of outside testing organizations or departments of manufacturing companies, are those dealing with calibration and repairs of the switchboard indicating instruments. Where there is an organized testing force this work on a large system is apt to keep several men fairly busy. The work requires considerable skill if it is to be done efficiently, that is, at lower cost than that involved in having it done by the repair departments of the manufacturing companies.

The requisite skill of the men varies naturally with the type of instrumental equipment, some makers using much more delicate construction than do others. As a general proposition, however, on systems of ordinarily large size really high maintenance standards can be obtained far more cheaply if the instrumental repair work is done by a testing force. Such repair work is so closely connected with calibration, that is, work in which errors are detected and corrected without the necessity of repairing broken parts or replacing them with new parts, that the two kinds of work are generally done by the same men. The instruments requiring this sort of attention on an a.c.-d.c. system include ammeters, voltmeters, static voltmeters, synchroscopes, frequency meters, indicating wattmeters, etc.

Calibration of Ammeter and Other Shunts

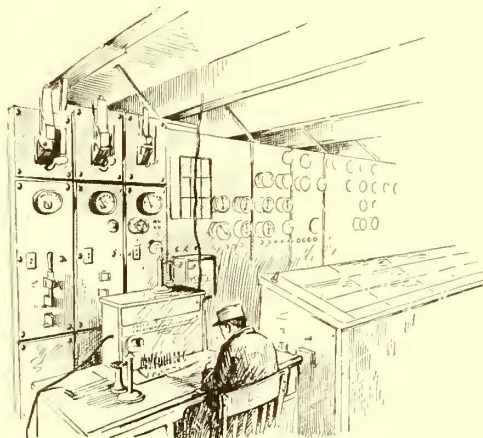
An organized testing force is apt to find itself pretty intimately concerned with the measurement of the ohmic resistance of meter shunts. Such shunts are subject to incidental deterioration. Now and again such a shunt will be overloaded and the avoidance of such overloading may temporarily be impossible. It may as a result suffer change in resistance.

More serious than this, however, because more likely to occur, is possible change in resistance due to handling during installation. Ammeters working on shunts are, of course, in reality milli-voltmeters, and the nominal potential for full scale deflection is generally on record expressed in terms of millivolts. Ammeter calibration itself therefore resolves into nothing more than the calibration of so many millivoltmeters. It is idle, however, to work upon this basis unless it is really known that the shunt resistances either actually have their nominal values or some other values which may be looked upon as substantially fixed for reasonable intervals.

I am speaking, of course, of those systems where effort is made to attain thorough-going accuracy founded upon a substantial basis. In this connection, however, it is worth while to point to the increasing use of the mercury type of watt-hour meters. If charges between one electric company and another or an electric power company and a railway company are to be based upon mercury-type watt-hour meters the resistances of the shunts ought to be measured *in situ*. This measurement of the resistances of shunts after installation is somewhat difficult and complicated. In large stations or substations it is a matter needing not only proper instrumental testing equipment but considerable skill.

There Is Work on Gages to Be Done Also

Turning to the steam plant, and considering tests which may be called necessary, the pressure gages naturally come in first for attention. There are indeed other ways for a manager to be assured that steam pressures are really what the station log indicates than



The heart of the power plant—the accuracy of every meter must be checked carefully

to have a testing force to calibrate steam gages. But it is true that in a large station where there are many gages the average of accuracy is apt to be low unless an organized testing force is looking after them.

If such gage testing is done it is naturally done all along the line—water gages, air pressure and draft gages, vacuum gages, etc. In a large station with considerable instrumental equipment, maintenance and calibration of such instruments have just about the same status as in the case of electrical instruments. That is, to a considerable extent repairs are made by the testing force, and the general maintenance of instrumental accuracy where repairs are not necessary provide a considerable amount of work. To specify definite instruments may seem to be criticising certain of them, but broad experience will not lead to such a deduction. If there is a plentiful supply of steam-flow meters, recording pressure gages and thermometers, not to speak of CO₂ recorders, there is apt to be plenty of work.

Adjustment of Relays Naturally Falls to the Testing Department

A somewhat different viewpoint in considering the testing department from any of the above may be had by considering certain apparatus, and the adjustments and tests made upon it relating to automatic handling

of emergency conditions. Going back to the electric plant, an extremely important case in point is that of relays operating oil switches of the high-tension system. The practice of different operating companies seems to vary very widely with respect to the underlying ideas upon which relay adjustments are made, and there is also much variation in the plans used to insure reliable operation. Companies differ also in the extent to which they have pushed experimental investigations along this line.

Where there is a testing force it naturally handles the matter of relay adjustments. The ease, accuracy, and reliability of such work have been increased in recent years by the development of a device which uses the cyclic variation of current of an alternating system as the quantity against which the operation of relays is checked, rather than against time measurements with a stop-watch. In using this plan it is only necessary to see that the frequency of the system at the time of making adjustments is substantially normal.

Adjustment of relays with a stop-watch is unsatisfactory because the only truly significant thing about relay action is how it acts when the actuating current is large. When it is large the relay action is quick and the time interval so short as to render stop-watch measurements unreliable. With a cycle counter accurate measurements of very quick relay action are at once attainable. Hence it becomes possible to adopt adjustment schemes which not only make provision on paper for properly selective action between relays on different parts of the power transmission circuits but which actually allow of the attainment of such selective action.

In practically all inverse-time relays in actual use at the present day, excluding only certain very old types, the relations between time and current are very definite. These characteristics are more flexible than are sometimes supposed. A well-designed system for the several relays at different parts of the power transmission circuits will show provision for selective action based upon a given margin of relay reliability at any currents within the limits of possible action. It will also include in its provisions the time required for the successive operation of oil switches as distinguished from relay operation. All this can be shown in a group of curves.

The testing force making relay adjustments will work with these curves so that, although the testing loads during successive calibrations may not for one reason or another always be identical, the adjustments given the relays will be such as will make them operate in a definitely known manner. The need for, and the great operating benefit derived from, accurately working selective relays on a complicated system is such that a testing force engaged in the work of adjustment is used also to keep track of the maintenance of adjustment in a systematic and routine manner.

To take an illustration from the field of matters more

or less akin to the above discussions of electrical maintenance, let us consider the subject of safety valves. Safety valves, whatever else they are, are mechanisms of sufficiently complicated principles of design to give them in certain service characteristics not widely appreciated. Ordinarily one thinks of "popping pressure" and "blow-down" as about the whole safety-valve story, but a testing force can sometimes reveal unexpected limitations of types a bit antiquated, indicating the desirability of modernization.

The Organization of the Testing Department

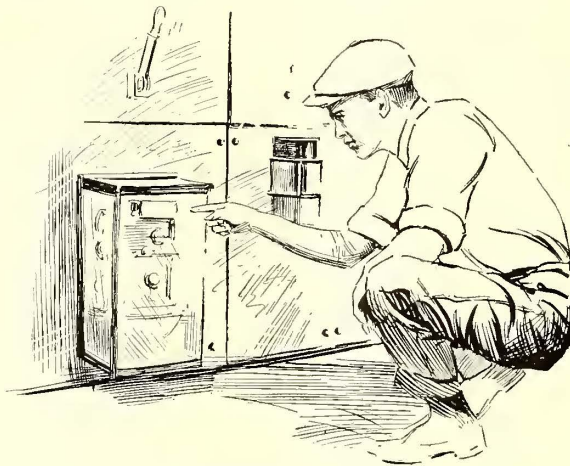
With respect to organization of the testing force, its three divisions are manifested at once. Incidentally they follow rather inevitably the broad division lines which appear in the field of engineering education in so far as that field has direct relations to power plant service.

The young men engaged in testing work are, generally speaking, graduates of engineering schools. Probably no such testing force is, however, exclusively composed of such men. The schools turn out among others graduates in electrical engineering, in mechanical engineering and chemistry or chemical engineering. The testing work of such power plants naturally falls into these three classes. There is no small amount of interchangeability between the electrical and mechanical engineering graduates, since all electrical engineering courses teach much concerning mechanical engineering

and mechanical engineers are taught a whole lot about electrical engineering. This interchangeability is such as to be able to bear considerable strain in actual service. Exigencies of organization building and the natural capabilities and adaptabilities of individual men, which after all always override any rigid educational demarcation lines, bring about now and then applications of this sort of strain. The writer once had simultaneously, for instance, an electrical engineering graduate in charge of steam testing and a mechanical engineering graduate in charge of electrical testing.

In the line of chemistry interchangeability hardly works. Electrical and mechanical engineers are taught chemistry but they are not chemists. In the testing work of a small or moderate size electric power plant a man not a specifically graduated chemist often does sufficiently well, but in the more highly specialized work of really large plants no great success could be expected. Much of the testing work of a mechanical nature around an electric power plant is fairly simple, but some is not. Where any approach to general quantitative analytical work is made a real chemist is required.

The writer ventures to predict that in the not distant future another branch of the engineering educational field will be tapped in manning the testing force of large electric railways, that of metallurgical engineering. The extension of the metallurgy of steels in re-



Here is the watt-hour meter. If its readings are inaccurate great loss of money may result

Labor-Saving Methods in the Way Department

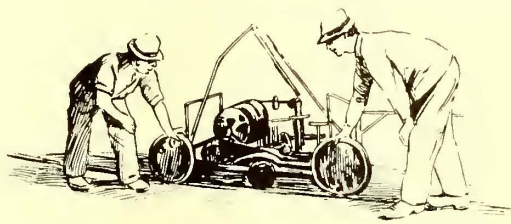
The Author Analyzes the Possibility of Utilizing Effectively the Many Machines and Tools Which Are Now Available for Performing the Operations Involved in the Up-Keep of Track Work

By Roy C. Cram

Assistant Engineer Department of Way and Structure
Brooklyn Rapid Transit System.

THE labor conditions created by the entry of the United States into the war have had a strong influence in directing attention of way departments to the possibilities for saving labor through the extended use of machinery. The use of machinery, up to a comparatively short time ago, was gradually increasing, but there was still a tendency to hold back expenditures for equipment. This was largely due to the fear that too much money might be tied up in equipment, a great deal of which is limited in scope and liable to be idle for long periods, especially in the winter season.

During the past two years, however, it has become evident that the main opportunity to overcome labor handicaps lay in the direction of labor-saving devices, and such machinery and tools now form a part of the way department equipment to an extent which would have excited wonder a few years ago. The way department yards have taken on an aspect resembling contractors' yards, and the general result has been that a much more businesslike procedure



Each class of rail grinder has its place

has taken its proper place in the scheme of things.

If there are any doubts as to the advisability of using labor-saving machinery to the fullest possible extent they should be dispelled by the results obtained from their use by the way department in track work in Elmira, N. Y., last summer, as described by F. H. Hill in the JOURNAL for June 30, 1917. Furthermore, John A. Beeler in his recent report on the Boston Elevated Railway, in commenting on the way department methods, says: "The methods employed are to be commended. Labor-saving devices have been introduced extensively and the amount of hand work has been reduced wherever possible. This has undoubtedly aided in keeping down maintenance costs. The use of such devices should be extended wherever possible, especially in view of the present shortage of labor."

With the advent of machinery, it has been necessary also to increase the supervision to some extent, because much of it requires a reasonable amount of attention and care if it is to be kept in a condition to give the best service, both in its application to the work and its performance as machinery.

General Tendency in Adoption of Equipment

The general trend of the interest in special tools and equipment has been toward the adoption of improved forms of work cars, such as crane cars and automatic dump cars; the increased use of the power shovel both for grading and for loading cars; the rapid adoption of pneumatic or electric tie-tamping tools; the broadened scope of the electric arc welders; the increased use of power drills in regular maintenance as well as construction work, and the general rearrangement of storage yards, including the installation of various forms of labor saving devices therein.

Arc Welders Assume Importance in Effecting Economies

It is somewhat difficult to indicate just where the greatest savings have been effected or to indicate any particular tool or device which has been so signally successful as to excite exceptional comment. Yet there can be but little doubt that the use of the several forms of arc welders now available has contributed a very large share in effecting many economies in men and materials. These devices had their origin in the use of the acetylene flame as first presented to the industry under the name of the "autogenous welding process." Since it involved the use of rather expensive gases, and its range of use was somewhat limited, the process soon gave way to the arc welder, using the very convenient

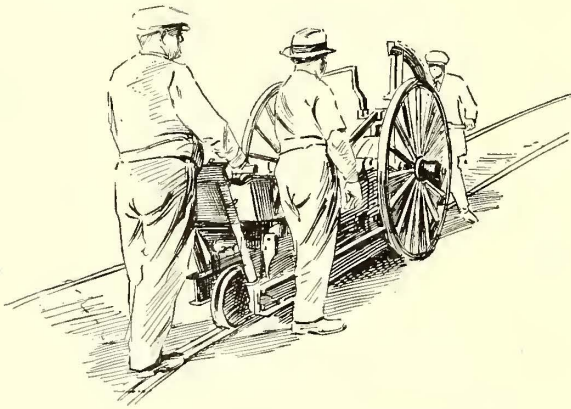
(Concluded from page 516)

cent years, for example, has been very rapid. Likewise, special steels have been developed for special uses and complicated heat treatment is given to such steels during their manufacture and afterward. There is a growing recognition of the value of inspection during purchase of large orders, and a general extension of research in industry. The rapidly extending use of metallography in such work will demand the service of young graduates of the metallurgical schools.

It would also seem possible that the testing work of electric railways will find place for another branch of engineering, if such it may be really called, efficiency engineering. Of course all engineers think of themselves, let us hope rightfully, as in some degree efficiency engineers. Further, it is only too well known that many rather ill-advised activities of so-called efficiency engineers have been such as not to commend themselves to the practical minds of many very capable executives—and electric railway executives on the whole are mighty practical. Still there does seem hope that the wisest among efficiency engineers will overcome the the fairly justified prejudice with which a good many of the cult are now viewed, and we may find some young representatives of the class substantially established among the others in the prominent testing organizations in the electric railway field.

power from the overhead wire, until to-day there is no road of any size which is without some form of arc welding apparatus. With the use of the arc welder came a rapid development in the use in connection with the application of a simplified form of electrically-welded rail joint.

The early type of arc welder consisted of an arrangement of grid resistances which was effective but costly if the exorbitant use of power due to resistance losses



The rail grinder should be used for new rail and incipient corrugation

was seriously considered. This has led to the development of dynamotor or motor-generator apparatus which has a greater range of use and is also highly efficient electrically, due principally to the absence of energy consuming resistance. With it all forms of joint welding, metallic electro welding, carbon arc metal cutting and electric bond welding may be done, using only 10 per cent of the current required by resistor types of apparatus.

It has been found that with the arc welder the repair of defective rail joints can be done more quickly, with little or no disturbance to traffic and for about 10 per cent of the cost as compared with the method of cutting out the defective joint, installing an insert with two joints, with the incidental destruction and restoration of pavement and bonding.

Grinding Equipment a Necessity Even on New Rail

In connection with arc welders it is to be noted that their effective use, in track work at least, is limited to a certain extent by the accompanying grinding apparatus. The grinding equipment must be proportionate to the welding equipment if the full value of the work of the former is to be secured. Incidentally the grinding equipment investment can be minimized and the amount of grinding work done can be greatly increased if arrangements are made for rapid transportation of grinding apparatus by autotruck, so that one grinding machine may follow up from two to three welding gangs which may be widely separated.

Rail-grinding equipment is now a necessity where it was once considered a toy, and, aside from the grinding equipment long in use by the Lorain Steel Company in its joint work, the need for grinding apparatus was not generally recognized until rail corrugation began to be troublesome. Another factor which ultimately created a field for grinders was the rather late and sudden recognition of the fact that all rail joints, no matter what their kind, must be ground. There was also a period of experimentation in connec-

tion with conflicting views over the relative merits of the rotary and reciprocating principles. All of this delayed the general adoption of grinding apparatus until it was finally found that, while each type has its peculiar field of usefulness, good results can be had by the use of both types.

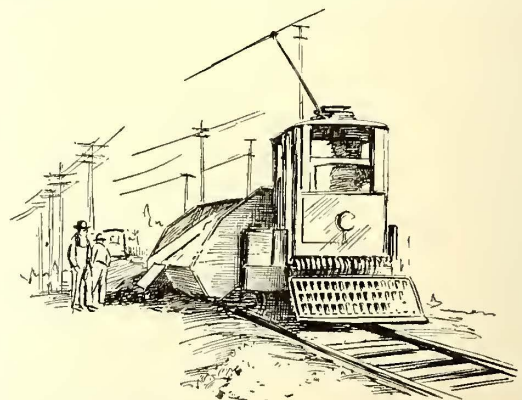
Types of Rail Grinders—Power Tampers No Longer an Experiment

Grinding apparatus may be classified into four general type groups, as follows: 1. Rail files (push files), hand operated, reciprocating. 2. Rotary grinders, flexible-shaft type. 3. Rotary grinders, machine-type, mounted on small trucks. 4. Reciprocating grinders, machine-type, mounted on small truck or special carriage.

The rail file, manually operated, served its purpose while labor was comparatively cheap and during the period of development of machines. Its chief use was for filing or grinding newly made joints. The flexible shaft rotary grinder came into use for the same purpose. It is now confined to grinding special track work where its peculiar construction has adapted it to this difficult field. It is a costly piece of apparatus to maintain, due to the abnormal failures of the shafting, and a new grinder has recently been developed for the same work which is far less expensive to maintain and less liable to cause injury to the workmen. This machine was illustrated in the *ELECTRIC RAILWAY JOURNAL* for May 26, 1917.

The larger machine types of rotary and reciprocating grinders and their uses are so generally familiar that they need not be described more fully. It suffices to say that both types are effective and efficient and that in general at least one machine of each type may be used advantageously on almost any property. In fact some classes of grinding work can be done best by the use of both, the one supplementing the other.

Incident to the use of grinding machines is the material composing the grinding wheels or blocks. All of this apparatus except the push files (which require a form of special steel bastard file) consume large stocks



Specialized dump cars are playing an important part in modern track work

of abrasive material, and in consequence the selection of this stock needs careful attention, with the view to securing the most durable and effective material obtainable.

Tie tamping has been a bugbear with everyone who has had anything to do with track work. The time-honored custom of tamping by hand, with the tendency of the men to either "go to sleep" on each tie or else to skimp the work when pressed to wake up and cover

ground, has at last given way to machinery. The mechanical tie-tamping devices now on the market came to the front just in time to be of great assistance at a time of extreme labor shortage. No longer an experiment, the pneumatic and electric tie tampers have become a part of the equipment of many way departments almost over night. The pneumatic type has had the greater development and is in more general use, but there are certain points in favor of the electric type which have great merit, principally the feature of availability of power, and if the electric machine can be made to overcome some present disadvantage it may ultimately supplant the pneumatic apparatus.

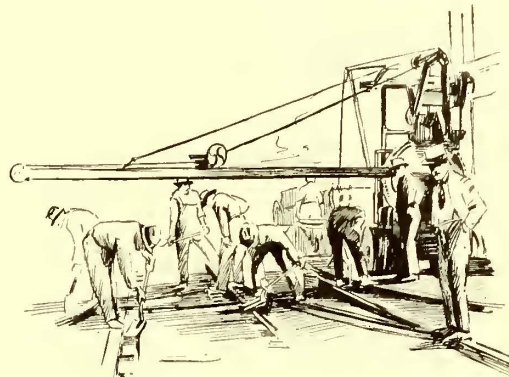
The pneumatic tampers have produced savings that are remarkable. Tamping can be done mechanically for half the cost of manual tamping. The proportionate saving in men, however, is even greater, and this is a particular advantage, as the much smaller force required is also of a higher grade. The number of men required for mechanical tamping is only 30 per cent of the number required for hand tamping. In addition the tamping itself is far superior to the best hand labor.

Power Drilling Machines Save 75 per Cent Over Hand Drilling

Rail drilling is another field where mechanical means have been resorted to with beneficial results in labor saving. That old-time standby, the ratchet drill, has been displaced almost entirely by the electric power drill, except for emergency use and for certain classes of repair work. It has been found that the power drill will cut the cost of track work in its sphere at least 75 per cent over hand methods. By cutting down the number engaged on drilling the power drill has also released a large number of men for other work. Incidentally there is a saving in drill bits and cost of sharpening due to the uniformity of working conditions created by the use of the power machine. In hand work with ratchets there is apt to be distortion in position of bits and other parts created by careless handling which lead to rapid breakage of bits.

In connection with power drilling it should be noted that there is a new type of power-operated ratchet drilling device which is available for use wherever

to drill even with the highest grade of special tool-steel drill bits. At this point the special tool-grinding machinery of the portable type comes into service. By means of special tool holders, any type of bit can be resharpened by the average laborer and the bits will do better work than if sharpened by the average machinist at a shop. There is no lost time waiting for fresh bits and a smaller stock can be carried, which is an item of moment when the present very high cost of



Track concreting á la mode

drill bits is considered. Special tool-sharpening devices of this character are now considered indispensable on jobs where more than a few holes are to be drilled, and they should be in every gang tool box.

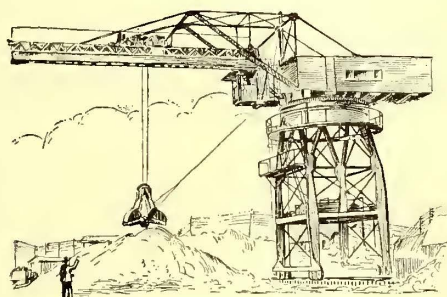
Power Shovels for 50 per Cent Economy

The electric shovel has also come into quite a general use as a labor-saving device, and consideration should be given to its use at every point where the controlling conditions will permit. It is invaluable when it can be employed for breaking up concrete, in excavating and grading on extension work, and in reconstruction work where the street widths will permit. In the latter situation it can best be used when there is room for the installation of a temporary third track. These shovels have been known to save their cost in doing two miles of track work. Under favorable circumstances they will reduce the cost of excavating by 66 2-3 per cent, and cut the cost of teams 50 per cent, which latter is a very great advantage at this time, when teams are not only high in cost but also difficult to get at any price.

**The Pavement Plow As a Man Saver—
Specialized Work Cars Beat Junk**

Another labor and time-saving device is the pavement plow, the use of which has greatly extended in the past two years. As an aid in the removal of block pavements of all types and with all kinds of paving joint fillers it has proven its worth as a labor saver. This device will do as much work of the most difficult kind, in an hour or less, as five men can do in three nine-hour days and for less than 25 per cent of the manual labor cost. The need for men is so great that the saving in man-energy alone would make the device worth while even if the costs were the same.

An active interest has been created in the improvement of work cars for handling materials and the shortage of men has done more than anything else to direct attention toward the need for reduction in men used in this branch of the work. Until recently most bulky material, such as paving blocks, sand, gravel and crushed stone, were handled by men, who loaded the



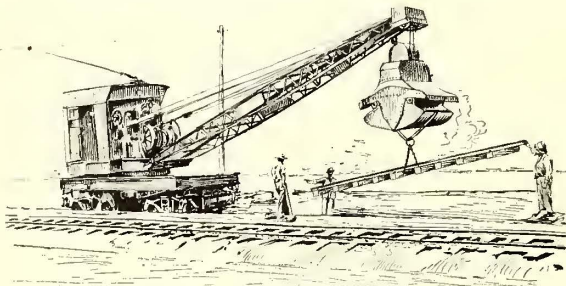
A great crane that literally "eats up" the work

pneumatic tools are used in track work. This device has the compactness of the hand-operated ratchet and is available for use in cramped space at joint repairs when the electric drilling devices cannot be used without destruction of a considerable area of pavement to make room in which the apparatus can work.

Regardless of the nature of the drilling device, the drill bits receive very rough treatment, and the high carbon steel rails in general use are particularly difficult

material onto ordinary flat cars at the yards and unloaded it again at the job. Sometimes the men were transported with the load, where there were none available at the point of unloading. From eight to ten men are usually required for this sort of work.

There was a time, not long ago, when any old collection of junk on wheels was considered good enough for a work car. In that day the way engineer who asked for specially designed work-car equipment was apt to be considered somewhat crazy. The development of the automatic side-dumping car has changed all this, much to the advantage of the companies. It is now possible to unload a 3-car train of automatic dump cars with one man, where six or eight were formerly required by such cars. The whole trainload can be dumped in from 3 to 5 min. where it formerly required about 20 to 30 minutes per car. Such equipment has



The great thing about the crane car is its ubiquity—it's always there

further advantages in the saving of time of the equipment on the road, in lessening of tie-up of passenger car traffic while unloading between cars under regular service conditions, and in availability for use in general revenue freight service in hauling material for highway contractors as well as in the railway coal service.

It has been authoritatively stated that automatic dump-car equipment has saved as much as 30 cents per foot in the cost of track work in a large city in the Central West. The locomotive crane and the pillar crane, mounted upon cars, have taken an important place in the list of labor-saving equipment. When especially designed for electric railway work they are of particular value in handling special-work installations, in loading and unloading rails upon the street, and in the general work of handling materials. As an indication of the savings which may be accomplished through use of derrick cars the table below is reprinted from the ELECTRIC RAILWAY JOURNAL for Dec. 23, 1916:

SAVING EFFECTED IN FOUR YEARS BY USE OF 3-TON PILLAR CRANE CAR ON ELECTRIC RAILWAY SYSTEM

| Number of Tons Handled | Cost of Handling | | Total Saving |
|-------------------------------------|------------------|------------|--------------|
| | Without Crane | With Crane | |
| 4000 tons miscellaneous | \$1.00 | \$0.25 | \$3,000.00 |
| 3324 tons load on cars | .75 | .20 | 1,828.20 |
| 3324 tons to yard | 1.00 | .25 | 2,493.00 |
| 6340 tons unloaded | .50 | .20 | 1,902.00 |
| 6340 tons to job | .75 | .25 | 3,170.00 |
| | | | \$12,393.20 |
| Cost of crane car, ready to run | | \$7,000 | |
| Depreciation 5 per cent, four years | | 1,400 | |
| Interest 5 per cent, four years | | 1,400 | |
| Upkeep 2½ per cent, four years | | 700 | |
| Net saving four years, one car | | | \$3,500.00 |
| | | | \$8,893.20 |

In connection with the subject of dumping cars it may be well to call attention to a phase of the work of handling materials where there is room for the development of mechanical means which will save a great deal of labor. We have reference to the need for some

form of power loading device which can be used in the confined areas of narrow city streets, alongside track trenches, for the purpose of placing the excavated materials upon the cars, thus lessening the amount of manual labor which is still employed for this purpose. Both grab buckets with cranes and electric shovels may be used to a limited extent in this way, but street conditions more often prevent this.

The subject is being studied in several quarters and there is no doubt that once the attention of manufacturers of several types of automatic loading devices now used extensively in coal yards for loading coal from the piles into wagons is called into active consideration of the field waiting for development we may expect to see a satisfactory solution of the problem.

Air Drills and Skull-Crackers for Concrete

In removing old track prior to reconstruction it is often necessary to remove a concrete paving base. Several methods have been adopted recently to do this work mechanically in order to replace the old method of digging jack holes, raising the track and breaking down the concrete with heavy mauls. This method is tedious, requires a great many men and is liable to cause serious disturbance to adjacent concrete under roadway pavement which is to be left in place. Such disturbances lead to excess cost of concrete for the new track because of the necessity for breaking out and replacing shattered concrete.

In this field there have been two developments, each of which is effective in saving of labor. One is the use of air drills in connection with compressor apparatus available for operation of tie tampers. With four air drills a gang of six men can remove as much of the hardest kind of track concrete in a day as a gang of fifteen men can accomplish manually, using heavy bull punches, jacks and mauls.

Another method is to utilize the so-called "skull cracker," which is a heavy casting weighing about a ton, attached to simple derrick, moving on the track and so rigged with a release trigger as to drop the casting from a height of about 12 ft. onto the concrete. It has been reported that this comparatively simple device has effected a saving of from 15 to 20 cents per foot of single track in labor cost of this work. The "skull cracker" is moderate in first cost and is available in many cases where there is no air equipment suitable for operating air drills.

Concrete Mixing Machinery Will Save Its Cost Many Times Over

There has been a rapid development in the application of machinery to mixing concrete and cement grout for track pavement work. This has been assisted, particularly in the case of mixers, by the change in opinion as to the practicability of machine mixing compared with hand mixing. There are at least two mechanical grout mixers now on the market which are acceptable to highway engineers. In fact, one of these had the advantage of being developed by its manufacturer under the direction of a board of experienced highway engineers with gratifying results. It is now possible with the mechanical mixer not only to save materials and secure a high uniformity of mixture, but also to save from 3 to 5 cents (42 to 70 per cent) per square yard in the labor cost of mixing. In addition a mechanical

grout mixer will follow up and complete the grouting of all the pavement which can be laid in a track job in any one day under ordinary conditions. The advantages in completing the grouting so quickly are apparent.

In the concrete-mixing field the development has branched in three directions: (1) In the increasing use of the moderate-sized batch mixer; (2) in the adoption of very large-sized batch mixers with self-loading hoppers, mounted upon trucks and self-propelling, generally upon the track and sometimes on the roadway surface alongside, and (3) in the assembling of complete and rather complicated mixing plants upon a train of two or more cars.

Each of these methods has its field and has proved very successful. For all round use, particularly because of its mobility, the small batch mixer operated by a gasolene engine may be considered the most serviceable, especially in view of the fact that the cost of this machine is very moderate.

The larger, self-propelled mixers are more for use on very large jobs where a large volume of concrete must be produced rapidly. It has been observed that one, or at the most two, of these machines will serve very extensive reconstruction programs on systems of the greatest size, and the output of such machines by the mixer manufacturers for railway customers has so far been somewhat limited. To some extent this restriction may be due to the prevailing custom on many systems of letting the track-paving work out to contractors who usually have the paving work for the city. This is often being done in conjunction with the railroad track work.

The special concrete mixing plant mounted on trains of cars has been used in but few instances and interest in this type of plant has been revived by the action of the Denver Tramway Company in selecting it for that property, as described in the *ELECTRIC RAILWAY JOURNAL* for Oct. 6, 1917. The particular advantage claimed for this equipment is in the elimination of the storage of any concreting materials on the street. This does away with a large amount of labor required for handling, obviates complaints from property owners fronting the work and tends to preserve the cement from theft and from damage by the elements.

From the foregoing it will be observed that the railroads are alive to the fact that concrete mixing machinery, when properly selected, will save its cost many times over, and there is no reason why every property should not take advantage of some one of the several types of apparatus which are available.

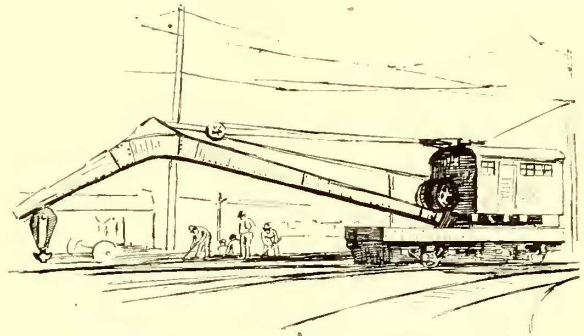
Kerosene Torches and Asphalt Surface Heaters

During the winter season there is a great amount of labor expended in keeping switches, switch-operating mechanisms and interlocking free of snow and ice. In this work the kerosene torch has come into use and it has been found that one man equipped with such a torch will displace from three to five men and do better work. These torches have other uses which make them serviceable the year round. They are indispensable in connection with the work of resetting hard-center plates in special track work.

Where there is a considerable amount of asphalt pavement in tracks the asphalt surface heater or burner is effecting large economies in men and materials. It consists of a set of five or more burners using kerosene

and arranged on a carriage which also has a sheet-iron hood, about 4 or 5 ft. square, over the burners. The burners and hood are very close to the pavement surface, so that the heat is concentrated and the flames are protected from the wind. These heaters are used to soften the asphalt surface where it is desired to fill up worn areas which have not exposed the concrete. By their use the cutting out of much good surface material is avoided, as it is only necessary to add more material on top of the old material, after sufficient heating, and to finish the surface by rolling or tamping. Specially shaped hoods and heaters have been devised for use in repairing narrow ruts in asphalt along the rails, and by their use a saving of 50 cents per square yard of pavement surface has been effected.

These heaters have also been used to great advantage in heating cobble and block pavement in extreme



In popularity the crane car heads the list
(see pages 522 and 523)

cold weather preparatory to its removal for emergency track repairs, and have made possible the making of repairs in three or four hours' time which would have otherwise consumed a day.

Methods of Cutting Asphalt Surface

It is often necessary to remove sheet asphalt entire for new track construction or for reconstruction. There have been at least three recent improvements in methods of doing this work which have been described in these columns. Each of them does away with the onerous and expensive method of cutting manually with the asphalt mattox. One method involves the use of a special cutting tool designed to operate with the air-operated tie tamping machine, as described in the *JOURNAL* for June 30, 1917. Another utilizes an ingenious arrangement of a cutting wheel mounted in outrigger fashion upon a work car (see *ELECTRIC RAILWAY JOURNAL* for Jan. 20, 1916).

Still another plan involves the use of a tee-iron with a cutting edge laid upon the surface and made to cut by operating a small road roller over it. (See *ELECTRIC RAILWAY JOURNAL* for July 7, 1917.) Again, the work has been accomplished by mounting special cutting edges completely around the circumference of the rear roller of a small tandem road roller and running the roller over the area to be cut.

Each scheme has a good deal of merit, and any one of them will be found clearly in the labor-saving class. For instance, the air-operated cutting device is reported as having worked at the rate of 47 feet per hour. It would take one laborer several hours to do the same work manually.

The oxy-acetylene cutting flame or torch has proved

to be effective as a time and labor-saving device. It is now used extensively in the work of removing old rails, replacing the chisel and sledge in cutting bolts at joints and replacing hack saws for cutting rails into short lengths prior to loading on cars. It is also of great service for cutting the ends of frog arms and other special work made of manganese steel, which is almost impossible to cut by any other method. There are many other uses to which this tool may be put, and these illustrations serve to call attention to a piece of apparatus which is almost indispensable as a part of the labor-saving equipment of the way department.

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[Supplement to

How Way Engineers Rate Labor-Sav

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1. What piece of special machinery or special tool has been the greatest labor saver on your property or properties in way department work?

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In regard to the relative importance of different pieces of track equipment, I would arrange them as follows: Question 1—Crane car. Question 2—Arrange in this order: crane car, electric shovel, air tamper, concrete mixer, stone crusher, dump car, arc welder, rail grinder, ballast spreader, track drill, acetylene torch.

From A. E. HARVEY, engineer maintenance of way Kansas City (Mo.) Railways:

All things considered I believe that our crane car has saved us more in labor than any other one piece of equipment, but I believe that there are several other kinds of equipment that are just as necessary to the accomplishment of the work in an economical manner. As to the second question I do not believe that a fair comparison can be made as to the relative economic value of the devices mentioned, as each is suited to its particular kind of work. Where such work predominates the machine that is fitted for it takes precedence in an economic sense over all other equipment. All of the devices mentioned are such great labor savers that where there is any con-

siderable quantity of work to be done to which they are adapted they are just as essential to the proper handling and economical conduct of the work as are the most common hand tools. They should, therefore, not be considered as special tools but just as necessary a part of the outfit as a pick or shovel.

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In answer to your request would state that the arc welding outfit to be the most useful apparatus. I should arrange in the following order the list given in question 2: Arc welder, crane car, power drill, air tamper, automatic dump car, electric shovel, concrete mixer, pavement plow, concrete breaker, acetylene cutting flame.

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We have not as yet given the pavement plow a trial and usually purchase stone already crushed for ballast. We have not tried the electric shovel or the air tamper but believe the latter at least has great possibilities.

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These two articles in particular served to emphasize the importance which the storage yard itself, its location and its handling problem have assumed. At the same time they presented definite facts which indicated the large saving in labor which must always result

from a concerted effort to improve conditions in this quarter.

This is well illustrated by the statement made in the Denver article, in which it is stated that with the new yard layout three men can handle as much material as fifteen could handle in the old yard. At Cleveland one item of unloading a car of granite, for instance, showed a 25 per cent reduction in labor cost.

While it is quite clear that no one best way will be found to handle materials most economically on all properties there is no doubt but that the locomotive crane has been found to be one of the most useful pieces of apparatus for this sort of work, suitable alike to large and small yards and having other uses out on the road which make it a profitable investment.

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erties operated:

Ithaca (N. Y.) Traction Corporation
—The rotary sweeper for removing
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crane, automatic dump car, concrete
breaker, concrete mixer, acetylene
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Summary

THE answers to question 1 indicate that, as far as
this questionnaire is concerned, the crane car
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The acetylene torch comes next, and there is honor-
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Better Car Maintenance an Urgent Necessity

Electric Railways Should Have First-Class Talent in Charge of Shop Repairs and Should Spend More Money on Maintenance—The Equipment Department Should Be the Training School for Most Other Departments

By M. B. Lambert

Assistant Manager Railway Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

THE winter months which have just passed were the most severe on electric railway equipment that have been experienced in a number of years. About the middle of the winter many properties found themselves seriously crippled, with 35 to 40 per cent of their cars out of service, due to all kinds of equipment failures. Some of the larger properties had as many as 450 to 500 crippled cars at one time. Prompt repairs were impossible, due in part to a shortage of experienced armature winders and car equipment mechanics and in part to the difficulty of getting promptly the great amount of repair material that was necessary. Neither the railway companies nor the supply manufacturers were prepared for any such emergency.

The situation was a most trying one for the industry as a whole, and especially so where increased fares were being introduced. The people were agitated about the increased fare, and their demands for better service were more pronounced than ever. The severe weather made it impossible for the companies to provide anything like the usual service, and, incidentally, every passenger that had to suffer inconvenience became far more impatient and critical than usual. As a result, the public in many localities are more resentful than ever toward the public utility corporations. A solution for this trouble must be found and steps must be taken during the coming summer so as to prevent a repetition of this situation as far as possible.

The Maintenance Department the Last to Be Considered

One thing that appears quite evident is that more consideration must be given by operating executives to the maintenance of car equipments, since one of the biggest factors in securing the good-will of the public lies in providing reliable service. It is probably true that the average operating executive gives far less thought to his maintenance of equipment problem than he does to the numerous other perplexing questions with which he is obliged to contend throughout the year. When the great importance of having first-class talent in charge of shop repairs and maintenance, as well as providing adequate facilities, is mentioned to him, he will invariably assent, but will point out that, under existing conditions, his company is not in a position

to pay such salaries and cannot afford to provide such facilities as the big companies do, etc.

Some of the fairly large companies do have first-class men in charge; but, as a rule, these men do not have the money to do all the things they know should be done. The result, in both cases, invariably shows up in the form of unreliable and interrupted service, causing far greater criticism from the public than curtailed but reliable service would cause. In other words, it would appear to be better to economize by less frequent service but to have the equipment that was in operation so well maintained that it would be as reliable as possible.

The Experience Last Winter Should Teach a Lesson

The general breakdown that occurred this winter will, without doubt, result in a change of attitude on the part of many operating executives regarding their equipment maintenance department. As a rule, one of the first departments they think of, when further reduction in expense must be had, is the shop maintenance, and orders are issued to reduce expenses there when it ought to be about the last resort. Perhaps the reason for this is that it is always possible for a company to cut down expenses there with less commotion or immediate effect than in some other departments. However, it would appear that greater discretion should be exercised in the future, especially during the fall months, when equipments are being put in shape to withstand the winter storms.

The average man will defer painting his house or his automobile and other similar things until he is financially able to do so, but he knows that if he neglects the plumbing or heating outfit, he will have serious trouble and that, in such maintenance, a stitch in time saves nine. The maintenance of the propulsion equipment on cars comes under the same category. That it has not, except in a few cases, received proper consideration is evident when an analysis is made of the whole country, and shows that a very large number of railway properties do not have adequate maintenance facilities nor adequate maintenance organizations. Moreover, the average master mechanic is underpaid and his job is not as attractive as it ought to be, largely because many operating executives have not, as previously mentioned, heretofore given to this phase of their problem its proper consideration.

Finally the fact that there are very few men available who are fully competent to handle the maintenance



Which kind of master mechanic is preferable?

A Kilowatt-Hour and the Coal Required to Produce It

Discussion at Manila, P. I., Brought Out Concretely the Losses Which Occur in Transforming the Energy in Coal Into Electrical Energy

AT A RECENT meeting of the electric railway company section of the Manila Electric Railroad & Light Corporation, B. H. Blaisdell, chief engineer of power plant, described graphically the ways in which losses occur as the stored energy in coal is transformed into electrical energy. To make his story tangible he exhibited a lump of coal from which he removed a portion as he discussed each individual loss. Some of the more striking passages in his talk follow.

Most people have a fair idea of what they will get when they ask a storekeeper for a meter of cloth or a kilo of potatoes, but there are few who have any conception of the nature and magnitude of a kilowatt-hour, other than that is 30 centavos' worth of electrical energy. This is because electrical energy cannot be seen.

Its value must be appreciated by observing what it can do. For instance, a 40-watt incandescent lamp can be burned from 6.30 to 10 o'clock each evening for a week with a consumption of 1 kw.-hr.

To produce this amount of energy requires, in the Manila plant, 3 lb. of coal, the cost of which is more than 75 per cent of the total cost of producing the energy.

Coal is, of course, simply compressed and mineralized

(Concluded from page 524)

of equipment shows again that this extremely important part of the industry has been more or less neglected. If the positions of master mechanics were more attractive on the majority of roads, there would be, without doubt, a tendency for men with more or less technical ability to endeavor to fit themselves for such positions, but they are not doing so now.

The Maintenance Department the Place to Develop Young Men

It is true that a few operating managers have interested themselves sufficiently in this subject to see that they had one or two promising men coming along in the organization who would be developing themselves for better and more responsible positions. But there are very few railway companies in this position. The majority of roads have one man they call master mechanic, and if he drops out for any reason whatever they are usually up against it until they find some other man who will, in some measure, fill the bill.

In the writer's opinion the equipment repair and maintenance department should be the training school for most other departments on the railway. Technically educated young men (preferably young men who are educating themselves) should be induced to work in the shops with the understanding that opportunities are open to them to advance into the traffic and transportation departments. This plan should bring about a condition whereby the men of promise, coming along in the organization, will have had a good mechanical training and will always appreciate the value of properly maintaining the rolling stock.

vegetation. One of its earliest forms was peat, from which great pressure squeezed the moisture and high temperature drove off more or less of the volatile combustible constituents. Thus were formed lignite, bituminous coal and anthracite. The first named, lignite, still contains much moisture and volatile combustible matter, bituminous coal contains less of these, while anthracite is almost wholly fixed carbon.

A lump of coal has stored within itself sufficient energy to lift it a distance of 2000 miles, but of this energy only about 10 per cent is converted into the electrical form in the usual power plant. The remaining 90 per cent is lost in a number of ways as follows.

LOSSES IN THE POWER PLANT

In the first place, coal is rarely dry, but as the Manila company buys coal according to its heat value coal containing 10 per cent of moisture would cost 10 per cent less per ton than if it had been dried. However, a real loss due to moisture occurs in the furnace because some heat must be consumed in evaporating it. Except in the rainy season this amounts locally to about 1 per cent.

The second loss is from coal and coke falling through the grates. While this loss can be reduced by the use of minimum width of air spaces between grate bars and the elimination of unnecessary stirring of the fuel bed, the loss may be from 1 to 10 per cent. Locally it is about 1 per cent.

A third loss is from incomplete combustion, with production of smoke and carbon monoxide. This is mainly caused by poor draft, excessive thickness of fire, careless firing and faulty furnace design preventing proper intermingling of the fuel gases with air. It may be from 1 to 5 per cent, and in the Manila plant is about 1 per cent.

The fourth loss, the greatest of all occurring in the boiler plant, is that through the flue gases. In a natural-draft plant, like that at Manila, it is necessary to lose about 15 per cent of the heat to maintain the draft. Even with forced draft some energy would be used in driving the fans. There are also some unnecessary losses in the flue gases caused by the admission of excess air to the furnace (either through the grate bars or through infiltration through the boiler setting), scale and soot on the boiler tubes which permit heat to escape which should be absorbed by the water, deranged damper walls in the boiler which may allow the hot gases a short-cut to the flue, etc. In Manila these losses total about 5 per cent, making a total flue-gas loss of 20 per cent.

The fifth and last important heat loss in the boiler plant is from radiation from exposed boiler surfaces, piping and settings. While this may be reduced by proper lagging, it, with sundry minor ones, amounts to about 7 per cent.

Thus in the local plant about 30 per cent of the total heat in the coal is lost in the boiler room.

LOSSES IN THE TURBINE ROOM

Of the 70 per cent of the energy originally in the coal which comes to the turbine room, some must be used in driving pumps for circulating condensing water, removing air and condensate from condensers, feeding water to the boilers, cooling the oil, furnishing

water to glands, etc. In Manila the auxiliary machinery takes approximately 16 per cent of the heat in the coal. Of this, however, more than a third (6 per cent) is returned to the feed water in the heaters, leaving 60 per cent of the original energy to be accounted for.

Next, heat is lost in radiation from the turbine casing, friction in bearings, internal losses in the electric generators and in excitation, and these amount in all to about 10 per cent of the total heat in the coal.

The last and greatest of all the losses occurring in this system of generating power is in the exhaust steam discharged from the turbine into the condenser, carrying with it 40 per cent of the total heat in the coal. This heat is absorbed by the condensing water and is carried away. The loss is necessary on account of the limited heat range through which steam can be worked. Increasing the initial pressure or the temperature of the steam in the boiler to begin with, and reducing the pressure or temperature in the condenser to end with, will increase the range of expansion of the steam so that more energy can be produced from it. However, there is a limit to the pressure or temperature at which it is safe to operate boilers, and there is a limit to which the pressure and temperature can be reduced in the condenser.

THESE FIGURES FURNISH NO CAUSE FOR DISCOURAGEMENT

Although, as Mr. Blaisdell pointed out, the local company pays for ten times the energy in the coal which is transformed into electricity, there is no reason to be alarmed but rather encouraged, because during the last two years the local power plant has reduced its coal consumption per unit of electrical energy by more than 15 per cent. A goodly part of this was brought about by the increased operating efficiency of power-plant employees. This point was emphasized, in the discussion of Mr. Blaisdell's paper, by J. P. Ripley, railway engineer J. G. White Management Corporation, who pointed out some of the lines in which further savings can be secured. He referred particularly to the use of higher boiler pressure and of powdered fuel. Another great possibility is in the production of by-product coke. Mr. Ripley had also a good word to say for the Diesel engine.

Comparing the local fuel consumption of 3 lb. of coal per kilowatt-hour with the 1.75 lb. of some plants, he said that the former figure was not by any means discreditable. The latter plants probably have larger generating units, use higher boiler pressure, are able to secure cooler condensing water, the auxiliary equipment may be of a more elaborate character and the fuel itself may be of a higher heating value.

New York Commission Issues Report

The Public Service Commission for the First District of New York has just issued Volume 1 of its report for the year ended Dec. 31, 1916. Besides the usual statistics, which were abstracted in this paper when the commission made its 1916 report to the Legislature, the volume contains an extensive résumé of the rapid transit construction program in New York City and the progress of the work. Many illustrations are used to show details of construction work under the various contracts.

AMERICAN ASSOCIATION NEWS

War Board Transacts Routine Business

A MEETING of the American Electric Railway War Board was held in Washington on March 8. Those in attendance were Messrs. McCarter, Budd, Brady and Gadsden. Charles L. Henry, Indianapolis, was also present by invitation. The appointments of E. C. Faber, manager, and W. V. Hill, assistant manager of the board, mentioned last week, were confirmed. Mr. Hill was also appointed electric railway representative on the fuel administration staff in place of Colonel Moore.

Announcement was made that the fuel-saving posters prepared by the Fuel Administration had been distributed to the electric railways. Altogether 280,000 of these posters have been sent out to electric roads, namely, 10,000 of the "firemen" poster, 20,000 of the "Uncle Sam" poster and 250,000 of the "Eagle" poster. The latter is the one put up in the car vestibules. All the expenses of issuing and distributing these posters were defrayed by the Fuel Administration.

Mr. Budd, the member of the board in charge of traffic matters, made a report to his associates of the progress on this work, and Mr. Faber made a detailed report. The next meeting of the board will be held in Washington on Friday, April 5.

Delegates to Chamber of Commerce Convention

PRESIDENT STANLEY has announced the appointment of ten delegates to the convention of the United States Chamber of Commerce in Chicago on April 10-12. P. H. Gadsden will be chairman of the delegation and representative of the association on the national council. The other delegates are: Thomas N. McCarter, H. H. Crowell, J. K. Choate, L. S. Storrs, Thomas Finigan, James H. McGraw, Britton I. Budd, A. W. Brady and Walter A. Draper.

Good Judgment More Important Than Strict Obedience to Rules

A SENTENCE found in the rule book of many railway companies reads as follows: "Use judgment and discretion in all matters pertaining to your duties."

The daily papers in a Middle West city commented favorably the other day on an incident brought about by a storm blockade there. One of the few electric railway cars which had been able to get through reached a point where the crew had been instructed to turn back. The order "All out, take the next car" was given by the conductor to his passengers. The usual remonstrances arose and the conductor saw for himself that there had been no car for some time and none was in sight behind. "All right, get aboard," he said, "I'm not going to let you people freeze—orders or no orders."

The railway president was asked by a reporter if he would discipline or commend this conductor. "I shall commend him," he said. "That was an exercise of judgment under unusual circumstances which I wish more employees would imitate. He acted correctly."

CONSTRUCTION, MAINTENANCE AND EQUIPMENT

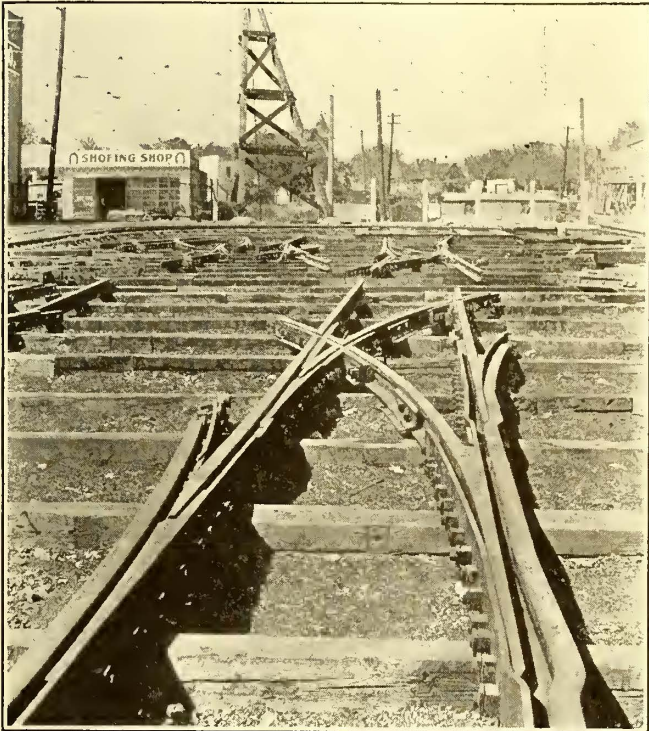
SHORT WORTH-WHILE ARTICLES FOR THE ENGINEERING AND MECHANICAL DEPARTMENTS WHICH SHOULD PROVE HELPFUL IN DEVELOPING ECONOMICAL PRACTICES IN SHOP, TRACK, LINE AND POWER HOUSE

Special Work Designed to Give Longer Life

By W. L. WHITLOCK

Office Engineer the Denver (Col.) Tramway

A NEW type of special work which represents a radical departure from the standard construction of the Denver Tramway was recently installed at a downtown intersection in Denver. This layout, shown in the accompanying illustration, has been termed the "outside" switch. The construction is 100 lb. contin-



NEW DESIGN IN SPECIAL WORK USED ON DENVER TRAMWAY

uous joint A.S.C.E. rail, the casting being held by $1\frac{1}{8}$ -in. heat-treated bolts with lock nuts. The unusual feature of the "outside" switch is that main-line traffic does not operate over the switch tongue, the only time when this is actually under traffic being when a car takes the curve. The labor of maintenance and danger of derailment are reduced and the life of the switch is increased, as the stock rail rather than the switch tongue carries the wheel load.

It will be noted that there is an offset in the stock rail to make provision for the switch point when open for the curve. This offers the one objectionable feature of the layout as the wheel flanges strike the offset when cars are leaving the switch. The trouble is due to the fact that it is impossible to put a guard on the mate to pull wheels away from this point. Wheels running out of the switch and striking this offset have gradually

shaped the point off until it no longer offers an obstacle for wheels to strike. A few broken flanges resulted at first, but no trouble has been experienced since the point has worn down and future construction will eliminate this trouble entirely.

Convex Versus Concave Bonding Compressor Screw Terminals

The Author Concludes That Each Form of Screw Point Is Suited to Certain Kinds of Bond Terminal

By G. H. MCKELWAY

Engineer of Distribution Brooklyn Rapid Transit System

ASK the average electrical or track engineer what kind of point is used on the screws of the bonding compressors operated on his road and, unless he will admit that he does not know, he will generally say "The ordinary kind," or something similar to that. Very few persons have noticed that there are two distinct and opposite types of these points. They can be most easily described by saying that one is convex and the other concave.

The compressors made by three large manufacturers of this equipment have convex ends to the screws, while those made by two other such companies have concave ends. The compressor of one of the latter companies has a point in the center of the cup for the purpose of helping properly to center the compressor on the bond terminal, while that of the other has no point, the center of the cup being flat. With the latter reliance is put upon the sides of the cup for bringing the compressor into the proper position.

The theory upon which the cone-pointed screws are designed is that the points of the compressor screws, where fitted with convex studs as in the case of those of the three manufacturers first referred to, will enter the bond hole slightly, forcing their way through the copper terminals of the bonds and spinning the copper outward so as to compress it tightly against the sides of the holes. Here it will come into the most intimate possible contact with the steel rails, thereby making the contact resistance very low. The copper is spun closely against the rim of the bond hole, sealing it and preventing the entrance of moisture, which would tend to oxidize the metals and cause the contact resistance to increase with age. Above the edge of the rail the copper which is pushed out by the pointed screw helps to form the button which is driven down closely on the rail by the shoulder of the stud.

The idea back of the cup-shaped stud, on the other hand, is to fill up the hole in the rail by forcing the

copper in the terminal straight ahead into the hole. The sides of the cup and the collar around the end of the screw prevent the copper from spreading out too far at the sides and thus direct all of the surplus metal into the hole.

Which is the best type to use? There are good arguments in favor of both. It is probable that with the ordinary drop-forged terminal, when well made, a closer contact between the rail and the bond terminal can be made with the convex type. The reason for this is that the cup-shaped terminal tends to compress the copper in the end of the terminal and harden it so that the pressure inside the hole is not as strong in forcing the copper against the sides as when it is spun outward in the manner explained for the convex terminal.

On the other hand the spinning motion given to the terminal by the convex point will tend to crack a poorly made drop-forged terminal. This leaves long cracks extending from the circumference of the ter-

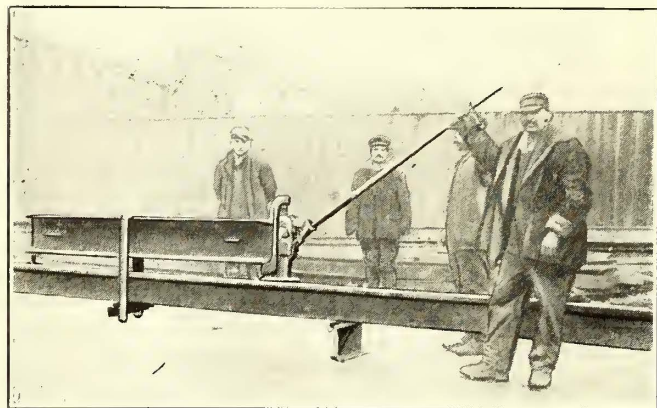


FIG. 1—SURFACE-BEND STRAIGHTENER PLACED AS IN SERVICE AT SPRINGFIELD

A Cure for Surface-Bent Rails

Apparatus Quickly and Economically Removes Irregularities in Track Without Taking Up the Rails

BY H. K. SULLIVAN

Roadmaster Springfield (Mass.) Street Railway

FOR about a year surface-bent rails on the Springfield Street Railway have been straightened effectively by the equipment illustrated. This device, which is quite simple and costs less than \$40 to develop, was designed by the writer with the assistance of two of the track foremen associated with him. As shown in Fig. 1 it consists of a combination of I-beam, U-strap, keys and 15-ton Barrett jack by which pressure of about 60,000 lb. can be applied to the rail section.

A 12-in. I-beam 8 ft. long is provided with a welded fork at the right-hand end and designed to receive the working surface of the jack. This fork is made up of two 5½-in. x ¾-in. x ¾-in. pieces of steel welded to the

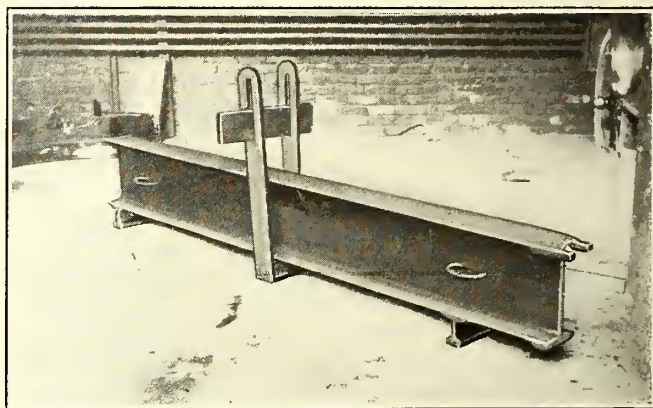


FIG. 2—DEVICE FOR REMOVING SURFACE BENDS IN ELECTRIC RAILWAY TRACK

minal nearly to the center, and moisture may work in and destroy the contact. The material from which some bonds are made is very susceptible to these cracks, although soft enough to be more easily and efficiently driven into the hole by the cup-shaped compressor than is the ordinary drop-forged terminal. It would therefore seem wisest to employ that form of compressor with this particular type of bond and the convex type with other bonds unless there is no question as to the softness of the metal in the terminals.

One other objection may be raised against the use of the cup-shaped point in that the edges of the cup, although carefully hardened by the makers, may become broken and in this condition will badly tear the bonds. This can and always should be remedied at once by turning up the end of the screw, but there is the difficulty that many shop men cannot properly harden the metal again. If the hardening is not properly done the same trouble will soon occur again, especially if the end of the screw is allowed to grind against the rail at the time when the bonds are being compressed.

The collar around the screw of the concave-end type is so heavy that it cannot be damaged in that way and is, for that reason, not exposed to the same trouble as the point.

top of the girder. At the opposite end a short transverse piece of 60-lb. A. S. C. E. T-rail is welded to the base of the I-beam and serves as a fulcrum, a second short piece of T-rail being welded to the base near the right-hand end to serve as a pedestal. Experience has also shown the desirability of reinforcing the center of the I-beam with two 10-in. x ¾-in. x 5-in. steel plates welded diagonally to the web and top, as shown in Fig. 2. Four handles or elliptical rings of ⅝-in. wrought iron 5 in. x 2 in. in diameter are provided by means of which four men can easily lift the device from a work car and carry it to the job.

The U-strap is about 32 in. high, 3 in. wide at the bottom (Fig. 2), and offset to a width of 4¼ in. at the upper part to provide for slotting and insertion of the wedges. The inside width of the U-strap is 7 in., the two sides being ⅞ in. thick each, and the keys taper from ⅞ in. at one end to 3⅜ in. at the other. The working slot for the wedges is 9 in. deep and about 1 in. wide, the keys being 15/16 in. thick. In Fig. 2 the U-strap is shown inverted as compared with Fig. 1. It can be used either way, but the adjustment below a piece of rail in service is made easier when the keys are driven in at the bottom, as indicated in Fig. 2.

In using the equipment, the ground is usually opened about 6 ft. on each side of the joint. The I-beam, straps and keys are put in place, and the rail is jacked up to

New York Railways Convert 439 Cars to Prepayment Type

Over \$250,000 Saved by Revised Method of Construction—Folding Doors and Steps, Fare Boxes and Coasting Recorders Installed

THE New York (N. Y.) Railways Company is converting 439 box-type open-platform cars to the prepayment type with folding doors and steps, the control of which is interlocked with the motor circuit so that the cars cannot be started while the doors are open.

The old open-platform cars are of wooden construction throughout and weigh 28,850 lb. light. An end view of this car is shown in Fig. 1. The over-all width is 7 ft. 9 in. and the over-all length 37 ft., with a platform measuring 4 ft. 6 in. over the bumpers. The cars are double truck, equipped with two GE-57 motors, K-27 GE controllers and Westinghouse air brakes. All seats are arranged longitudinally, covered with carpet and the seating capacity is thirty-six. The successive steps from the ground to the car floor are 14 in. to the first step, 12 $\frac{3}{8}$ in. to the platform and 8 $\frac{1}{4}$ in. to the car floor.

Some years ago a number of these box cars were converted to a pay-as-you-enter type, an end view of

(Concluded from page 528)

about $\frac{1}{4}$ in. above the proper height. By applying upward pressure with the jack, with the U-strap in place around the I-beam and the rail section being straightened, the surface bend is taken out of the rail in an average time of about five minutes per joint, not including the time required for excavation or back filling. The jack is then slacked off to bring the rail to the exact surface, and the rail is tamped carefully, followed by withdrawal of the equipment. The speed with which surface bends can be removed, especially in connection with a general reconstruction job, is a most useful feature of the equipment which performs work hitherto imposing great difficulties upon the way department.

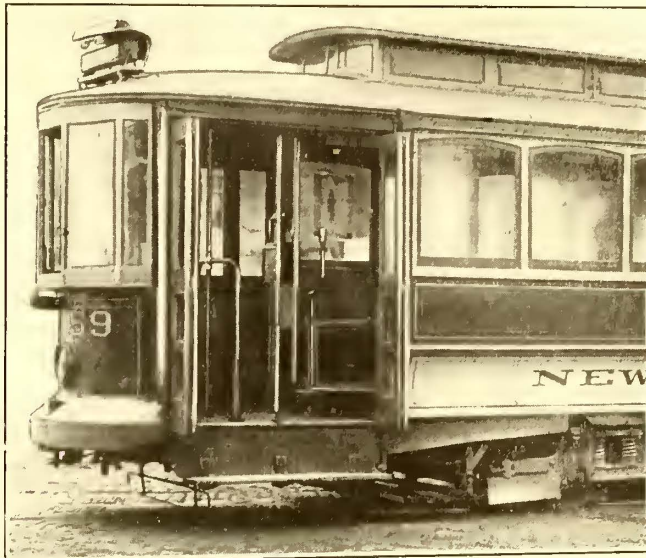


FIG. 3—FIRST CONVERSION INTO PAY-AS-YOU-ENTER TYPE

which is shown in Fig. 3. The method of construction used at that time was to remove the old platform and bonnet and rebuild the platforms, 6 ft. 6 $\frac{1}{2}$ in. over the bumpers, giving a door opening of 57 $\frac{1}{2}$ in. The conductor and the fare box were placed on the platform.

When it was recently proposed to convert the remainder of these cars to the prepayment type, a study of the matter showed that satisfactory door opening and platform arrangement could be made without demolishing the old platform and bonnet. This was accomplished by moving the vestibule corner post forward, cutting off the buffer angle at the step, moving the controller forward close up against the dashboard and substituting a drop-handle ratchet brake staff for the ordinary hand brake staff. All cars are equipped with air brakes and the hand brakes are used only occasionally. The bulkheads were removed and the longitudinal seats cut away at the corner, drop seats being provided in their place for use at the end not occupied by the conductor. The conductor is placed in-



FIG. 1—OLD OPEN PLATFORM CAR

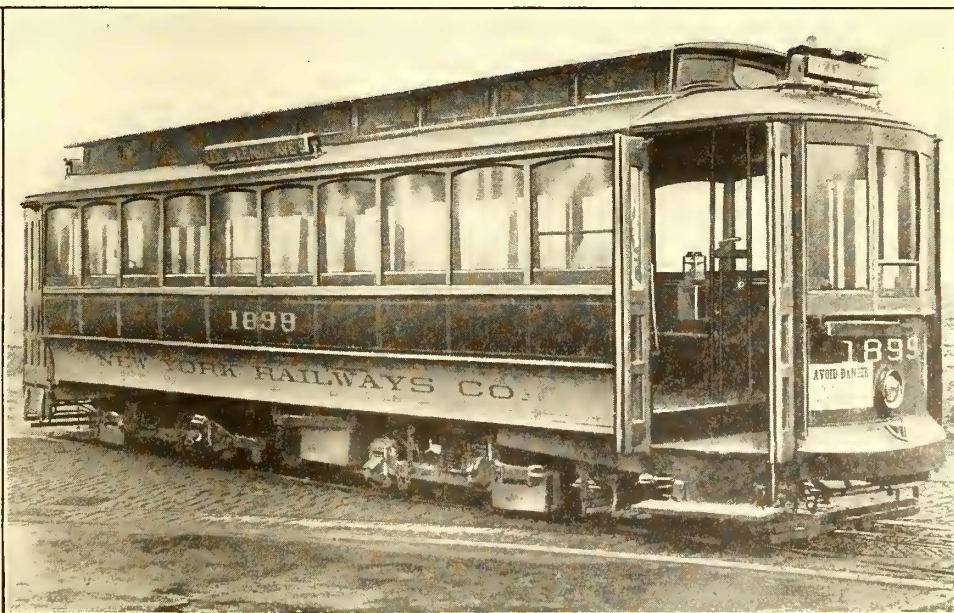


FIG. 2—NEW YORK RAILWAYS CAR REBUILT FOR PREPAYMENT OPERATION

side the car with control stand and fare box. This arrangement gives a 40-in. door opening which has been shown by numerous tests to be entirely satisfactory for handling two streams of passengers, one entering and one leaving. It is also possible to pick up on this platform, lined up before the fare box, as many people as could be handled on the older long-platform cars which were considerably obstructed by the conductor,

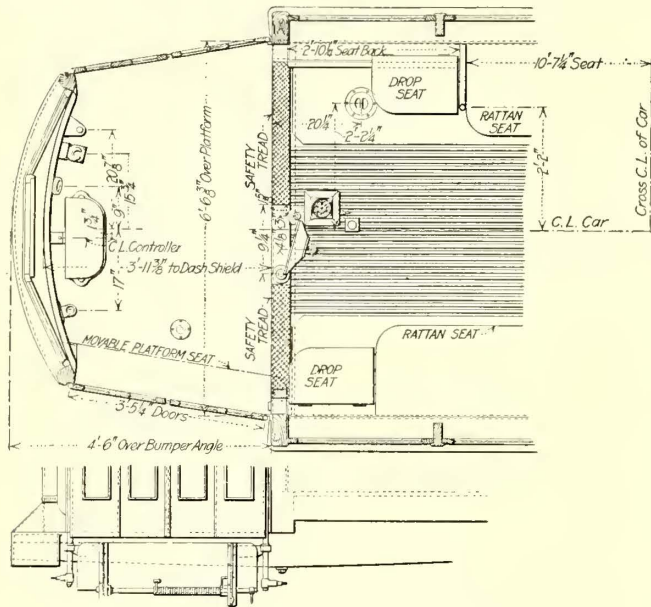


FIG. 4—DETAILS OF NEW YORK RAILWAYS CAR CONVERTED FOR PREPAYMENT

fare boxes and prepayment railings. A plan of the new car is shown in Fig. 4 and a photograph in Fig. 2.

Manually operated, double folding doors and folding steps furnished by the National Pneumatic Company are being installed, all operating levers of which are located beneath the platform. The motorman operates the front door by means of a handle at the left of his controller and the conductor operates the rear or entrance doors by means of a handle very similar to a controller handle located beside the stanchion upon which his fare box hangs. The fare boxes are of the Johnson type and Sterling fare registers already on the cars are retained and are operated either by hand strap or by pedal mechanism. Rico coasting recorders are installed on all cars.

In rebuilding the cars the cutting off of the longitudinal seats and the substitution of drop seats provides a seating capacity of thirty-four in place of the original thirty-six. All seats are now being recovered in rattan, replacing the original carpet covering. With the folding step arrangement the successive heights from ground to car floor are now $13\frac{3}{8}$ in. to the step, 13 in. to the platform floor and $8\frac{3}{4}$ in. to the car floor. The same motor and control equipment is retained, with the addition of the folding-door interlock arrangement. The lighting system is also unchanged. It consists of three five-light series clusters and one light at each end. The weight of the car has been increased to 29,686 lb. by the changes.

The cost of the work has proved to be \$600 per car less than for the conversion first made in the original car by extending and entirely rebuilding the platforms and bonnets.

Shop Rearrangement in Rochester

Shifting of Tools and Installation of Materials—Handling Equipment Has Greatly Increased Capacity of General Repair Shop

THE St. Paul Street shops of the New York State Railways at Rochester are limited as to floor area, so that, with the increase in demand upon their facilities, it has become necessary to make the most of the available space. The general arrangement of the shop layout was explained in the issue of the STREET RAILWAY JOURNAL for April 11, 1903, page 548. A supplementary article appeared in the issue for Jan. 16, 1904, page 100. Recently a number of changes have been made for the purpose of increasing the amount of work which can be turned out with a limited shop force, largely by placing the tools where they can be served more readily while keeping the operators out of each other's way, and by introducing devices for handling heavy pieces. This rearrangement has been a factor in the large car remodeling job now going through the shops.

The principal changes in the shops have been in

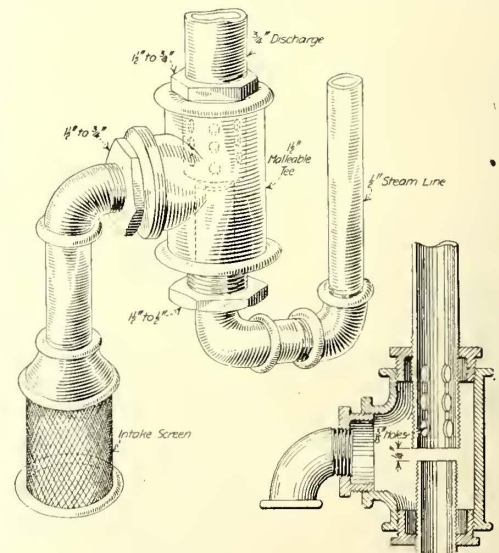
Inexpensive Water Ejector for Pit Use

BY J. E. HESTER

Union Traction Company of Indiana, Anderson, Ind.

SOME years ago the writer took charge of a shop where the working pits became flooded with water whenever any considerable amount of rain fell. This had to be removed by hand-dipping, a very slow and expensive method.

There were no funds available with which to purchase a pump or other suitable device to remove the



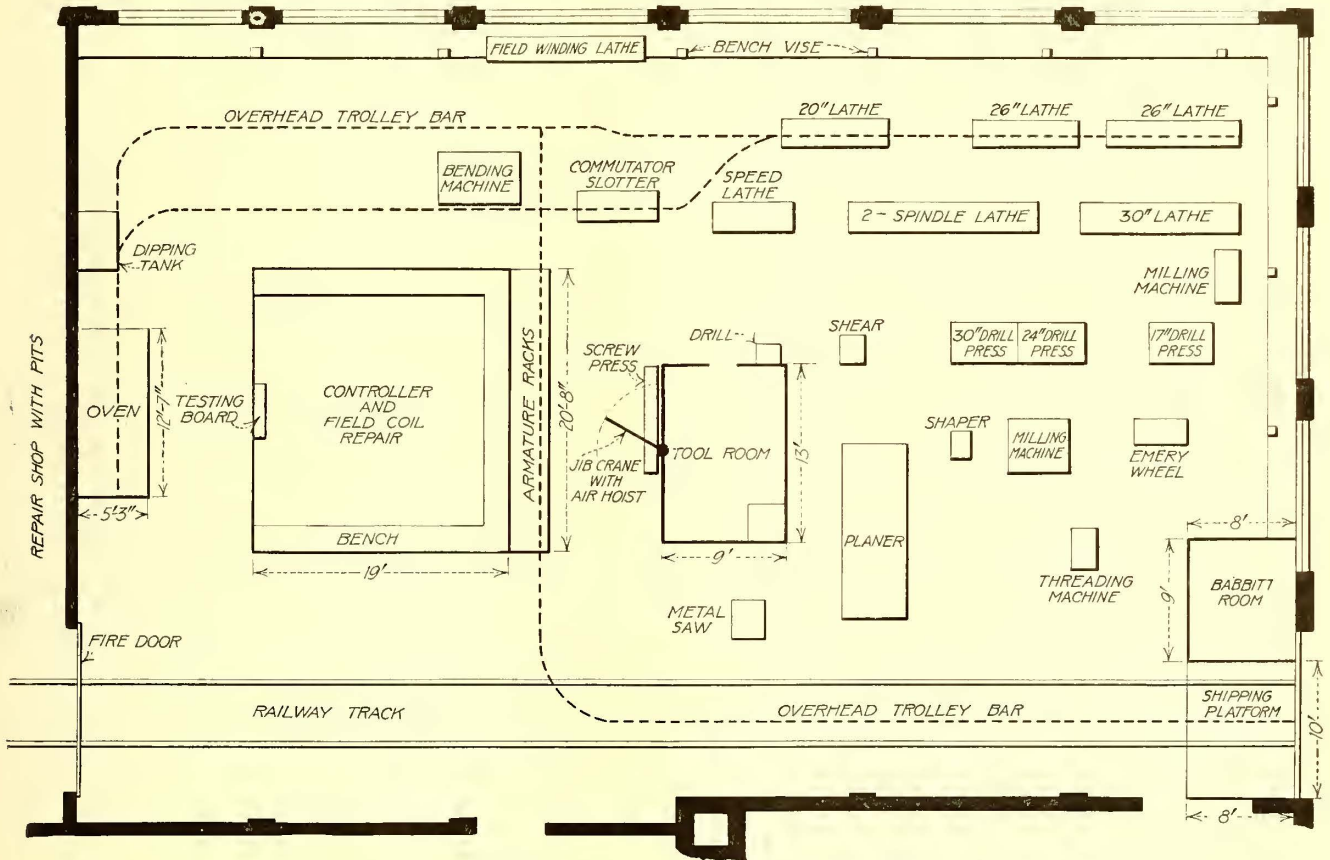
WATER EJECTOR CONSTRUCTED FROM ORDINARY PIPE AND FITTINGS

water, so the writer secured some pipe and fittings from the stockroom and constructed the ejector shown in the accompanying figure. The drawing is self-explanatory. The ejector can be made in a few minutes and has proved most effective in overcoming the trouble. Fittings of any size can be used, but naturally the larger the fittings the more rapid will be the displacement of water.

the large room which accommodates a number of machine tools, the armature winding section and the controller repair department. The plan of this room is shown in the accompanying drawing. Near the center is the toolroom, within easy reach of all parts of the shop. One corner is taken up with the lathes, arranged in rows with excellent natural lighting from windows in two walls in addition to the skylight. Near them is a battery of drill presses compactly arranged. A planer, a metal-cutting saw, a grinder, a screw press, etc., are all placed to good advantage. A General Electric commutator slotter is the latest addition to the machine equipment in this shop.

The sections of the room assigned to the armature winding and controller repair work have not been ma-

vision for heating glue has been made by the simple expedient of putting a sheet metal cover, with holes for the pots, over an ordinary kitchen sink. The water in the sink is kept hot by steam from a pipe, the end of which projects below the surface. A steam drying table, for giving pieces of trim a final heating before use, has also been put into this shop. It consists simply of a long, flat radiator made up of ordinary pipe and fittings. J. F. Uffert, master mechanic of the company, who is responsible for the changes mentioned, has also refitted the office section of the building, which is a two-story division at the St. Paul Street end of the building. The second floor has been divided into two small offices, the outer one for the clerks and the inner one for the master mechanic. These are simply but



LAYOUT OF GENERAL REPAIR SHOP NEW YORK STATE RAILWAYS, ROCHESTER, N. Y.

terially changed. The former work is done in a bright corner, and for the latter a rectangular space is railed off, as shown. A trolley bar has been installed to serve all important machines and storage spaces. This is a home-made outfit consisting of a 1 in. x 3 in. flat steel bar suspended by means of hangers of the same, the hangers being given an offset at the bottom to clear the trolley wheels. The location of the trolley bar is indicated by a dash line on the drawing. Chain hoists are hung from the bar on simple trolleys.

From the number and size of machines in this shop one would think that it would appear crowded when in full swing. This is not the case, however, and there is no confusion even when the full number of men are at work.

In the pit shop the main improvement has been the putting into commission of a number of previously purchased air hoists carried on trolley bars. In the wood shop the changes have been of minor character. Pro-

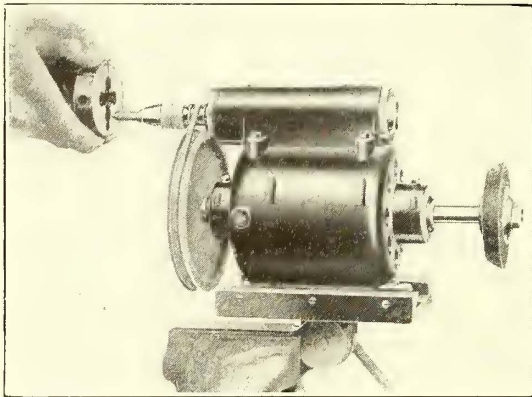
attractively finished and furnished. On the first floor are offices for the assistant master mechanic and time-keepers.

Like master mechanics generally, Mr. Uffert is enthusiastic regarding the possibilities of saving money by the use of gas and electric welding. Last spring he had on hand an accumulation of 532 broken motor cases. Of these all but fifty have already been reclaimed, the welders working on jobs of this kind when routine work is light. The local railway has been purchasing new motors of late in connection with large orders of front-entrance center-exit cars. These motors are the source of so few repairs that Mr. Uffert has been able to utilize the armature and field winding force for bringing the older equipment up to date, especially in respect to insulation, thus greatly reducing the number of pull-ins. At the same time the bearings are being rebored where necessary and the motors fixed up generally as a part of a large rehabilitation program.

Portable Electric Grinder with Speeds Up to 30,000 R. P. M.

A PORTABLE electric grinder with interchangeable equipment which permits the handling of a wide range of work is known as the "Dumore" and is adapted for work on dies, reamers, gages, deep internal grinding and "hard to get at" jobs.

It is claimed that the secret of the tool's success lies in the high cutting speed of 10,000 to 30,000 r.p.m. obtained on the various ball-bearing mounted spindles. Another important feature is that each armature is



HIGH-SPEED PORTABLE ELECTRIC GRINDER

dynamically balanced and there is said to be no possibility of chatter marks in the work.

The grinder is equipped with a "Universal" motor which operates on either direct or alternating current and develops $\frac{1}{4}$ hp. The outfit complete includes a number of attachments, full equipment of wheels, cutter rest, etc., and the weight is only 17 lb. This grinder is manufactured by the Wisconsin Electric Company, Racine, Wis.

New Types of Joint Plates for Welded Joints

THE Atlantic Welding Company, New York, has completed arrangements with The Rail Joint Company whereby the latter company will roll a special type of joint plate for the Gailor welded rail joints exploited by the welding company.

The plates possess a cross section, as shown in Fig. 1. The design permits the Atlantic process welding under the head of the rail and brings the weld to the base in

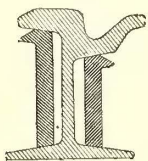


Fig. 1

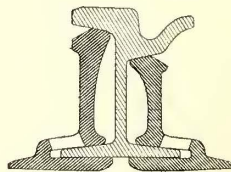


Fig. 2

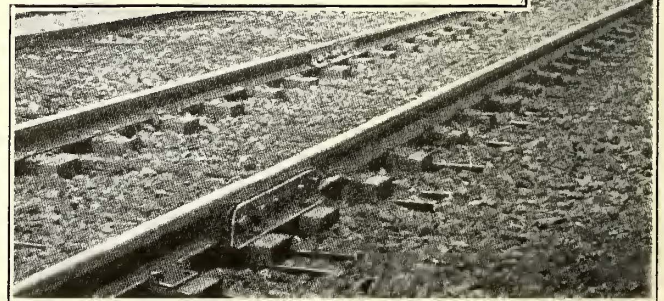
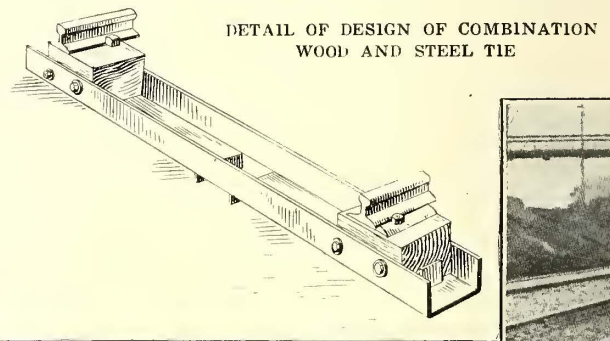
the most desirable place for all sections. These plates are adaptable to all types of girder, T and tram sections. Due to this arrangement plates for welding can be obtained at figures almost as favorable as ordinary mechanical plates.

A special type of a Continuous joint has been also developed adaptable to the welding company's methods. The plates of this joint are the plates of the usual mechanical Continuous joint, specially prepared with a

bevel to allow welding the top of the plates to the underside head and groove, and have apertures in the base members of the plates for welding them to the top of the base. (See cross section, Fig. 2). This type of joint permits a short length plate to be used, making the cost very attractive. The first trial installation of these joints (see ELECTRIC RAILWAY JOURNAL, Sept. 1, 1917, p. 362), which have now been in service a year, are reported to have given perfect satisfaction to date.

New Steel Tie Retains Advantages of Wood

THE Dallas Railways Company has recently placed an order for a carload of a combination steel and wood tie which has been tried out satisfactorily by several railways in the last two years. This tie is made of a rolled channel section, placed in the ballast trough-side up, with wood bearing blocks to support the rails. The creosoted blocks, which are 18-in. long and about the same width and thickness as an ordinary tie, are firmly bolted into the channel and stand up nearly 2 in. above the side walls. The good features of a treated



COMBINATION WOOD AND STEEL TIE IN SERVICE

wood tie are thus retained and the objectionable features of solid steel or concrete are obviated.

The rail is fastened to the block with any of the ordinary appliances, and, as there is no metal connection between the rail and the channel, perfect insulation is afforded. The blocks reinforce the tie under the rail, where the heaviest stresses have to be met, and thus give substantially the same strength as though the blocks extended the entire length of the channel. By overcoming the rigidity of steel on steel, a more resilient and quieter roadbed is secured. Holes punched in the bottom of the tie provide drainage and afford anchorage in the ballast.

The life of the tie is said to be limited only by the effect of corrosion, as there is no wear of the rail on the channel, and the wood blocks may be readily renewed. The designers of this combination tie, the Standard Steel Tie Company of Dallas, Tex., claim that the renewal of these blocks is offset by the value of the tie as scrap.

New Steam-Ejector Condenser Air Pump

A NEW FORM of condenser air pump operating on the steam ejector principle has been put on the market by the C. H. Wheeler Manufacturing Company, under the name "Radojet" air pump. While steam ejectors for removing air were used as early

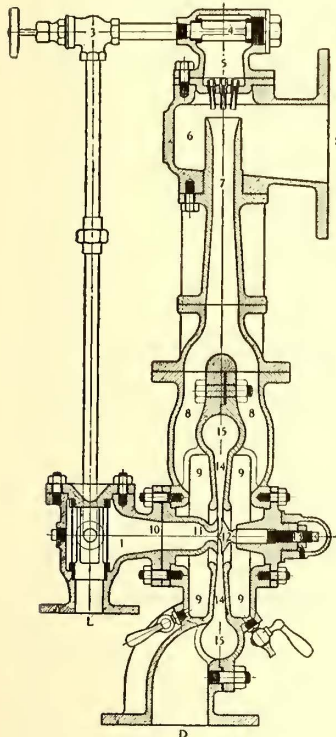


FIG. 1—CROSS-SECTION OF STEAM-EJECTOR CONDENSER AIR PUMP

as 1868 it is believed that this is the first time that the device has been used to produce a high vacuum commercially.

The principle of operation is shown in the cross-section, Fig. 1. The air entrance from the condenser is at S and the ejector outlet is at D. The steam enters at L, dividing into two paths. One path is through the strainer 1, the vertical pipe, the steam valve 3, strainer 4, expansion nozzles 5 and across suction chamber 6 of the first ejector stage. The steam expands in the nozzles, leaving with a very high velocity, and while passing across suction chamber 6 entrains the air and vapors to be compressed.

The mixture passes into the diffuser 7 from which it is discharged, at an absolute pressure higher than that of the air entering at S, into a double passage 8 communicating with the suction chambers 9 of the

is delivered radially in the form of a sheet and, in passing across the suction chambers 9, entrains the air and steam coming from the first stage and carries them into the annular diffuser 14. The compressed mixture is discharged into casings 15 and to the exit D.

From the ejector the mixture of air and vapors can be delivered into a small tank supplied with fresh water for boiler feed as illustrated in Fig. 2.

The makers of the ejector air pump summarize as follows the advantages which accrue from the use of the steam ejector principles: (1) Low steam consumption. (2) Extreme simplicity. (3) No moving parts. (4) No lubrication. (5) Minimum space. (6) Minimum waste. (7) No foundation. (8) Noiseless operation. (9) No attention required during operation. (10) Quick starting. (11) Continuous service. (12) Safety in operation.

The weight of one of these pumps suitable for a 7500-kw. surface condenser is stated to be 450 lb. In a test of a surface condenser equipped with this pump, the following data were noted:

| | |
|--|--------|
| Cooling surface in condenser, sq. ft..... | 21,000 |
| Load on turbine, kilowatts..... | 11,200 |
| Barometer reading in inches..... | 30.01 |
| Vacuum at turbine exhaust (mercury column)..... | 28.15 |
| Vacuum at air pump suction (mercury column)..... | 28.25 |
| Temperature of turbine exhaust, deg. Fahr..... | 98 |
| Temperature of circulating water inlet, deg. Fahr..... | 75 |
| Temperature of circulating water discharge, deg. Fahr..... | 90 |
| Temperature of hot well, deg. Fahr..... | 94 |

About 1,000,000 kw. capacity of "Radojet" pumps has been contracted for, a large portion of which is in successful operation in the United States Navy and on United States Shipping Board vessels.

Checking Devices and Conservation

IN STUDYING the subject of devices for economical operation of electric railway cars L. E. Gould, president Economy Electric Devices Company, has listed a number of ways in which such devices assist in the saving of energy and materials. The most important of these are summarized below.

In the first place the motorman can save energy:

- (1) By not accelerating too slowly. Fifty per cent of the energy drawn from the line during the notching-up process is wasted in heat in the resistance grids.
- (2) By not accelerating too rapidly; that is, to the point of spinning the wheels. This wastes power, injures equipment and is uncomfortable for the passengers.
- (3) By not coasting up grade between stops. This calls for reacceleration and consequent losses.
- (4) By avoiding unnecessary slowdowns.
- (5) By not using the brakes and power simultaneously.
- (6) By not "fanning" the brakes.

Mr. Gould divides the possible savings in car operation into three groups, as follows:

Power Savings.—Direct saving from improved handling of controller and brakes. Lower peaks. More efficient schedule speeds. Distribution system relieved of part of its load. Wider recognition of power waste.

Equipment Savings.—Constant inspection of condition of motors and brakes. Data show most efficient equipment for given service. Less wheel wear from spinning. Less brakeshoe wear. Less roasting of motor coils. Quick detection of short-circuited fields.

Accident Savings.—Crews are more watchful. Power is on for a shorter time. Maximum speeds are lower. More uniform braking is secured.

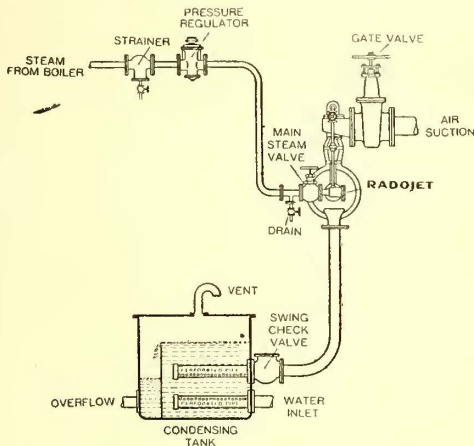


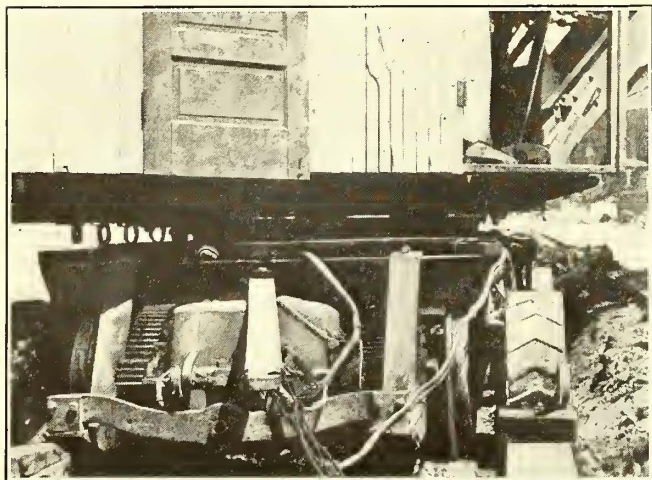
FIG. 2—DIAGRAM SHOWING APPLICATION OF STEAM-EJECTOR CONDENSER AIR PUMP

second stage. These two suction chambers are annular, giving the commingled fluid a large entrainment surface.

The second path of the steam is through strainer 1 into passage 10, which communicates with the annular expansion nozzle formed between two circular disks, 11 and 12. The distance between these disks is adjustable by means of the set screw 13. Thence the steam

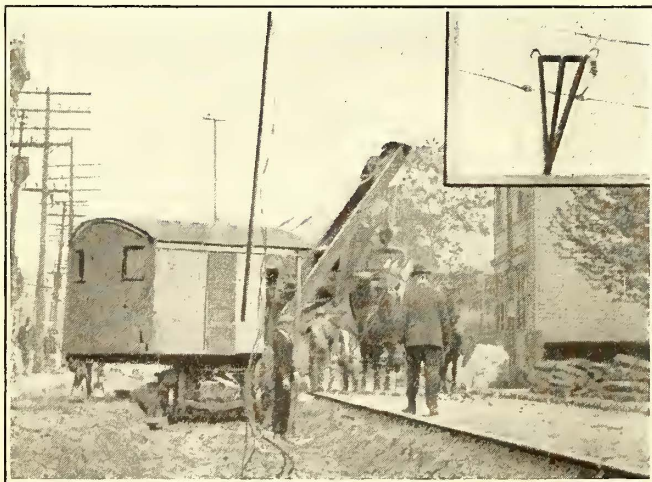
Electric Shovels Prove Their Value in Cincinnati

THE Cincinnati (Ohio) Traction Company has had in operation for some time two Thew shovels, electrically equipped, which have given excellent service. They are used primarily for excavating track trenches, but are found equally satisfactory for breaking out concrete. For unloading sheet steel from railway cars the dipper is removed and a lifting magnet is substituted. At other times a small clam-shell bucket is



TRUCK WITH BULL WHEELS OPERATING ON PLANK TRACK

used to remove excavated material which has previously been placed alongside the track by the dipper when operating conditions were such as to prevent completing the operation in one movement. Another instance which shows the adaptability of this machine is when it is used with the clam shell to keep the stone side of a Foote continuous concrete mixer full and thus accomplish the work of eight laborers.



ELECTRIC SHOVEL IN OPERATION, CINCINNATI TRACTION COMPANY—INSET, CONTACT DEVICE

When operating on track the shovel is propelled on standard car wheels, but is mounted on bull wheels for traveling in the trenches. The truck axles are long enough for the bull wheels to be pressed into place outside the car wheels. The bull wheels are of smaller diameter than the car wheels, and when used are operated over a plank track made in short sections. The shovel is operated as a trailer when moving it to

a new location on the system. The bull wheels are then keyed into position, and it is run into a short trench previously excavated.

Power is taken from the trolley by a flexible connector, which also completes the circuit as the company uses an overhead ground. The electric equipment consists of GE-800 motors for traction and 20-hp. Westinghouse motors for operating the bucket. Between 250 and 400 ft. of single-track trench can be made in ten hours, depending upon the class of materials, length of haul and street congestion.

Remote Control of Heavy Electric Current Switches

THE Texas Power & Light Company has recently purchased from the Union Switch & Signal Company interlocking material for operating from a central point a large number of oil switches located out of doors on pole construction. They are to be installed at the Payne switching station, Dallas, Tex. The ultimate switching system will comprise one one-lever, three two-lever, twenty-five three-lever and eleven four-lever Union dwarf machines, each completely equipped, making a total of 126 levers. For the present there will be one one-lever, three two-lever, eleven three-lever and six four-lever frames, with forty-four working levers. The levers will be arranged in three parallel banks, the mechanical leadout leaving the building in two directions. About one-third of the levers in each bank, located near the center, will be so interlocked that but one lever of certain groups can be reversed at a time. This is to prevent the closing of conflicting switches inadvertently. The above is a novel means of distant control of heavy current switches which heretofore have been solenoid or motor operated, involving considerably greater expense.

Street Car Seats in 1868

WASHINGTON had its street car troubles fifty years ago, as now, though not so serious. There was room for everybody on the car, but, according to the following in the *Star* of Jan. 7, 1868, the room was not always equitably apportioned.

"It is suggested that our street railway companies could save their conductors as well as passengers a good deal of needless annoyance by dividing the benches in their cars into single seats. Each person would then know just how much room he is entitled to and no two or three would be able, as they often do now, to compel others to stand by occupying more room than they need. A change of this sort would greatly promote the convenience of passengers in general and relieve conductors of a duty which is often as difficult as it is unpleasant." —*Washington Star*.

Towline Helps to Keep Tracks Clear

C. H. Clark, engineer maintenance of way of the Cleveland (Ohio) Railway, makes a practice of carrying a towline in his automobile as he travels around the city performing his duties. Recently he found a tie-up caused by an automobile stalling on the railway track, and with the aid of the towline soon had the tracks clear. At least six times during the past winter he has ended traffic tie-ups in this manner.

News of the Electric Railways

TRAFFIC AND TRANSPORTATION

FINANCIAL AND CORPORATE • PERSONAL MENTION • CONSTRUCTION NEWS

Further Conferences in St. Louis

Present Emergency May Necessitate Important Changes in United Railways Franchise Terms

A proposal to repeal the mill tax and franchise taxes aggregating \$480,000 a year, which are now imposed on the United Railways, St. Louis, Mo., was made by a committee of the Chamber of Commerce at a conference on the proposed franchise settlement in Mayor Kiel's office on March 5, attended also by street railway representatives. The Chamber of Commerce Committee proposed that the pending settlement bill be amended by striking out the proviso that the company pay 3 per cent of its gross earnings to the city, and that instead of paying the accrued mill tax of \$2,300,000 in five annual installments with interest at 6 per cent, the company be permitted to pay the mill tax debt in ten annual installments without interest.

As a result of the meeting on March 5 the Mayor instructed President Kinsey of the Board of Public Service to invite representatives of the United Railways, a committee of the Chamber of Commerce and members of "such organizations as he sees fit" to confer on the proposed changes. No date has been set for this conference.

PROPOSED AMENDMENTS

Amendments, to which Mayor Kiel and other city officials have given their assent, would introduce into the pending bill these provisions.

Abolition of the mill tax and the franchise taxes, totaling \$480,000 a year.

Extension of the time period allowed for the payment by the company of the accrued mill taxes, amounting, with interest, to \$2,500,000.

Acceptance of the new franchise ordinance by the company practically at its own convenience.

Recognition of \$60,000,000 as the valuation of the company's properties, which, President McCulloch announced, would be returned for assessment by the State Board of Equalization at that figure.

The bill now awaiting a report from the Board of Public Service, after having been finally amended by the Board of Aldermen, abolishes the mill tax and the franchise taxes, but imposes a tax of 3 per cent on the company's gross earnings and a supertax on its net revenues above 7 per cent on the \$60,000,000 valuation established; requires the payment of the accrued mill tax within five years, with interest at 5 per cent, and allows nine months after the adoption of the ordinance for its acceptance by the company.

Thomas M. Pierce, general counsel for the company, is reported to have said that the company cannot formally accept the ordinance, if passed, and reorganize its finances until at least six months after the termination of the war.

Philadelphia Hearing March 27

The Public Service Commission of Pennsylvania has fixed March 27 in Philadelphia for the hearing on the proposed lease of the high-speed rapid transit lines by the city to the Philadelphia Rapid Transit Company. The agreement has already been approved by the company and the city.

Railway Men Donate Ambulance

A fully equipped automobile ambulance was accepted by the United States Army on March 9 as a gift from the Interborough Brotherhood, composed of employees of the Interborough Rapid Transit Company, New York, N. Y.

The presentation ceremony took place in the Twelfth Regiment Armory. Governor Whitman reviewed the regiment.

Theodore P. Shonts, president of the Interborough Rapid Transit Company, introduced John Phelan, president of the employees' association, praising the loyalty of the employees.

Mr. Phelan said the ambulance was given in honor of the 1800 employees of the company who are now serving in the army and navy. It was accepted by Governor Whitman, who paid a splendid tribute to the patriotism expressed by the Interborough men at home in behalf of the Interborough men abroad. Major Guthrie, in charge of the ambulance section of the Metropolitan Division at Yaphank, accepted the ambulance for the government.

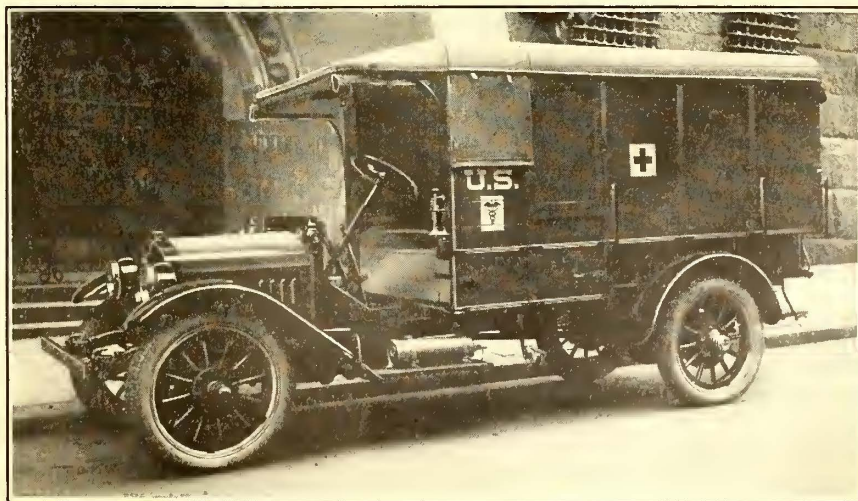
Sticks to Electricity for Belt Line

Expert for Buffalo Thinks Fifteen-Mile Steam Line Could Be Electrified Quickly

It is practically assured now that the New York Central Railroad belt line around the city of Buffalo, N. Y., will be electrified by the International Railway providing money can be raised to finance the proposed improvement.

John C. Brackenridge, New York, retained by the city as an electric traction expert, has held a series of conferences with International Railway and New York Central Railroad officials and he says the work of electrifying the New York Central belt line, a distance of approximately 15 miles, can be accomplished very quickly and that the cost of the work would not be excessive. All that he says is necessary is the stringing of overhead wires and the bonding of the rails. Mr. Brackenridge suggests that the discarded cars of New York City's rapid transit lines be secured and rebuilt for use in Buffalo.

The proposed electrification was discussed at the meeting before the Public Service Commission at Albany on March 4, to which reference is made on page 537 of this issue. It was said that the plan proposed by Mr. Brackenridge would cost \$1,200,000. General Manager Crowley of the New York Central said such a proposed electrification would be unwise for Buffalo. Relief for the transit situation should be undertaken in some other way. President Connette, of the International Railway, said there were so many details to be considered that he hesitated to express an opinion. He said he would consider the project and inform the commission.



AMBULANCE PRESENTED TO THE ARMY BY INTERBOROUGH EMPLOYEES

Municipalization Progress in San Francisco

Six Different Points of Agreement Reached in the Negotiations for the Purchase of the United Railroads by the City

William von Phul, vice-president and general manager of the United Railroads, San Francisco, Cal., and City Engineer M. M. O'Shaughnessy have been in consultation for several weeks in an effort to work out a plan agreeable to both parties and under which the city could purchase the entire United Railroads' system. The actual values involved have not as yet entered into the discussion. The chief subject of debate has been the method of valuation to be adopted.

A notable step in the progress toward common ground was the agreement that the cost of reproduction is to be based on an inventory of properties and unit prices representing an average of normal conditions for the five-year period, 1913 to 1917, inclusive. A difficult question will be that of the net earnings which the company may expect to receive from the system in case it were retained until the expiration of franchises. The points of agreement that have been established are as follows:

SIX POINTS OF AGREEMENT

1. The sale price of the properties of the United Railroads of San Francisco to the city and county of San Francisco shall be the agreed present physical value of the property plus an amount equivalent to the probable net earnings of the railroad properties during their remaining franchise life.

2. The present physical value shall be the cost to reproduce new as of Dec. 31, 1917, with allowance for betterments to date of consummation of sale, less depreciation, based on the actual physical condition at the date of the consummation of sale. The cost to reproduce new shall be based on a physical inventory of the property and unit prices representing the average of normal conditions for the five-year period 1913-1917, inclusive, and cognizance shall be taken of existing conditions at the time the present property was constructed. The general principles recognized by the Interstate Commerce Commission and the State Railroad Commission shall be followed in making the valuation. In the valuation of the physical property, abandoned trackage shall be taken at its value for old material, and allowance made for its removal and the restoration of the streets.

3. The probable net earnings—to be computed by the best agreed methods—of the properties during their remaining franchise life shall be the difference between the probable gross revenue and the probable gross operating expense for the properties for the period from the date of consummation of sale up to and including the year in which franchises, approximating 134 miles, have expired, plus an allowance for the additional net earnings of the remaining several and isolated lines, if operated independently, to the expiration of the several franchises. The net earnings shall be taken as the remainder of the

gross receipts of the property after deducting operating expenses, taxes, depreciation sufficient to maintain the properties in their present condition under like future operating conditions, and interest on the agreed value of the physical property at the same rate which the city shall pay upon its deferred payments for the physical property.

4. Payments on the purchase price of property shall be made semi-annually from the operating receipts. Deferred payments on the physical value of the property shall bear interest at 4½ per cent per annum. Payments on that portion of the net earning value of the property shall bear no interest.

5. Nothing in the above basis of valuation shall be construed to prevent the establishment of a fair price for the purchase and sale of the properties as between a willing seller and a willing buyer.

6. In the event that the representatives of the United Railroads and of the city are unable to reach an agreement, then such matters as are in dispute shall be referred to an arbitrator, who shall be jointly selected by the city engineer and the representative of the United Railroads. Any expense incurred in arbitration shall be borne equally by the United Railroads and the city of San Francisco.

OPPOSED TO PIECEMEAL SALE

Jesse W. Lillenthal, president of the United Railroads, in answer to a request from the city engineer's office, has stated that the board of directors of the company has decided that it would be unwilling to sell the properties piecemeal and that therefore an offer for the purchase of the Parkside lines cannot be considered.

Columbus Publicity Continued

The refusal of the City Council to grant the Columbus Railway, Power & Light Company, Columbus, Ohio, an immediate increase in the rate of fare is only an incident in the company's campaign for relief from oppressive requirements of its 1901 contract. The action of the Council is only an expression of opinion, and eventually the question will be submitted to a vote of the electors. First, however, the company will put the truth before the people in the publicity campaign that has been started.

The request submitted to the Council involved two questions. One was an immediate increase in the rate of fare from eight tickets for 25 cents to seven tickets for 25 cents. The other was a service-at-cost proposition. An increase in the rate temporarily is needed by the company to maintain proper service, and the company feels that this should have been granted. The service-at-cost plan would have involved quite a period of time for consideration, but

it seems to be uppermost in the minds of the officials. The present franchise has about nine years to run.

In its publicity campaign the company is endeavoring to adhere implicitly to the truth in every statement. It has invited criticism, favorable or unfavorable, in order that it may clearly set before the people every detail of the franchise situation.

Only 1 mile of track has been built in a number of years. That something must be done to enable the company to finance improvements and extensions is obvious. The city is growing and increasing in population and will shortly need increased facilities and additional trackage. It is the desire of the company that some arrangement be made that will enable it to carry out such construction work as is needed.

Transit Act Upheld

Court Passes Upon Bauer Act, Under Which Cincinnati Transit Program

Will Be Put Through

In a decision handed down on March 5 the Ohio Supreme Court upheld the constitutionality of the Bauer act, under which the city of Cincinnati was authorized to name a rapid transit commission and construct a rapid transit road, and also approved the contract between the city and the Cincinnati Traction Company, except that portion wherein the city guarantees the obligations of the railway. This provision is held to be in violation of Article VIII, Section 6, of the Ohio constitution which forbids the passage of a law authorizing any county or city to become a stockholder in any joint stock company or loan its credit to or in the aid of any such company.

The contract between the city and the company provides for the distribution of the gross proceeds of the rapid transit line which is to be operated by the company, but specifies that certain obligations of the company and securities hereafter to be issued by it shall be paid before the payment to the city of the sums specified in the contract. The court held that this is a loan of the city's credit to the company for these payments.

All other portions of the contract were approved, as were the various steps taken by the Rapid Transit Commission in planning for the construction of the road. The court said the road is needed for the proper transportation of the people to and from the suburbs. The city has a right to enter into a contract with the company for the operation of the road and to provide by contract for the payment of all expenses of operation, depreciation and maintenance out of the gross proceeds received from all sources of operation under such terms and conditions as the city and its duly authorized officers and boards may deem for its best interests. The rental or compensation to be paid to the city must, however, be determined by some method which, while not necessarily a fixed sum, shall not leave the city's fair and just rent or portion of the earnings subject to hypothecation

by the company or applicable to the company's independent obligations.

The opinion prevails that a new contract will have to be made with the company for the operation of the proposed rapid transit road and that it will be necessary to secure the approval of the voters, as was done before. Extreme care will have to be exercised in the formulation of the contract to prevent violation of any of the laws relating to public credit.

Cleveland will benefit by the experience of Cincinnati in this matter, as a rapid transit commission has already been appointed to work out a plan.

Grave Labor Situation

Contractors Engaged on New York's New Rapid Transit Lines Fear Financial Ruin

The Public Service Commission for the First District of New York has taken up with the Board of Estimate and Apportionment of New York City the question of whether it may not be necessary as well as advisable to secure legislation which will permit the completion of contracts for construction of some of the lines of the dual system of rapid transit in order to assure the beginning of operation of those lines at an early date. The progress of construction has been interfered with so seriously with embargoes on materials and by the labor situation due to the great amount of government war work going on that remedial legislation is deemed necessary to solve the problem.

A conference has already been held between members of the commission and Acting Mayor Alfred E. Smith, and it is probable that another conference will be held soon between representatives of the commission and the transit committee of the Board of Estimate and Apportionment to determine what legislation, if any, may be had.

The commission in a letter to the Acting Mayor pointed out that the situation was vital and directly affected the city. The letter states that contractors who entered into agreement before the United States declared war are now threatened with financial ruin from the unanticipated conditions which have arisen, while the commission finds itself confronted with the prospect of the abandonment of the work by contractors and consequent inability to get the work completed at a cost within reason.

In order to retain construction forces contractors have found that they must assume burdens which they state they are no longer in a financial position to meet. They are willing to complete their work on an actual cost, no-profit basis, but they do not feel able to advance wages further except on some basis which recognizes the unexpected character of war time exigencies. The commission states that unless this situation is met and legislation obtained which will permit an allowance to contractors sufficient to meet the increased labor cost, cessation of work on some of the new lines seems imminent.

Protest Against Proposed Buffalo Bills

International Railway Objects to New Legislation—Chamber of Commerce Has \$30,000,000 Transit Program

Continual unjust criticism of the International Railway, Buffalo, N. Y., by the City Council, daily newspapers and the Municipal Street Railway Commission has so affected the securities of the company that it is even unable to dispose of its bonds at 88, according to a statement made before the Buffalo City Council by Henry W. Killeen, of Penney, Killeen & Nye, of counsel for the railway. Mr. Killeen said that unless the company received the support of the federal reserve bank in marketing bonds to finance approximately \$2,000,000 of improvements planned for this year, the company "will be forced into bankruptcy with three-fourths of the other electric railway properties of the State."

LEGISLATION PROTESTED

When it was suggested that the city purchase some of the company's bonds, Mayor George S. Buck replied that the municipality would be willing to lay the new rails and make other improvements to the company's real property and then lease the equipment to the company. Mr. Killeen appeared before the Council to object to the three legislative measures pending before the Mayor and the Council for their approval. All of the measures affect the International Railway.

One provides that the city can own and operate automobile bus lines in competition with the railway; another provides that the city can license jitney lines operated by private companies, and another legislative measure would allow the city to own and operate electric railway properties.

In appearing before the Legislature at Albany to object to the enactment of these measures, Mr. Killeen branded them as unjust and discriminatory and urged the Legislature not to allow them to pass. Referring to traffic conditions in Buffalo, Mr. Killeen declared that the weather during the past winter was the most severe in the city's history; that the company suffered a loss by fire of almost fifty of its best cars; that a large Westside carhouse was burned and that floods crippled more than 100 cars. He said that this combination of circumstances crippled more than 50 per cent of the company's equipment and was wholly responsible for the alleged inadequate service about which the city complains.

\$30,000,000 EXPENDITURE RECOMMENDED

The transportation committee of the Buffalo Chamber of Commerce, which has been studying local traffic conditions for almost a year, has submitted a comprehensive report embodying the expenditure of approximately \$30,000,000 to improve the city transportation facilities. This plan of the Chamber of Commerce, includes the construction of a series of electric subway and elevated lines through the congested retail business section. A four-track subway in Main Street from La-

fayette Square to East Ferry Street, a distance of approximately 3 miles, and another four-track subway on the east side between Lafayette Square and William Street and the West Shore Railroad tracks is recommended, together with a double-track elevated line connecting the end of the proposed east side subway with the seawall strip on the extreme south side of the city.

CONFERENCE WITH COMMISSION

Nothing is mentioned in the report of the Chamber of Commerce regarding an immediate relief of traffic conditions through rerouting of surface lines, but it is pointed out that there is a real demand for relief from the congested traffic in the retail business district and in the congested industrial centers.

Mayor Buck of Buffalo, General Manager Crowley of the New York Central Railroad; E. G. Connette, president of the International Railway, and the members of the Public Service Commission for the Second District, discussed Buffalo's transportation facilities on March 4. Chairman Hill presided and spoke of the conditions in the northern part of Buffalo, where about 37,000 persons are to be employed in industrial plants whose output is required by the government.

It was shown that surface cars can handle about 14,000 employees while the other employees must be transported by the steam roads. Mayor Buck explained the city's needs to relieve the situation and General Manager Crowley said his company would operate five trains of fourteen or fifteen cars in the morning and at night instead of two as at present. The additional service will require the installation of semaphores, telephones, etc., which will take two weeks to install.

Electrical Engineers Organize Regiment

A new regiment, composed largely of electrical engineers and known as the Thirty-seventh Engineers, is being recruited for early service in France. Positions still open to volunteers, including men in the draft age, are operators of steam, oil and gas engines and electrically driven pumps, machinists, blacksmiths, sheet metal workers, molders, pattern makers, pipe fitters, oxy-welders and electricians of all kinds, especially wiremen, linemen, armature winders, etc. A special recruiting office has been opened at the State Council of Defense Building, No. 120 West Adams Street, Chicago, Ill., in charge of Major A. B. Kratz, where all applications for this service should be made.

The regiment will be commanded by Col. T. A. Dillon, an officer of the Engineering Corps of the Regular Army, who has been relieved from duty as electrical engineer of the Panama Canal to command this regiment.

News Notes

Mayors Favor Municipal Ownership.—At the State conference of Mayors of New York on March 7, resolutions were adopted unanimously urging the Governor and the Legislature to a speedy enactment of a measure that would permit any municipality in the State to own public utility properties.

Increase in Wages in Sioux City.—An increase of 3 cents an hour will be made in the wages of conductors and motormen in the employ of the Sioux City (Iowa) Service Company. The request for shorter working days, the other important feature of the petition submitted by the employees, will be taken up with the men immediately.

Statement Regarding C. Loomis Allen.—At Syracuse, N. Y., on March 13 T. C. Cherry, business associate of C. Loomis Allen, former director of the Electric Railway War Board, issued a statement in regard to Mr. Allen as follows: "Mr. and Mrs. C. Loomis Allen are now at a quiet resort, the location of which is withheld at their request. Mr. Allen has not advised his friends of his future plans."

Utility Magazine Discontinues.—Owing to conditions growing out of the war the Utilities Bureau, Philadelphia, Pa., has decided to suspend the publication of the *Utilities Magazine*. The Utilities Bureau is the bureau of which Morris L. Cooke is acting director. Arrangements have been made so that if it becomes expedient at any time prior to the regular resumption to issue one or two special numbers of the magazine, it can be done.

Will Continue Park.—The lease of Wheeling Park by the West Virginia Traction & Electric Company, Wheeling, W. Va., to Griffiths & Crane has been canceled by mutual consent, but the park will be operated as usual this year. Arrangements are being made with J. A. Moore, Wheeling, to run it. In an item published in the *ELECTRIC RAILWAY JOURNAL* for Feb. 23, page 384, it was inadvertently made to appear that the operation of the park would be discontinued.

Flood of Municipal Ownership Bills.—There was a debate in the Senate of the State of New York on March 12 as to where a bill of Senator George F. Thompson, providing for a referendum on the subject of municipal ownership by all towns, villages and cities, should be referred. Senator Brown insisted that the bill should go to the public service committee this time. In the course of his talk he made the suggestion that there were so many municipal ownership bills coming in that it might be necessary to appoint a special committee that could take care of the subject.

One-Man Car Criticised.—The *Motorman and Conductor* for February, 1918, contains a signed article by W. D. Mahon, president of the Amalgamated Association of Street & Electric Railway Employees, critical of one-man car operation. Mr. Mahon says that his article is based on a report of the general executive board of the Amalgamated Association. The conclusions are, briefly, that the purpose of the designers and operators in introducing the cars is primarily profit, to save on platform expenses and with no thought for the safety and convenience of the public.

Plan to Revoke Franchise Put Over.—The City Council of Portland, Ore., following recommendation of City Attorney La Roche, recently laid on the table the ordinance introduced into the Council by Commissioner Bigelow, asking the revocation of the railway franchises of the Portland Railway, Light & Power Company on the ground that the company is violating the terms of the grant by charging a 6-cent fare. City Attorney La Roche stated that consideration of such an ordinance at this time might interfere with the suit which the city has brought in the courts to annul the 6-cent fare order of the Public Service Commission.

Frank Putnam States the Company's Case.—Frank Putnam, counselor of public relations to public utility companies, who is associated with the North American Company, which controls the United Railways, St. Louis, Mo., has written for the *St. Louis Globe-Democrat* a survey of the St. Louis electric railway situation, apropos pending negotiations between the company and its employees as to wages, and the company's plea to the Public Service Commission of Missouri for increase of revenue. During the last six months Mr. Putnam has also written a series of forty-five advertisements for the United Railways. Mr. Putnam was formerly on the editorial staff of the *Post-Dispatch* of St. Louis.

New Twin City Labor Finding.—The labor situation in the Twin Cities as it affects the Twin City Rapid Transit Company appears to be clearing up. Final action on the proposed settlement of the Federal Mediation Commission, which has been in session in Minneapolis more than two weeks, is up to the company officials. The basis is practically that recommended by the former commission several weeks ago, namely, that union men may return to the company's employ "as fast as vacancies occur." Present company employees, however, object to the provision that restores strikers to their seniority rights when they are reinstated. The union men on March 10 adopted the commission's recommendations, indorsed the commission and pledged loyalty to the government.

Bonus for Richmond Employees.—The Virginia Railway & Power Company, Richmond, Va., recently posted a notice on wages as follows: "Commencing March 1, 1918, and until further notice, the company will pay to all

employees who are in the service of the company at the end of each calendar month in the several operating departments, including the shops, line department, power houses, substations, division offices, motormen and conductors and trackmen, a bonus of 3 cents an hour for men working by the hour, and \$9 a month for men working by the month. This bonus is independent of regular wage scales, and is made to assist our employees in meeting the emergency confronting them during the war period in the high cost of living."

Programs of Meetings

Railway Signal Association

A meeting of the Railway Signal Association will be held at the Auditorium Hotel, Chicago, Ill., on March 18. The committee reports to be presented will be on: mechanical interlocking, power interlocking, standard designs, direct current relays, a.c. automatic block signaling, signaling practice, batteries and switchboards, electrical testing, harmonizing of specifications and regional committees. There will also be a memorial service for the late secretary, C. C. Rosenberg.

United States Chamber of Commerce

Business readjustment to war will be the dominant note of the sixth annual meeting of the United States Chamber of Commerce at the meeting in Chicago on April 10, 11 and 12. The four critical questions of the day—financing the war, railroads, centralized control of industry, and shipping—will be considered from the twofold point of view of filling the government's requirements, but with the minimum disturbance to private industry. More than 500,000 business men will be represented.

American Railway Engineering Association

The American Railway Engineering Association, through its president, John G. Sullivan, chief engineer of the Canadian Pacific, Western lines, has announced the nineteenth annual meeting to be held in Chicago on March 19, 20 and 21.

The program to be arranged will take cognizance of the changed conditions of the present time in the railway world, more particularly with reference to war emergency yard improvements to relieve the freight congestion; ways and means for overcoming or meeting the shortage of material and labor; devising new ways of labor saving in maintenance work; reclamation and utilization of scrap material; substitution of other materials for wood and steel; conservation of resources; and discovering, if possible, new sources of economy.

The National Railway Appliances Association has similarly seen the special field for its exhibit this year, and preparations have long been under way for a show that will best meet the needs of the railroads under the present circumstances. In all 158 firms have arranged for space.

Financial and Corporate

London Income Cut in Half Another Canadian Company Is Hit by the Rising Cost of Electric Railway Operation

The gross earnings of the London (Ont.) Street Railway for the calendar year 1917 amount to \$417,862 as compared to \$426,314 the preceding year. The last year's earnings, therefore, represented a decrease of \$8,452 or 1.98 per cent.

This was due in a measure to the large number of soldiers entraining in the city in 1916, thereby causing an abnormal increase in that year.

This decrease in earnings was greatly exceeded by the rise in operating expenses. These for the calendar year 1917 amounted to \$331,094 as compared to \$292,401 the preceding year, an increase of \$38,693 or 13.23 per cent. Owing to the redemption of bonds, the deductions from income decreased \$1,012. The net income for the year totaled \$47,477 as compared to \$93,610 in 1916, a decrease of \$46,133 or 49.28 per cent.

The maintenance of equipment expenses in 1917 amounted to \$46,713 as compared to \$32,410 in 1916, an increase of \$14,303. Included in the 1917 maintenance is an item of \$10,267 for the rebuilding of cars, as compared to \$1,978 in 1916. The operating expenses in 1917 showed a large increase in both materials and labor, the total being 79.24 per cent of the gross as compared with 68.6 per cent for 1916.

On March 8, 1915, the company began to redeem its bonds at the rate of \$35,000 a year, the bonds redeemed to date totaling \$105,000. While the company has improved its road and equipment on an average of \$46,514 a year, it has not been able to increase correspondingly its bonds and capital stock. The result is, therefore, that on Dec. 31, 1917, there was invested in road and equipment \$233,848 more than the total outstanding bonds and capital stock. With a surplus of only \$194,542 available, the financial operation is said to have become difficult. The directors deemed it inadvisable to declare a dividend for the six months ended Dec. 31, 1917, on account of the large decrease in net income in 1917 and the other prevailing conditions.

Steam-Electric Deal Proposed

The Southern Pacific Railroad, the Southern Pacific Company, the Visalia Electric Railroad, the Minkler Southern Railway and the Atchison, Topeka & Santa Fé Railway have asked the California Railroad Commission to approve an agreement whereby the Visalia Electric Railroad proposes to sell its line of railway and property south from the city of Porterville, Tulare County, to the

Minkler company. The purchasing company proposes to pay for the properties an amount equivalent to that actually expended by the Visalia Electric Railroad and reconstruct the line acquired so as to be suitable for steam and electric operation. It further proposes to extend the lines to Ducor to connect with the Southern Pacific lines.

The Minkler Southern Railway is controlled through stock ownership by the Santa Fé company, and through funds advanced by the parent company has been engaged in constructing a railway from Exeter to Porterville. It is now proposed to complete this line to Ducor, where connection will be made with the Southern Pacific lines.

Bay State Abandonment

Receiver Donham Authorized by the Court to Discontinue 125 Miles of Unprofitable Lines

The Bay State Street Railway, Boston, Mass., may abandon 125 miles of electric railway in sparsely settled districts. Permission to do this was granted to the company on March 11 by the United States Circuit Court. Discontinuance of the lines is not hedged about by alternatives. The order of the court carries with it no restrictions. The entire matter is left to the discretion of the receiver of the railway, Wallace B. Donham, who appealed to the court for the order.

Coincident with this request announcement was made that the communities thus threatened with loss or curtailment of service would be given reasonable notice of the intention of the company. The announcement was unsigned. It was contained, however, in an envelope bearing the return address of the Association of Owners of Massachusetts Street Railway Securities.

THE STATEMENT

The announcement was as follows:

"The Bay State Street Railway, through Receiver Donham, has just filed a petition with the United States Circuit Court for authority to discontinue operating approximately 125 miles of track. This, with the track already discontinued, and awaiting other proceedings, totals 141 miles.

"The receiver states that these lines in general are in the sparsely settled communities where the travel is insufficient to make them pay.

"Under present conditions, with abnormal operating costs on the whole property, and particularly with the high cost of coal, it is impossible to raise money for proper maintenance of these tracks.

"It is the intention of the receiver to give ample notice to the communities involved before service is discontinued,

as it is realized that in many respects the decrease in values which would follow the giving up of these lines would be a serious problem to the communities affected.

"There are pending at the present time before the Legislature a number of bills, passage of which would authorize local communities to consider the question of whether they prefer to have the lines operated with some local assistance, or desire to have them given up, and it is the hope of the receiver that this legislation in some form will be passed, and before the actual taking out of the service that the wishes of the local communities may be thoroughly considered."

Financial News Notes

Mr. Dodge a United Director.—At the annual meeting of stockholders of the United Gas & Electric Corporation, New York, N. Y., the retiring board was re-elected with the exception of S. J. Dill, who was succeeded by Marshall Dodge.

Stock Increase Authorized.—The Ohio Public Utilities Commission has authorized the Cleveland (Ohio) Railway to increase its capital stock \$2,700,000. The sum of \$1,230,000 will be used to pay floating debt and the remainder will be spent for improvements to be made during the present year.

Southern Illinois Company Purchased.—The Public Utilities Commission of Illinois has authorized the Central Illinois Public Service Company, Mattoon, Ill., to purchase the entire outstanding capital stock of the Southern Illinois Railway & Power Company, Harrisburg, Ill., which operates 17 miles of line.

New Directors for Syracuse Suburban Lines.—C. Loomis Allen, Syracuse, N. Y., on March 12 was succeeded on the board of directors of the Syracuse & Northern Electric Railway, Inc., by W. J. Harvie, on the Rochester & Syracuse Railroad by W. K. Zinsmeister, and on the Auburn & Syracuse Electric Railroad by Frederick W. Barker.

Bond Issue Contemplated.—The directors of the Cities Service Company, New York, N. Y., are said to be considering the issue of between \$2,000,000 and \$5,000,000 of convertible 7 per cent debenture bonds, the proceeds to be used in chief part for the extension of operations in the organization's oil fields in Kansas.

Road Being Dismantled.—Thomas Flynn, Bluffton, Ind., has begun the dismantling of the property of the Bluffton, Geneva & Celina Traction Company, which he purchased at receiver's sale last November, and as a consequence the operation of the prop-

erty has been discontinued. The affairs of the company were reviewed briefly in the ELECTRIC RAILWAY JOURNAL of March 9, page 475.

Receiver Appointed for St. Paul Southern.—The St. Paul (Minn.) Southern Railway has been placed in the hands of a receiver by Judge W. L. Converse of the District Court at Hastings. Application was made by the Northwestern Trust Company, St. Paul. A. R. Walbridge has been named trustee for the bondholders. A deficit of \$51,934 has accumulated since the road was placed in operation late in 1914.

Reduction in Common Dividend by Twin City.—The Twin City Rapid Transit Company, Minneapolis, Minn., has declared a quarterly dividend of 1 per cent on the common stock payable on April 1 to holders of record of March 15. The common stock has been on a 6 per cent a year basis since 1910. It is understood that the reduction in the dividend was due largely to the increase in the cost of labor and supplies, the higher prices for coal being a prominent feature in this respect.

Two-Year Bonds Offered.—Harris, Forbes & Company, New York; Harris, Forbes & Company, Inc., Boston, Mass., and the Harris Trust & Savings Bank, Chicago, Ill., are offering for subscription \$750,000 of first mortgage 7 per cent gold bonds of the Chicago & West Towns Railway, Chicago, Ill. The bonds are dated March 1, 1918, and are due Sept. 1, 1920. Interest is payable March 1 and Sept. 1 in Chicago. The bonds are in coupon form in the denominations of \$1,000 and \$500. They have been approved by the Illinois Public Utilities Commission.

Cape Electric Earnings.—During the year ended June 30, 1917, the Cape Electric Railway, Ltd., Cape Town, South Africa, carried 23,752,016 passengers

and earned £231,105, as compared to 22,477,366 passengers earning £212,791 in the preceding fiscal year. The profit and loss account at the end of the year totaled £79,893. The difficulty of obtaining supplies, the high cost of materials and the increased war bonuses kept the cost of operation at a high level during the year. The expenditures were further increased by the additional taxation imposed by the government.

Louisville Net Falls Off.—At the recent annual meeting of the Louisville (Ky.) Railway it was reported that the gross earnings during the calendar year 1917 were \$3,849,805 as compared to \$3,365,376 in 1916, or an increase of \$484,429. Operating expenses and all charges during the year were \$3,214,474, an increase of \$638,011. The net income at \$635,330 showed a decline of \$153,883. During the year the company built several miles of track to Camp Taylor, which are now bringing in good returns. The interurban lines had to meet heavy competition from passenger automobiles and from freight trucks. As a result business for the year was not satisfactory. A switch to handle interurban livestock was built into the Bourbon Stock Yards, but it was constructed too late in the season for any benefit in 1917.

Common Stock Dividend Policy Announced.—The stockholders and the directors of the Cities Service Company, New York, N. Y., have approved the following resolution: "Resolved, That until such time as there has been invested in the property of the Cities Service Company, or its subsidiaries, a sum equal to the entire par value of the preferred stock then outstanding, there shall be no dividends paid in cash on the common stock in excess of 6

per cent per annum, unless the company shall, for a period of six months, have purchased and retired all preferred stock that can be purchased in the open market at 110 per cent of par or less."

Bay State Order Vacated.—With the consent of all parties concerned Federal Judge Dodge has vacated an order issued on Jan. 2, under which Wallace B. Donham, receiver for the Bay State Street Railway, was authorized to issue receivers' certificates to the amount of \$379,000 to meet interest and tax obligations. This action was taken pending a decision by the Federal District Court on the claim of the State of Massachusetts for a franchise tax. Of the amount originally authorized \$162,000 was for interest on bonds of the Boston & Northern Street Railway, \$136,000 for similar payments to the bondholders of the Old Colony Street Railway, and the remainder to meet the State franchise tax.

Detroit United Bonds Offered.—The Guaranty Trust Company, New York, N. Y., is offering for subscription at 97 and interest, yielding about 7¾ per cent, \$4,500,000 of Detroit United Railway five-year 7 per cent collateral trust gold notes due April 1, 1923. The notes are to be the direct obligation of the Detroit United Railway specifically secured by pledge with the trustee, the Central Trust Company, New York, N. Y., of \$9,000,000 par value of bonds and dividend-paying stocks. The notes are to be issued to refund \$3,500,000 of notes due on May 1 next; to reimburse the treasury for advances made to refund underlying bonds, and for capital expenditures. The issue of the notes has been passed upon by the capital issues committee of the Federal Reserve Board. The bonds are offered subject to the approval of the Michigan Railroad Commission.

Electric Railway Monthly Earnings

BATON ROUGE (LA.) ELECTRIC COMPANY

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$21,584 | *\$10,780 | \$10,804 | \$3,630 | \$7,174 |
| 1 " " '16 | 20,204 | *7,084 | 13,120 | 3,555 | 9,565 |
| 12 " " '17 | 231,965 | *119,414 | 112,551 | 42,736 | 69,815 |
| 12 " " '16 | 211,694 | *100,858 | 110,836 | 42,003 | 68,833 |

BROCKTON & PLYMOUTH STREET RAILWAY, PLYMOUTH, MASS.

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$8,910 | *\$10,038 | †\$1,128 | \$1,318 | †\$2,446 |
| 1 " " '16 | 8,788 | *9,185 | †397 | 1,121 | †1,518 |
| 12 " " '17 | 124,316 | *124,778 | †462 | 14,755 | †15,217 |
| 12 " " '16 | 122,614 | *109,113 | 13,501 | 13,286 | 215 |

EASTERN TEXAS ELECTRIC COMPANY, BEAUMONT, TEX.

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$85,477 | *\$44,114 | \$41,363 | \$12,303 | †\$29,060 |
| 1 " " '16 | 75,471 | *39,710 | 35,761 | 9,625 | 26,136 |
| 12 " " '17 | 938,074 | *516,993 | 421,081 | 137,120 | †283,961 |
| 12 " " '16 | 826,313 | *444,422 | 381,891 | 107,698 | 274,193 |

EL PASO (TEX.) ELECTRIC COMPANY

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$108,471 | *\$71,215 | \$37,256 | \$6,508 | \$30,748 |
| 1 " " '16 | 117,342 | *59,202 | 58,140 | 5,335 | 52,805 |
| 12 " " '17 | 1,283,525 | *801,771 | 481,754 | 67,007 | 414,747 |
| 12 " " '16 | 1,110,717 | *658,564 | 452,153 | 59,127 | 393,026 |

JACKSONVILLE (FLA.) TRACTION COMPANY

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$69,590 | *\$44,919 | \$24,671 | \$15,866 | \$8,805 |
| 1 " " '16 | 62,300 | *38,149 | 24,151 | 15,552 | 8,599 |
| 12 " " '17 | 698,123 | *469,712 | 228,411 | 188,896 | 39,515 |
| 12 " " '16 | 627,193 | *423,707 | 203,486 | 183,907 | 19,579 |

NORTHERN TEXAS ELECTRIC COMPANY, FORT WORTH, TEX.

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$294,207 | *\$141,871 | \$146,336 | \$28,950 | †\$126,969 |
| 1 " " '16 | 182,357 | *101,221 | 81,136 | 28,597 | 52,539 |
| 12 " " '17 | 2,582,113 | *1,445,663 | 1,136,450 | 348,744 | †816,455 |
| 12 " " '16 | 1,930,320 | *1,157,078 | 773,242 | 346,929 | 426,313 |

PADUCAH TRACTION & LIGHT COMPANY, PADUCAH, KY.

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$29,302 | *\$21,177 | \$8,125 | \$7,990 | \$135 |
| 1 " " '16 | 28,281 | *20,659 | 7,622 | 7,268 | 354 |
| 12 " " '17 | 304,682 | *232,079 | 72,603 | 90,200 | †17,597 |
| 12 " " '16 | 310,962 | *213,600 | 97,362 | 86,676 | 10,686 |

PENSACOLA (FLA.) ELECTRIC COMPANY

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$35,081 | *\$20,282 | \$14,799 | \$7,829 | \$6,970 |
| 1 " " '16 | 26,843 | *14,657 | 12,186 | 7,664 | 4,522 |
| 12 " " '17 | 350,458 | *203,680 | 146,778 | 93,668 | 53,110 |
| 12 " " '16 | 280,100 | *157,336 | 122,764 | 92,675 | 30,089 |

SAVANNAH (GA.) ELECTRIC COMPANY

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$92,611 | *\$58,317 | \$34,294 | \$24,832 | \$9,462 |
| 1 " " '16 | 80,096 | *49,649 | 30,447 | 23,986 | 6,461 |
| 12 " " '17 | 968,173 | *645,592 | 322,581 | 290,549 | 32,032 |
| 12 " " '16 | 826,093 | *553,695 | 272,398 | 282,756 | †10,358 |

TAMPA (FLA.) ELECTRIC COMPANY

| Period | Operating Revenue | Operating Expenses | Operating Income | Fixed Charges | Net Income |
|----------------|-------------------|--------------------|------------------|---------------|------------|
| 1m., Dec., '17 | \$87,952 | *\$50,019 | \$37,933 | \$5,085 | \$32,848 |
| 1 " " '16 | 91,444 | *45,504 | 45,940 | 4,368 | 41,572 |
| 12 " " '17 | 1,001,311 | *563,540 | 437,771 | 56,118 | 381,653 |
| 12 " " '16 | 967,086 | *527,719 | 439,367 | 52,414 | 386,953 |

*Includes taxes. †Deficit. ‡Includes non-operating income.

Traffic and Transportation

Flat Five-Cent Fare for Fort Wayne

Indiana Commission Sanctions Withdrawal of Reduced Rate Tickets During Period of War

The Fort Wayne & Northern Indiana Traction Company on March 4 was granted permission by the Public Service Commission of Indiana to charge a straight 5-cent fare and eliminate reduced-rate tickets during the period of the war. This change was noted briefly in the *ELECTRIC RAILWAY JOURNAL* of March 9, page 482.

The city opposed the petition for a straight 5-cent fare, and at a hearing given by the commission in Fort Wayne submitted argument to prove that the company was bound by its franchise contract. The commission found that the company made a franchise agreement under a general law of the State, and that under the recent Supreme Court decision in the Logansport telephone case the Public Service Commission had the power to change the terms of the contract. The Fort Wayne company surrendered its franchise and received an indeterminate permit from the commission last year.

COMMISSION HAS POWER TO CHANGE CONTRACT

The commission draws a distinction between the general law under which the Fort Wayne franchise contract was made and the specific law under which the Indianapolis Street Railway contract was made. In the former case, it is held, the Legislature did not surrender its power to regulate fares at any time, while in the latter case it did surrender its power for the period of the contract it authorizes.

At the hearing in Fort Wayne, over which Commissioner Edwards presided, eighty citizens filed a petition asking that the commission grant the company temporary relief.

The commission found the physical value of the company's property in the city \$1,800,000, not counting intangibles. It further found that the company had an operating deficit in 1915 of \$13,760; that the company's net earnings in 1916 were less than 1¼ per cent of the value of the physical property; and its net earnings in 1917 were about 1 1/3 per cent of the physical value of the property.

CHANGE EXPECTED TO INCREASE GROSS

The straight 5-cent fare may increase the gross earnings of the company \$75,000 a year, but the commission says that this will depend upon a normal increase in traffic. The commission believes the company will be fortunate if the straight 5-cent fare enables it to realize from 5 to 5½ per cent on the physical value of the property. The in-

crease in fares may reduce traffic somewhat so that the \$75,000 estimated increase in gross earnings will not be realized.

The commission found that high prices of material and labor, owing to the war, had resulted in financial difficulties for the company, and it further found that 3500 automobiles in Fort Wayne have cut off a great deal of patronage the company formerly enjoyed.

More Than 100 Fare Increases

Big Gain Since Jan. 1, 1917, in Number of Companies Securing Financial Relief

Since about Jan. 1, 1917, electric railways numbering 119 have secured permission from regulatory bodies to increase fares or have increased them where such consent was unnecessary. This total includes two companies which secured higher fares late in 1916, and also one Canadian company. The information has been compiled by the information bureau of the American Electric Railway Association.

According to similar data previously collected by this bureau and published in the *ELECTRIC RAILWAY JOURNAL* of July 7, 1917, sixty-seven electric railways in the United States and the Dominion of Canada had secured increases in fare from the beginning of 1914 up to June 1, 1917. This total included six Canadian companies. The latest data, therefore, show a big increase in favorable fare awards during the last half of 1917 and the early part of 1918.

CITY AND SUBURBAN INCREASES SEPARATED

The 119 increases in the recent period to date are divided so as to show fifty increases for urban lines and sixty-nine increases for interurban lines. Higher fares for the urban lines were granted in twenty-three states, Pennsylvania leading the list with ten increases. New York came next with nine increases. Vermont, Massachusetts and Washington each reported three increases. There were interurban increases in seventeen states, Pennsylvania ranking first with thirteen, New York second with eleven, and Massachusetts third with ten. Ohio had six increases, Illinois five increases, and California, Connecticut and Indiana each three increases.

The information bureau also reports that at the present time sixty-one cases for higher fares are pending. These cases cover twenty-one states. Most of them are in New York, which has a total of seventeen. There are six cases pending in Illinois and five each in Ohio, Pennsylvania and Indiana.

The earlier data compiled by the information bureau were secured from reports of fare increases made by commissions and through the technical press. The later data, however, were secured by means of a questionnaire sent to member companies of the American Electric Railway Association. This explains the overlapping of the periods covered by the data.

Fare Rehearing Put Off

Up-State Commission of New York Puts Over Until March 21 Rehearing in Peekskill Cases

The Public Service Commission for the Second District of New York on March 7 postponed for two weeks action in the petition filed by the village of Peekskill for a rehearing of applications of the Peekskill Lighting & Railroad Company and the Putnam & Westchester Company for permission to increase fares.

The hearing resulted in an agreement between R. F. Barrett, corporation counsel, and M. S. Decker, former Public Service Commissioner, representing the companies, to inspect the company's books as to the allocation of certain charges, and if Mr. Barrett discovers anything to notify the commission and the rehearing will be considered. Otherwise the village's application will probably be denied.

The commission declined to take up a request for a rehearing of the 5-cent fare provision in the franchises given the company because the Appellate Division has upheld the commission.

APPLICATION FOR REHEARING UNSUPPORTED

Mr. Barrett complained against the provision of the commission's order under which transfers were canceled. He said the railroads were now charging a 7-cent fare, with no transfer privilege, but Mr. Decker said four tickets were sold for 25 cents.

Mr. Decker objected to a rehearing, saying no facts had been presented in support of the application that in any way tended to throw doubt on the accuracy or propriety of the decision of the commission in both cases. He said that it had been shown that in the first six months in 1917 expenses exceeded receipts by about \$6,000, and that for the year the companies were \$12,175 behind in operating expenses. He said allocations had been made in accordance with the requirements of the commission. At the commission's suggestion Mr. Decker agreed to permit Mr. Barrett to inspect the books of the corporations.

It was stated that the Putnam & Westchester Traction Company had lost more than 6500 fares because of people walking to their homes or to the other line. It was asserted that the company suffered most under the transfer system.

The reasons for the request for the rehearing were reviewed in the *ELECTRIC RAILWAY JOURNAL* for March 2, page 436.

Beeler Washington Report Considered

A Consolidated System and Increased Rate of Fare Suggested by Washington Railway & Electric Company

On March 10 the Public Utilities Commission of the District of Columbia submitted to the Senate a report on the local railway situation in answer to a resolution asking for this information. The commission also transmitted the comments of the companies on the Beeler reports.

The commission says that changes recommended by Mr. Beeler to reduce congestion in the vicinity of Fifteenth Street and New York Avenue have been put into force and have greatly relieved the situation. A second recommendation, to reduce the number of stops approximately one-third and have an average spacing of stops within the closely built sections of the district 8 per mile, and in the suburban districts 6 per mile, has been approved by the commission. The necessary stop signs have been ordered by the railway companies and as soon as they are received and erected the order will be made effective, probably about April 1.

Hearings on the proposed changes for the W. B. & A. cars will be begun on March 18. Reports on suggested rearrangement of stops on the most congested section of the Washington Railway & Electric Company's system and staggered working hours for the government departments, will be made public soon. Later the commission may ask for legislation to help the situation.

LABOR TURNOVER LARGE

In its letter to the commission the Capital Traction Company attributed the shortage of its rolling stock during the past winter largely to the unprecedented number of cars damaged through the weather conditions in the month of January, but twenty new cars have been ordered and will be available not later than Oct. 1. The labor turnover has also been large. During January, for instance, the company engaged 164 men or nearly 25 per cent of the total in the service at the beginning of the month and lost by resignation or otherwise 131. During the month an average of eighty men were absent from work on account of sickness. The company expressed its appreciation of the value of the Beeler survey and said that it desired to cooperate with the commission in an effort to overcome existing difficult conditions.

The Washington Railway & Electric Company said that it had experienced no lack of cars, but had suffered from lack of men to maintain and operate them. It attributed the shortage of men to war demands and war prices for labor. Severe weather conditions and shortage of coal also prevented many employees from reporting for work by reason of sickness. The company says that a proper development of public utility facilities to meet the inevitable growth of the city is dependent upon two things: First, upon authorization by Congress of a com-

prehensive and reasonable plan of financing "which is now lacking," and second, upon the consolidation of the two principal electric railway systems operating in the district. To the above should be added a higher rate of fare.

On March 5 the Public Utilities Commission of the District of Columbia, Chairman Brownlow presiding and Commissioner Gardiner present, held a hearing to consider the skip stops suggested in John A. Beeler's report of Feb. 7, abstracted in the *ELECTRIC RAILWAY JOURNAL* for Feb. 16.

Only two men representing the public attended the hearing. A. T. Gage, who spoke for himself and a number of other residents west of Connecticut Avenue in the Chevy Chase district, thought that the distance between stops would be too great inasmuch as many people resided a block back of Connecticut Avenue.

GENERAL IMPROVEMENT LIKELY

Chairman Brownlow pointed out that even if some citizens in this outlying section did not save much time, the universal use of a skip-stop system would produce a general improvement in the frequency of service and decrease congestion.

Walter Jackson, business manager of the *ELECTRIC RAILWAY JOURNAL*, testified that stops in European cities were much longer than in America, and that intervals like 800 ft. or more were considered necessary for good street railway service.

MR. BEELER ON THE SKIP STOP

In reply to Mr. Gage, John A. Beeler, consulting engineer to the commission, said that the stops had not been fixed arbitrarily, but had been laid out with the view of serving the greatest number of people, as established by his traffic checks. The average of 890 ft. was not as high as it seemed because of a 1500-ft. viaduct and other local conditions, which if eliminated from the calculations would result in adding only 100 ft. to the average walk. The average number of stops for Washington as a whole had been worked out as eight to the mile, the number eliminated being about 33 per cent. He added that both companies had already ordered the same style of "Car Stop" sign. This is a 12-in. diameter disk with yellow background and embossed black lettering.

Dr. H. W. O. Millington, representing three civic associations of the Brookland and adjacent districts, spoke very highly of the effort to establish better service through the medium of skip stops. He suggested some minor modifications which would be more helpful than certain others in serving a greater number of people.

W. F. Ham, vice-president and general manager of the Washington Railway & Electric Company, and G. E. Hamilton, president of the Capital

Traction Company, also favored the Beeler skip-stop report and said they would be glad to consider individual changes.

After Commissioner Brownlow had stated that the matter would be taken under further advisement, the civic and railway representatives had an informal conference with Mr. Beeler for the adjustment of the few stops in dispute.

ORDER OF POSSIBLE NATIONAL BEARING

The absence of any serious objection to the skip-stop report is of particular interest, as the way the skip stop will work out in Washington may have considerable influence on the decision of Dr. Garfield to issue a nationwide order on the subject.

Joint Commission Action Likely

Request for Fare Increase by Kansas City Railways May Engage Attention of Two Commissions

An innovation in public service handling of electric railway matters when a street railway operates across state lines may be provided with reference to the affairs of the Kansas City Railways. The Public Service Commission of Missouri, considering the matter of fares at Kansas City, suggested that the joint meeting of the Missouri with the Kansas Commission would probably be arranged to hear the argument. The commissions would have to hold separate meetings for their decision, though the obvious advantages of a joint meeting to receive evidence and testimony are thoroughly appreciated.

This announcement of the Missouri commission was the result of the argument of city officials at Kansas City, Mo., against any interference by the Missouri commission with the 5-cent fare and universal transfers provided by the franchise of the Kansas City Railways in Kansas City, Mo. The franchise provides in a general way that 5-cent fares and universal transfers shall prevail on all the city lines of the Kansas City Railways, including the lines in Kansas City, Kan., and in adjacent small towns, which form a metropolitan district.

APPLICATION IN KANSAS SOON

Officials of Kansas City, Mo., maintain that the city has the only authority over fares and that if inter-city fares are to be considered, the matter would be one for the Interstate Commerce Commission.

The Kansas City Railways will soon file its application before the Utilities Commission of Kansas for increased compensation for its service. Its petition to the commission in Missouri asks only that its revenues be increased to meet increased expenses. The petition in Kansas must be more definite and the company will therefore state whether it desires more than a 5-cent fare or merely a charge for transfers.

Another meeting of the Missouri commission will be held probably in April, at which time the city will file its brief setting forth its claims to exclusive jurisdiction in the matter of rerouting, fares, etc.

Brooklyn Company Protests Objects to Public Service Commission Order Requiring Time-table Data in Cars

The Brooklyn Rapid Transit Company, through President T. S. Williams, has issued a statement protesting against the provisions of the order of the Public Service Commission of March 5 in which the company was directed to carry certain time-table data in its surface cars. This order was reviewed briefly in the *ELECTRIC RAILWAY JOURNAL* of March 9, page 481. The statement made by the company to the press follows:

"The company will co-operate with the commission in any effective way to procure sufficient and regular car service under existing conditions. The order proposed, however, like any attempt to prescribe in detail precise operations covering seventy-five different lines of surface cars and 541 miles of track, leads to complications, absurdities and impossibilities which would probably, if efforts were made to carry it out in detail, impair service as much as it would help it. All electric railway operation in a big city must be elastic in order to be effective. With fluctuations of travel so great as they are in this community, varying not only from day to day but from hour to hour, and by reason of weather conditions or other influences being subject to constant changes, car service cannot be bound by iron rules.

"This applies equally to all congested territories in Greater New York, and we assume that whatever general rule the commission thinks good for Brooklyn will be equally applied to other parts of the city.

"We have had no chance to point out to the commission some of the clearly objectionable features of its order, and as soon as the commission has considered these we assume it will hesitate to compel the enforcement of the order without material modification."

Cleveland Fare Threatened

The operating report of the Cleveland (Ohio) Railway shows that the interest fund reached the low point of \$170,260 in January because of a deficit of \$55,776 for the month. This indicates another increase in the rate of fare by April 1 or May 1.

On May 1 it will probably be necessary to make an increase in the wage scale of motormen and conductors and after that it is predicted that the income from the maximum rate of fare allowed in the Tayler grant under which the company operates will not be sufficient for operation at a profit. The maximum fare under the franchise is 4 cents cash and seven tickets for 25 cents.

Portland Court Case Closed

Argument Completed in Action Growing Out of Fare Increase in Which Life of Commission Is Threatened

The hearing in the case of the Portland Railway, Light & Power Company, Portland, Ore., versus the city of Portland, before a tribunal of six circuit judges of Multnomah County, in regard to the matter of increased fare in Portland granted by the Oregon Public Service Commission, came to a close on March 4. Decision of the six circuit judges who sat en banc throughout the case will be the next step. No definite date for announcement of this decision has been set. The case will probably be appealed to the Supreme Court, regardless of the decision handed down.

THE COMPANY'S SIDE

The case closed with arguments by three attorneys. Franklin T. Griffith, president of the company, spoke during the last session, arguing that the act creating the Public Service Commission vested in that body the power to regulate all rates, whether or not the rates were in existence before or after the commission came into being. Mr. Griffith further contended that the city's charter did not give the city the right to make the railway grant inviolable.

The hearing concluded with an appeal from Attorney General George M. Brown on behalf of the Public Service Commission. Without placing any particular emphasis on the justice or injustice of the increased rate, Attorney Brown defended the act of the commission. He maintained that the commission has the right to fix rates on all public utilities, and asserted that to find the act of the commission invalid would destroy its usefulness.

R. A. Leiter, for the company, contended that the commission had a right to alter the rates, because the franchise ordinance under which the 5-cent fare was established was never included in the commission government charter passed by the people at the special election in 1913. This occasioned surprise, as it had been generally believed that the commission government charter was voted by the people of Portland under either the initiative or referendum rights. Attorney Leiter pointed out that the commission government charter had been framed by a committee of nine men, but that the people had never petitioned for the passage of the charter, as is required under the initiative and referendum rights under the "Oregon System." Attorney Leiter conceded that the city had every right to regulate railways and other public utilities, but "not one jot or tittle of power with reference to the regulation of rates." He said that power was solely and exclusively vested in the Public Service Commission.

Attorney Martin L. Pipes, for the city of Portland, stated that because the referendum act which gave existence to the Public Service Commission was not retroactive in its scope, that body had no authority to readjust rates which

had been fixed before the commission came into existence. He contended that the commission's power lay only in the right to readjust rates which had previously been fixed by the utility itself. This right did not include the fixing of rates which had been established by a municipality. Mr. Pipes endeavored to show that the powers and rights delegated in both the city charter and the act creating the commission were parallel, and pointed out that it would be impossible to have such co-existing authority. He asserted that either the city charter or the Public Service Commission must bow to the other.

Wilson T. Hume, representing the city, asserted that a legislative enactment passed in 1901 definitely fixing fares at 5 cents and no more was on the statute books, and in full force and effect. In answer to the contention of the defense that the sovereign power lay with the lawmaking bodies, Mr. Hume argued that this power lay only with the people themselves.

City Attorney La Roche attacked the constitutionality of the referendum measure creating the commission. He discussed the history of the Malarkey bill creating the commission and pointed out that the people of Oregon, who are supposed to retain the sovereign power, have no method of holding a referendum on any act or order of the commission. He asserted that this was sufficient to invalidate any act or order increasing or regulating fares. He further contended that the franchise contract by which the company was permitted and directed to charge a 5-cent fare was an inviolable contract. His third important point was with reference to the retroactive feature involved in the legal controversy. His argument on this line was similar to that of Attorney Pipes.

New Jersey Fare Case Postponed

The State Board of Public Utility Commissioners of New Jersey on March 14 granted an adjournment of twelve days in the hearing on the application of the Public Service Railway for permission to charge a 7-cent fare and 2 cents for a transfer, with an additional cent for a transfer on a transfer. The board also directed the company to amend its petition to show that the proposed increase would be an emergency measure and not permanent.

Thomas N. McCarter, president of the company, said that new construction work which would cost \$6,600,000 was necessary to sustain the burdens placed on the corporation by the war and that the only way in which this expense could be met was by increasing fares. The corporation would welcome a rate inquiry and co-operate with it, but its needs were so urgent that Mr. McCarter thought the petition should be granted without waiting for the result of an inquiry.

St. Louis Fare Case Started

President McCulloch the Principal Witness for the Company—Another Hearing to Be Held on March 20

Hearings were begun on March 5 before the Public Service Commission of Missouri with respect to the application of the United Railways, St. Louis, for permission to increase its fares. Richard McCulloch, president of the company, occupied the stand as a witness for six hours. He reviewed various operations of the company, particularly those relating to finance. Many exhibits were introduced, among them a statement of the value of the properties of the United Railways as of Dec. 31, 1917. This statement, reproduced from unofficial sources, follows:

| | |
|----------------------------------|--------------|
| Estimates of physical property | |
| July 1, 1911..... | \$35,666,359 |
| Less property sold or scrapped | |
| before 1917 | \$34,412,505 |
| Plus 20 per cent increase in | |
| construction costs | 6,163,983 |
| Plus additions to 1917..... | 4,364,473 |
| | \$44,940,962 |
| Plus construction overheads— | |
| Engineering | 5 per cent |
| Legal expenses | 2 per cent |
| Contingencies | 10 per cent |
| Interest | 10 per cent |
| Taxes and insurance | 3 per cent |
| Constructor's profit..... | 10 per cent |
| | 17,976,385 |
| | \$62,917,347 |
| Plus superseded property..... | 2,740,000 |
| | \$65,657,347 |
| Plus organization and bond dis- | |
| count | 6,565,734 |
| | \$72,223,081 |
| Plus working assets, Dec. 31, | |
| 1917 | 3,053,280 |
| | \$75,276,371 |
| Securities held in treasury..... | 1,155,000 |
| Grand total..... | \$76,431,371 |

ZONE SYSTEM FAIREST

Mr. McCulloch was of the opinion that a zone system of fares would be the fairest way of increasing revenues, but that it might be difficult to put such a system into effect successfully in St. Louis because of the delay the plan would be likely to cause in traffic during the rush hours. He thought that the zone system would tend to repopulate the so-called "deserted" districts and prevent unwise spreading of the city's area, but that it would not result in forcing congestion.

Mr. McCulloch estimated the total operating expenses of the company for 1918 at \$11,153,177, an increase of \$2,674,188 over the costs of 1917. He said that the labor costs would be increased this year 35.6 per cent, and the cost for materials more than 15 per cent. An outlay of \$3,074,152 would be required for transportation alone. He estimated the total income of the company for 1918 at \$12,569,035. After paying \$11,153,177 as before related for operating expenses \$1,415,858 would be left for depreciation and fixed charges. After allowing 10 per cent depreciation and a mill tax reserve of 2 per cent a deficit of \$92,426 would result. Adding the \$2,523,230 necessary for fixed charges the company would face a total deficit of \$2,615,656.

Mr. McCulloch said that since 1910,

when dividends were suspended, the company had spent \$13,199,714 in maintenance and \$6,779,784 in replacements, and that \$901,931 represented property retired from use. New construction paid for out of earnings cost \$1,988,907. The sum of \$2,463,000 had been expended in retiring bonds.

ANOTHER HEARING MARCH 20

Chairman Busby of the commission announced that the commission would proceed with deliberation in the case, paying no attention to insinuations of possible strikes. He fixed March 20 as the day of the next hearing, and Counsellor Daues of the city, after consultation with C. E. Smith, the city's railway expert, announced that the city would be ready at that time to cross-examine Mr. McCulloch.

The Board of Public Service has retained James E. Allison of James E. Allison & Company, St. Louis, consulting engineers, to serve as technical advisor of the city in its opposition to the application of the railway before the commission for permission to increase fares.

Talk on Collecting Fares

General Superintendent of Columbus Company Addresses Men on Matter Affecting Them and the Company

The Columbus Railway, Power & Light Company, Columbus, Ohio, issued under date of Feb. 15, over the signature of Harold W. Clapp, general superintendent, an eight-page booklet entitled "Collecting Fares." In it the company said frankly that it does not receive fares for all rides, used an example to show what large proportions the non-collection of fares might assume, and urged all conductors to "get all the fares." It followed this with the rules for collecting fares with the aid of fare boxes. In its introduction the company said:

MEN AND MANAGEMENT MUST WORK TOGETHER

"Whatever success this company may enjoy is just as important to conductors and motormen as it is to the management. If that success is dependent upon the amount of revenue received and there is a leak anywhere tending to lessen revenue, it is most certainly of vital importance to conductors and motormen for that leak to be stopped.

"Co-operation between men and management in stopping the leak cannot be had unless we all understand each other thoroughly. In reaching that understanding perfect frankness must prevail in the discussion of problems of mutual interest.

"In talking about the collection of fares we have one unpleasant truth to face, but why turn our backs on a big problem because it is disagreeable in some ways? Why fool ourselves by

any such action? Why not talk it over as man to man? That is the true spirit of co-operation, so let us be frank about it."

Emergency Fare Bill in New York

Railways to Seek by Legislative Enactment a Six-Cent Fare for Period of War

Theodore P. Shonts, president of the Interborough Rapid Transit Company, Col. T. S. Williams, president of the Brooklyn Rapid Transit Company, and officers of other electric railways, at a hearing before Governor Whitman on March 14, submitted for his approval a proposed bill which will be introduced in the Legislature, fixing a 6-cent fare on the electric railways throughout the State, beginning April 1 and continuing in effect until six months after the war.

The bill would give to the Public Service Commission the power of review of such new fares after they were fixed. Governor Whitman is reported to have told the railway men that the bill as it was presented appeared to oust the Public Service Commissioners from their power to fix fares. He suggested an amendment to the bill permitting the increase in fares with the approval of the Public Service Commissions. The bill declares 6 cents "a just and reasonable rate of fare."

Others at the hearing in addition to Messrs. Shonts and Williams representing the railways included S. W. Huff, president of the Third Avenue Railway; L. S. Storrs, president of the New York & Stamford Railway; James F. Hamilton, vice-president of the New York State Railways; W. O. Wood, president of the New York & Queens County Railway, and Horace E. Andrews, president of the New York State Railways.

Answer in Binghamton Fare Case

The Binghamton (N. Y.) Railway has filed with the Public Service Commission of the Second District its answer to the complaint of residents of Binghamton and Johnson City against the proposed stopping of sale of ticket books between Binghamton and Endicott and between Johnson City and Endicott.

The operation of the company's new tariff has been suspended until April 30. The company alleges that the rate under the dollar book, used between Binghamton and Endicott, is less than half a cent a mile and that the cost to the company is considerably more than the return on both the dollar book and the 60-cent book, used between Johnson City and Endicott. It is alleged that the ticket-book business is entirely one way and it is necessary to operate extra cars to maintain the service.

The rates in force were established about thirteen years ago when Endicott was "a mere hamlet" to aid its industrial development. At that time the cost of operation was much less than now. The answer cites the service given between the places by the Erie

Railroad and it is claimed these trains carry from 850 to 1000 passengers. The case was referred to in the *ELECTRIC RAILWAY JOURNAL* of March 9, page 482.

Kansas City Traffic Changes

Engineer of Commission to Assist City in Working Out Operating Details

The Public Service Commission of Missouri at a meeting in Kansas City on Feb. 28 took up many matters of operation of the Kansas City Railways and instructed its engineer, A. L. Harrup, to return to Kansas City to assist in working out new details. With respect to nearly every subject there were objections from city officials that they were matters properly to be handled by the city. In nearly every instance, however, the commission intimated that it could take care of such matters.

The company's request for permission to install a skip-stop system of approximately eight stops to a mile met with favor before the commission. The company was asked to go ahead with its plans for skip-stop operation on one line at a time. Cars will probably stop on all lines at odd numbered streets going out and at those with even numbers coming in.

The company's request as to rerouting cars was not taken up in detail. The commission expressed itself as favorable to shorter loops and turn-backs—an important element of economy in operation being worked out by the company especially on certain long lines on which traffic at the other third is comparatively light.

"We Walk!" the Cry

A walkers' club has been started at Harrisburg, Pa. Every member pledges himself or herself to walk to and from work, if the distance is less than 2 miles. This pledge is to be kept in all sorts of weather. The movement is another manifestation of the queer turn which the thrift idea has received. The appeal on which the campaign is based is stated as follows:

"In these days when the people generally are being urged to conserve all natural resources, it is our opinion that by walking instead of riding on the electric railway cars we will not only save time for ourselves and others and much of the coal necessary for the production of electricity needed to operate cars, but we will put ourselves in good shape physically—thus obviating the necessity of burning so much coal to keep our houses warm; and we will be effecting a saving in actual money which will not only enable us better to meet the high cost of living, but purchase additional Liberty Bonds and Thrift Stamps, as well as make contributions to worthy causes."

"Running a street railway nowadays is like setting a hen on china eggs—nothing in it."—*The Buzzer* of the British Columbia Electric Railway.

Commission Ordered Not to Change Fares Rhode Island Legislature So Directs and Creates Special Legislative Committee to Report by March 26

The Legislature of Rhode Island has prevented the Public Utilities Commission from carrying into effect the new fare rates established as just and equitable for the Rhode Island Company by a special commission created a year ago for that particular purpose. That commission ordered the adoption of a system with 5-cent central areas and recommended taxation and franchise reforms. Its findings were reviewed briefly in the *ELECTRIC RAILWAY JOURNAL* for March 9, page 480.

Two measures have been passed. One of these orders the Public Utilities Commission not to make any change in the rate of fare charged by the Rhode Island Company. The other created a special legislative committee of seven members to make a report before March 26 on the electric railway situation.

MEASURES ORIGINATE IN HOUSE

Both measures originated in the House the day after the report of the special commission was presented and a day after the Public Utilities Commission had, in accordance with the law passed a year ago, ordered the Rhode Island Company to put into force before April 1 the new rates set forth in the report.

The House provided for a special committee of five, two Senators and three Representatives, to consider the report of the investigating commission, but in the Senate the membership was increased to three Senators and four Representatives, one of each to be a Democrat.

Representative Jennings of Cranston, Republican majority leader of the House, declared in his speeches that the report was "absolutely unjust" and should never be allowed to go into force. He was supported by many of the House members. In the Senate both of the measures were unanimously passed, not one voice being raised in defense of the report.

The trustees of the Rhode Island Company, who are in control of the railway property under the decree of the Federal Court for the dissolution of the New Haven Railroad, have sent to each member of the Legislature the following statement:

TRUSTEES HAD CONFIDENCE IN REPORT

"The Chairman of the Board of Tax Commissioners, the chairman of the Public Utilities Commission, and the Banking Commissioner, constituting the special commission to investigate the affairs of the company, have now made a report, which has put into effect a system of fares worked out by the commission itself and its advisors as to the adequacy of which to meet the needs of the company the trustees can now form no positive judgment. They have, however, confidence in the commission and in the report of the commission's experts, upon which the action of the

commission is largely based, all of whom believe that, if the relief from excessive taxation which the commission recommends is granted by the Legislature, the new rates of fare will probably enable the company to continue in operation, and the trustees are willing to try the experiment.

COMPANY CANNOT CONTINUE

"In view of the action now proposed nullifying the results of the investigation by the official commission, the trustees of the Rhode Island Company feel it their duty to say that it is certain that the company cannot continue to operate until the next session of the Legislature of the State, unless action is taken by the Public Utilities Commission or by the Legislature which will result in a substantial increase of revenue.

"Obviously this increased revenue must come, if at all, from the riding public of the cities and towns in which the company operates. If the representatives in the General Assembly of the various cities and towns take the position that, whatever happens, their constituents must not be made to bear any part of the burden, the attempt to obtain increased revenue for the company must fail.

SYSTEM MAY FALL APART

"What will then happen. It is impossible with certainty to foresee, but it is not improbable that the traction system will fall apart into the separate companies which at the present time lease their properties to the Rhode Island Company."

Advocates Fare Change

Labor at London, Ont., Favors Fare Increases for London Street Railway

The Trades and Labor Council at London, Ont., on March 6 unanimously adopted a resolution advocating the granting of the appeal of the London (Ont.) Street Railway for higher fares on the ground that the best interests of the men in the employ of the company would thereby be served.

The labor men held the view that the company was not in a position to grant wage increases, as war-time conditions had imposed extreme financial burdens upon it. They therefore advocated favorable action by the Council on the fare application and requested that the Trades and Labor Council be granted representation upon the committee of the Council which it is proposed to name to inquire into the company's financial condition. The railway is bound by a fare agreement made in 1895. This year the company passed its dividend.

The company has for some time carried on an effective publicity campaign under the direction of Glenn Marston, New York.

Transportation News Notes

Fare Schedule Protested.—A complaint has been filed by the city of Coatesville, Pa., against the new schedule of fares filed by the West Chester Railway. It is claimed the increase will be a violation of the franchise.

Reduced Rate Tickets Withdrawn.—The Hot Springs (Ark.) Street Railway has discontinued the sale of six tickets for 25 cents and books of twenty-five tickets for \$1, in effect for several years, and is now charging a straight 5-cent cash fare.

Skip Stop in Oakland.—Several City Councils have passed skip-stop measures which will permit cars of the San Francisco-Oakland Terminal Railways (Key Route) to cut down stops outside the congested districts. The plan has not yet been put into effect.

Fare Increase Notices Filed.—Notices of increases in fares have been filed with the Public Service Commission of Pennsylvania, by the Bangor & Portland Traction Company, Bangor, Pa., and the Chambersburg, Greencastle & Waynesboro Street Railway, Waynesboro, Pa.

Lend-a-Hand Appeal in Harrisburg.—Cards asking the traveling public to co-operate with the Harrisburg (Pa.) Railways are being placed in all cars of the company. One of these reads: "Other persons say Harrisburg has better street car service than most cities of its size. Help us to make it still better."

More Men Secured in Kansas City.—The increase in the number of trainmen secured by the Kansas City (Mo.) Railways through advertising and other means has made it unnecessary to employ women on the trains. Several women who had been put in training to run cars are now employed in the general offices. They will be put on the cars only if an emergency arises.

Skip Stops in Indianapolis.—The Indianapolis Traction & Terminal Company, Indianapolis, Ind., will try out the skip-stop plan on the East Washington and North Illinois Street lines beginning March 17. The company has painted signs on telephone poles indicating where cars will stop under the new plan. On at least one of the lines the stops will be staggered.

Proposed Portland Tariff Suspended.—The Public Utilities Commission of Maine has suspended until June 7 the revised rates for the railway lines of the Cumberland County Power & Light Company, Portland, Me., included in the system of the Portland Railroad. The new rates were filed to become effective March 11. This suspension is to allow protestants to examine the company's evidence and perhaps to employ experts.

New Albany Fare Hearing on March 20.—The city of New Albany, Ind., has filed with the Public Service Commission of Indiana its answer to the petition of the Louisville & Southern Indiana Traction Company for permission to put into effect a new schedule of passenger rates and to discontinue the service on the Elkin Avenue line. The hearing on the petition will be held in New Albany on March 20.

Fare Increase Asked in Durham.—R. L. Lindsey, vice-president and general manager of the Durham (N. C.) Traction Company, has asked the Board of Aldermen of Durham for permission to increase the fare from 5 cents to 6 cents. The request has been referred to a special committee. It has been suggested that if statistical information is desired the books of the company will be open for the inspection of the city officials at any time.

Seven-Cent Unit On Pennsylvania Roads.—The Lykens Valley Railway, Williamstown, Pa., has filed a schedule of new rates effective on April 1, with the Public Service Commission of Pennsylvania. The rate per zone is increased from 6 cents to 7 cents. The fare from Lykens to Williamstown will be 14 cents; to Sheridan, 21 cents; to Tower City and Reinerton, 28 cents. Rates for chartered cars and cars making special runs are to be increased about 20 per cent.

Transfer Changes Suggested.—H. F. Dicke, general manager of the Utah Light & Traction Company, Salt Lake City, Utah, has presented to the Public Utilities Commission of Utah a proposal for a change in the rules regarding the issuance of transfers. In the proposed new forms the name of the line issuing the transfer would be printed, and the conductor would punch the transfer for the direction indicated by the passenger. The transfers would be good only at the junction of the two lines used.

Citizen Pleads for Company.—W. H. Fern, Scranton, Pa., has filed an unusual complaint with the Public Service Commission of Pennsylvania protesting against the complainants who are opposing the increase in fare by the Scranton Railway from 5 cents to 6 cents. Mr. Fern states he is a private individual with no interest in the company, but that he realizes the difficulties a corporation must have to meet because of war conditions. He thinks the increase will not hurt anyone and will be an aid to the company in giving good service.

Skip Stop for Dallas.—The skip-stop system is to be tried out by the Dallas (Tex.) Railway. The plan will be put in operation at once on the Ervay line and on several other lines in the downtown district. On the Ervay line the plan will cover the entire route. Careful check will be kept on the time of operation, and definite figures will thus be made available showing just how much time can be saved. If the plan proves successful on this line, which is one of the longest and most generally patronized of any in the city, it will

be extended to other lines. The staggered system will be used.

Further Discussion of Uniform Operating Rules.—At a hearing on Feb. 26 before the Connecticut Public Utility Commission, the uniform system of operating rules for all the electric railways in Connecticut was discussed. The matter of uniform rules has been under consideration for some time. An all-day conference was held with the commission at Hartford, on Oct. 25, as noted in the *ELECTRIC RAILWAY JOURNAL* for Nov. 3, page 840, and it was decided at the time that representatives of all the companies receive a copy of the rules and regulations of the commission and report back to the commission in regard to changes proposed by them.

Increase in Fare on Kansas Line.—The Public Utilities Commission of Kansas has authorized the Joplin & Pittsburg Railway, Pittsburg, Kan., to raise the fares on its Kansas lines to 2 cents a mile. The company asked an increase to 2½ cents a mile. The commission declined to allow any freight rate increase. It is estimated that the increased passenger rate, when put into effect by the company, will result in a considerable increase in the annual receipts. The increase represents an advance, on an average, of one-fourth to one-half cent a mile. The application of the company for a rate increase in Missouri has not been acted upon by the Public Utilities Commission of that State.

Passenger-May-Elect Decision Protest.—The Indiana Union Traction Company, Indianapolis, Ind., has filed with the Public Service Commission a petition for a rehearing in the case in which the commission granted persons traveling between Indianapolis and Carmel permission to pay 24 cents or 30 cents fare at their own option. In its petition the company states that the law provides that only one set fare may be charged between two points and that the commission had not power to permit the charging of two different rates. The decision of the commission in this case was reviewed briefly in the item, "Passenger May Elect," in the *ELECTRIC RAILWAY JOURNAL* of March 9, page 481.

Donation Bus Bill Vetoed.—Mayor Hiram C. Gill, Seattle, Wash., has vetoed the so-called free or donation jitney bus ordinance, passed recently by the City Council by a vote of seven to one. Under the terms of the measure the city defined a free or donation bus as "any motor-propelled vehicle engaged in the business of carrying passengers without compensation or charge therefor, provided, however, that any voluntary donation or contribution by any person so carried shall not be construed as compensation for such carriage." The bill carried an emergency, requiring the votes of seven members of the Council and the approval of the Mayor. The disapproval of the Mayor nullifies the bill, placing it in the same position as a bill vetoed by the Mayor and the veto upheld by the Council.

Personal Mention

E. T. Smith has been appointed master mechanic of the Tampa (Fla.) Electric Company to succeed George Hudson.

F. E. Fletcher has recently been appointed purchasing agent of the Tampa (Fla.) Electric Company to succeed C. A. Leonard.

J. C. Freelund has been elected secretary and treasurer of the Washington (D. C.) Utilities Company, to succeed W. W. Spaid.

F. J. Gwynn has recently been appointed assistant treasurer of the Tampa (Fla.) Electric Company to succeed E. J. Seaborn.

J. W. Gould has recently been appointed master mechanic of the Wilmington & Philadelphia Traction Company, Wilmington, Del., to succeed W. O. Demoss.

Emmet McClung has recently been appointed engineer of overhead construction of the St. Petersburg & Gulf Railway, St. Petersburg, Fla., to succeed C. N. James.

R. M. Marlowe has recently been appointed claim agent of the Connecticut Company at Hartford, Conn., to succeed John A. Crilly, who has been made special adjuster for Hartford.

A. T. Throop has recently been appointed superintendent of the light and power department of the Wilmington & Philadelphia Traction Company, Wilmington, Del., to succeed C. M. Cooper.

Norman Grey, president of the Washington (D. C.) Utilities Company, has been elected president of the Washington-Virginia Railway, Washington, D. C., to succeed Frederick H. Treat, deceased.

Chester Smith, for two years assistant to the president at the Kansas City (Mo.) Railways, has resigned. He is now in service in the transportation department of the government in Washington.

Thomas E. McCarthy, for the last four years chief clerk to the chief engineer of the Montreal (Que.) Tramways, has been commissioned lieutenant United States Reserves, stationed at Camp Sherman, Chillicothe, Ohio.

O. J. Richmond, formerly chief engineer of the power station of the Danbury & Bethel Street Railway, Danbury, Conn., has been appointed superintendent of power for the United Illuminating Company, Bridgeport, Conn.

C. F. Hayden has been appointed traffic agent of the Washington-Virginia Railway, Washington, D. C., to succeed C. L. Evans, who resigned from the company to take charge of his souvenir and lunch room business at Mount Vernon, Va.

Harry Reid, Louisville, Ky., has been elected president of the Interstate Public Service Company, Indianapolis,

Ind., to succeed Chester P. Wilson. The Interstate Public Service Company is a subsidiary of the Middle West Utilities Company.

Norman Litchfield has resigned as engineer of car equipment of the Interborough Rapid Transit Company and New York Railways, New York City, to become mechanical engineer of the American Car & Foundry Company, with headquarters in the same city. In his new position he will be associated with A. E. Ostrander, recently appointed general mechanical engineer of the last-named company. Mr. Litchfield was graduated from the Stevens



NORMAN LITCHFIELD

Institute of Technology in 1901 with the degree of mechanical engineer. He served his apprenticeship in electric railroading in the shops of the Brooklyn Rapid Transit Company. Later he was employed under L. B. Stillwell in the preparation of plans for the equipment of the New York subways and in the supervision of the experimental cars. When operation of the subway began, Mr. Litchfield joined the engineering staff of the Interborough Rapid Transit Company, with which he has since been continuously connected. He has been actively interested in the work of the American Electric Railway Engineering Association, and served as its secretary for a number of years. He was also a member of the executive and the standards committees of the association. He has contributed a number of articles on technical subjects to the *ELECTRIC RAILWAY JOURNAL*, and is now engaged on a series on the fundamentals of car-body and truck construction, one of which appears elsewhere in this issue.

S. T. Dow has been appointed acting general manager of the Atlantic Shore Railway, Sanford, Me., to succeed L. H. McCray, who has resigned to enter government service. Mr. Dow has long been connected with the company as assistant treasurer.

H. J. Cosgrove has been appointed master mechanic of the Rock Island Southern Railway, with headquarters at Rock Island, Ill. Mr. Cosgrove was formerly with the Great Northern Railway at St. Paul, Minn. He has served for twenty-five years with the railroads in the West and the South.

Lloyd Harris, secretary-treasurer of the Lake Erie & Northern Railway, Galt, Ont., has been appointed chairman of the Canadian War Mission to the United States, with offices in Washington, D. C. Mr. Harris has been associated with the British War Mission in Washington on behalf of the Canadian government for several months.

Lord Beaverbrook, a director of the British Columbia Electric Railway, Vancouver, B. C., has been appointed Chancellor of the Duchy of Lancaster, under the British government, and is undertaking general propaganda work relating to the allied nations' position regarding the war. In accordance with the general custom, he will have to resign from the railway.

H. G. Lawrence has resigned as superintendent of the railway lines of the Wisconsin-Minnesota Light & Power Company, Eau Claire, Wis., effective on April 1. Mr. Lawrence has acquired an interest in the newly organized Clemons Auto Supply Company, Eau Claire, dealers in automobile supplies and accessories, and will devote his full time to that business after April 1. Mr. Lawrence went to Eau Claire from Winona twenty-three years ago and started in electric railway work as a motorman. He was successively made conductor, carhouse foreman, assistant superintendent and superintendent, serving in the latter capacity for the last seventeen years.

L. H. McCray, for the last eight years general manager of the Atlantic Shore Railway, Sanford, Me., has resigned to accept a position with the Emergency Fleet Corporation, Boston. Mr. McCray's early railway experience was acquired in the Central West. He was assistant to the master of transportation of the Winnebago Traction Company of Wisconsin from 1904 to 1907, which position he resigned to become superintendent of the Sterling, Dixon & Eastern Electric Railway, Dixon, Ill. In 1908 he was appointed assistant general manager of the Atlantic Shore Railway, and was made manager in 1910. Shortly before Mr. McCray's departure from Kennebunk the employees of the Atlantic Shore Railway presented him with a watch and chain, as a token of their esteem.

R. H. Parsons, formerly general foreman of electrical repairs of the mechanical department of the Third Avenue Railway, New York, N. Y., has been made general foreman of the Sixty-fifth Street shop, in place of G. R. Jenkins, who has been assigned to other duties. Mr. Parsons was born in Syracuse, N. Y. He received his early training with the New York Central Railroad, advancing to a position of engine house foreman with that company. He

became connected with the electrical department of the New York Central Railroad when that road electrified its New York City terminal and in 1907 entered the employ of the Interborough Rapid Transit Company, from which company he resigned in May, 1908, to become connected with the Third Avenue Railway. In 1909 he was appointed to the position from which he is now advanced. Mr. Parsons has been a frequent contributor to the **ELECTRIC RAILWAY JOURNAL**.

C. A. Babcock, comptroller of the Rhode Island Company, Providence, R. I., recently completed forty years of service with the company. Associates of Mr. Babcock in the company arranged a dinner in celebration of the event which was attended by the following officers of the company: A. E. Potter, president; R. R. Anderson, superintendent of transportation; A. E. Paddock, general freight agent; Clifford Whipple, general counsel; G. Frederick Frost, attorney; H. B. Shafte, assistant to the comptroller; W. C. Slade, superintendent of power and lines; and H. W. Sanborn, chief engineer. Mr. Babcock entered railway work in Providence on Feb. 28, 1878, as clerk in the office of the Union Railroad. At that time the entire force consisted of 282 employees and officers. At present the force numbers nearly 3400. By the time the company moved its quarters to the Union Trust Building, Mr. Babcock had been promoted until he was treasurer of the company. As other companies were taken over from time to time he was elected treasurer and secretary of each. When the Rhode Island Company was formed in 1902 Mr. Babcock was made assistant treasurer and remained in that position until 1908, when he was placed in charge of the comptroller's office. As comptroller, Mr. Babcock has under his direction the following offices: auditor of disbursements, auditor of passenger receipts, auditor of freight receipts, receiving department, general accounting department, treasurer's office, paymaster's office. Since entering the employ of the company he has served under seven presidents.

Obituary

John M. Bowers, chosen by President Wilson to act on the Legal Advisory Board in connection with the draft in New York City, died on March 7 in Lakewood, N. J., where he had gone to recuperate from strain due to his war work. Mr. Bowers was in his sixty-ninth year. He had been a member of the New York Bar for nearly fifty years. Mr. Bowers' career was closely bound up with corporation law cases in New York. As counsel for the reorganization committee of the Third Avenue Railway, New York, N. Y., in 1912, Mr. Bowers had much to do with the rehabilitation of the property.

Construction News

Construction News Notes are classified under each heading alphabetically by States. An asterisk (*) indicates a project not previously reported.

Recent Incorporation

***Chickasaw Utilities Company, Birmingham, Ala.**—Incorporated as a subsidiary of the Tennessee Coal, Iron & Railroad Company to construct and operate an electric railway to the new Chickasaw shipbuilding plant. Officers: George G. Crawford, president; H. C. Ryding, vice-president, and L. T. Beecher, secretary and treasurer.

Franchises

New Albany, Ind.—The Louisville & Southern Indiana Traction Company has asked the Public Service Commission of Indiana for permission to abandon its Ekin Avenue line from Vincennes Street westward to East Fourth and Spring Streets and also certain track in the city of Jeffersonville.

Baltimore, Md.—An ordinance has been passed by the City Council of Baltimore and approved by the Mayor authorizing the Washington, Baltimore & Annapolis Electric Railway to construct additional connecting tracks required for the operation of an extension to its freight terminal facilities in the city.

Kansas City, Mo.—The Kansas City Railways has received a franchise from the City Council of Kansas City for the construction of a double-track extension on Twenty-seventh Street from Prospect Avenue to Main Street.

Tulsa, Okla.—The Oklahoma Union Railway has received a franchise from the City Council to construct a new line in Tulsa. It is proposed to construct a line to Guthrie via Coffeyville.

Fort Worth, Tex.—The Northern Texas Traction Company has asked the City Council for permission to construct new tracks on First Street from Houston Street to Throckmorton Street and to build a curve joining the Throckmorton Street line with the Weatherford Street line in order to relieve the congestion on Houston Street.

Seattle, Wash.—The Puget Sound Traction, Light & Power Company has petitioned the City Council of Seattle for a franchise to operate an electric railway from the intersection of West Spokane Street and Avalon Way, along Avalon Way and Thirty-sixth Avenue Southwest to the intersection of the latter street and West Snoqualmie Street. With the request the company submitted a proposed franchise ordinance, which provides for the completion of

the line within twelve months of the granting of the franchise. The proposed line will materially shorten the distance to the end of the Fauntleroy Park line, and eliminate long delays now occasioned by a single-track section of that line that will be abandoned by operation over the Avalon Way route, and will open up a large residential district within a short distance of the shipbuilding and other industrial plants in the Harbor Island and Riverside districts.

Track and Roadway

Alabama Interurban Corporation, Birmingham, Ala.—It is reported that the contract for the construction of the proposed line of the Alabama Interurban Corporation from Birmingham to the Warrior River, about 20 miles, has been awarded to A. T. Newell & Brothers. Thomas L. Cannon, Birmingham, president. [Feb. 23, '18.]

Pacific Electric Railway, Los Angeles, Cal.—A survey has been made by the Pacific Electric Railway for an extension from Redlands to Yucaipa City.

San Francisco-Oakland Terminal Railways, Oakland, Cal.—W. R. Alberger, general manager of the San Francisco-Oakland Terminal Railways, recently informed the City Council of Oakland that the board of directors of the company would consider the proposition of a railway line on Adeline Street from First to Sixteenth Streets.

Municipal Railway, San Francisco, Cal.—The Board of Public Works of San Francisco has awarded a contract to Eaton & Smith, San Francisco, for the construction of the "D" line extension of the Municipal Railway on Greenwich Street between Scott and Baker Streets, at \$28,600.

New Orleans Railway & Light Company, New Orleans, La.—An offer to put up money to help defray the expenses of laying tracks and other costs has been made to the New Orleans Railway & Light Company by Paul H. Maloney, representing property holders and residents of that section of the city bounded by Napoleon Avenue, Louisiana Avenue, Rampart and Magnolia Streets. Mr. Mahoney asked that Franklin and Howard Streets be used for the extension. It is proposed that the cars go up one of these streets and down the other.

Washington, Baltimore & Annapolis Electric Railroad, Baltimore, Md.—In order to protect the heavy traffic between Baltimore and Washington and to Camp Meade, near Admiral, the Washington, Baltimore & Annapolis Electric Railroad has contracted with the Union Switch & Signal Company, Swissvale,

Pa., for the material and installation of automatic block signals on its main line from Scott Street, Baltimore, where private right-of-way is entered, to Naval Academy Junction, where trains branch off for Camp Meade.

St. Louis & Illinois Railway, St. Louis, Mo.—The St. Louis & Illinois Railway, through its attorneys, Bishop & Cobbs, has notified Director of Public Utilities Hooke that it will accept the terms of a permit to operate street cars on the free bridge at St. Louis, give a bond of \$25,000 to extend its lines on the East Side and to use the municipal loop in St. Louis when it is completed.

Southwest Missouri Electric Railway, Webb City, Mo.—Operation has been begun by the Southwest Missouri Electric Railway on its extension from Galena to Baxter Springs. Work is now under way on the line from Baxter Springs to Picher.

International Railway, Buffalo, N. Y.—Within the next few months the International Railway plans to spend approximately \$2,000,000 for repairs and improvements to its surface lines in the city of Buffalo. Of this amount, the largest items include the cost of laying new track in a number of east side streets and for repaving the streets between the rails. The company is also trying to secure some new equipment.

New York & Queens County Railway, New York, N. Y.—Application has been made by the New York & Queens County Railway to Borough President Connolly for permission to operate a single-track extension over a loop beginning at Kingsland Avenue, Corona, and extending through Alburts Avenue to the terminal of the elevated route, thence along Roosevelt Avenue to Grand Avenue and through Grand Avenue back to Kingsland Avenue, where the cars of the Corona trolley line are now operated. Should this arrangement be granted, it is the intention of the company to operate College Point, Flushing and Jamaica cars to the Corona elevated terminal instead of taking them to the Fifty-ninth Street side of the Queensboro Bridge, as is now the case with the Flushing and College Point cars. The Jamaica cars now stop at Flushing Bridge.

Mahoning & Shenango Railway & Light Company, Youngstown, Ohio.—Plans are being considered by the Mahoning & Shenango Railway & Light Company for the reconstruction of its line between Sharon and the Wheatland Borough limits, at a cost of about \$150,000.

***Collinsville, Okla.**—It is reported that D. H. Siggins, Coffeyville, Kan., is interested in the construction of an electric railway from Collinsville to Nowata, Coffeyville and other points.

Oklahoma Union Railway, Tulsa, Okla.—A report from the Oklahoma Union Railway states that it plans to construct 2 miles of double track.

Bridgeburg, Ont.—The decision of the Ontario government on March 5 to vote \$3,000,000 for Niagara system exten-

sions is believed to indicate that the trolley line from Welland to Port Colborne to Bridgeburg will be started in a few months. This line was contracted for by the Ontario Hydro-Radial Commission, through Sir Adam Beck, two years ago when he made agreements with the municipalities en route to construct the line as soon as the necessary funds could be obtained, the Ontario government to undertake the expense and the municipalities benefiting thereby to bond themselves for the share of each involved.

Johnstown (Pa.) Traction Company.—Operation of street cars over the new Walnut Street bridge will be begun about April 1. The concrete work on the big structure is being finished rapidly and the Johnstown Traction Company will begin track work in a week or two.

Reading Transit & Light Company, Reading, Pa.—Preparations are being made by the Reading Transit & Light Company for the reconstruction of its tracks on Lehman Street, Lebanon.

Three Rivers (Que.) Traction Company.—This company contemplates a 2-mile extension of its line toward the western limits of the city.

San Angelo Water, Light & Power Company, San Angelo, Tex.—A communication from the San Angelo Water, Light & Power Company, which recently purchased the property of the San Angelo Power & Street Railway Company, states that it will not extend and place the system in operation until conditions are more nearly normal. The company expects to begin operation of the line as soon as material and rolling stock can be purchased to advantage.

Virginia Railway & Power Company, Richmond, Va.—The Virginia Railway & Power Company has been authorized to change the gage of the tracks on its Atlantic Terminal line from Twenty-third Street to Ninety-ninth Street.

Wheeling (W. Va.) Traction Company.—The Wheeling Traction Company has taken over the Wellsburg, Weirton & Steubenville Traction Company's line under lease and extensive improvements will be made to the road.

Shops and Buildings

Northern Electric Railway, Chico, Cal.—It is reported that the Northern Electric Railway will soon begin the construction of a string of grain warehouses along its lines in California.

Oklahoma Union Railway, Tulsa, Okla.—This company reports that it expects to construct a new carhouse.

Toronto (Ont.) Suburban Railway.—A small carhouse has been built by the Toronto Suburban Railway at the intersection of Bay and Dundas Streets, Guelph, to hold one radial car. The building is 20 ft. x 15 ft. and contains a passenger waiting room and a freight platform. It is necessary to house a car overnight and for certain hours during the day at Guelph.

Power Houses and Substations

British Columbia Electric Railway, Vancouver, B. C.—Work has been begun by the British Columbia Electric Railway on the extension and reconstruction of its Point Grey substation at King Edward Avenue, which will increase the equipment for feeding the railway lines in Kitsilano, Fairview and Point Grey. The new building will be 100 ft. x 60 ft., of reinforced concrete construction.

Shore Line Electric Railway, Norwich, Conn.—The Public Utilities Commission of Connecticut has granted permission to the Shore Line Electric Railway to furnish electricity to the Groton Iron Works, a large shipbuilding plant, for manufacturing purposes.

Woodstock Electric Railway, Light & Power Company, Woodstock, N. B.—This company is contemplating improvements to its plant this summer, including the installation of a Hercules turbine, type D of the Holyoke Manufacturing Company, developing 137½ hp. at 13 ft. head, belt-connected to a Westinghouse generator in synchronism with two other generators.

Oklahoma Union Railway, Tulsa, Okla.—This company reports that it will construct a new substation.

Harrisburg (Pa.) Railways.—Automatic stokers are being installed under the boilers at the power plant of the Harrisburg Railways so that river coal can be used entirely for firing. At present river coal is mixed with bituminous coal, but with the new equipment the entire fuel supply can be obtained in the city. Contracts have already been let to owners of coal fleets operating in the Susquehanna River at this point.

Reading Transit & Light Company, Reading, Pa.—This company has received a large shipment of insulators to be used on its high-tension line from Lebanon to Reading.

Chambersburg, Greencastle & Waynesboro Street Railway, Waynesboro, Pa.—A report from this company states that it has awarded a contract to A. R. Warner, Waynesboro, for the erection of a brick and concrete substation.

Virginia Railway & Power Company, Richmond, Va.—Plans are being made by the Virginia Railway & Power Company to erect an electric transmission line from Petersburg to Norfolk to supply electricity in Petersburg and Norfolk and to the towns between the two cities. The cost of the work is estimated at about \$750,000. Contracts, it is understood, will soon be awarded for the proposed work. The proposed line will provide connections with the three power plants in the cities of Richmond, Norfolk and Petersburg. In case of any accidents to any of the plants service can be supplied by the two other stations.

Manufactures and the Markets

DISCUSSIONS OF MARKET AND TRADE CONDITIONS

FOR THE MANUFACTURER, SALESMAN AND PURCHASING AGENT

ROLLING STOCK PURCHASES • MARKET QUOTATIONS • BUSINESS ANNOUNCEMENTS

Maintenance and Replacements Chief Concern

Situation Reflected in the Purchase by Railway Companies of Repair Equipment and Material

Probably for the whole of the past year or longer, and surely for the last nine months, the major part of equipment purchased by electric railways has been for maintenance or replacements. Conditions have been such that, with few exceptions, traction companies for many reasons, were compelled to husband their available working capital by economizing in every possible direction. A glance over the files of the *ELECTRIC RAILWAY JOURNAL* for 1917 to date will reveal the fact that the orders for new rolling stock were few and, as compared with former periods, far between, or, as an accessory manufacturer phrased it, more cars were bought and equipped in two months in normal times than are now ordered in a year. This, perhaps, may savor slightly of exaggeration, as an expression of the seller's personal experience.

Recently, however, for special reasons, a quantity of new cars has been purchased and are now on delivery. For a while it appeared as if the car builders were in no position to accept business for early, let alone prompt, delivery, on account of being engaged on government work. The situation has, however, greatly improved.

Diligent inquiry among all classes of railway equipment, supplies and accessory manufacturers and sales agents, from time to time, proves the statement that for a year or more the bulk of the buying has been confined almost exclusively to auxiliary machinery, apparatus, appliance, tools, etc., required to maintain the power house, substation, transmission lines, rails and roadbed in a proper state of efficiency. A careful survey of the situation, fortified by first-hand information, compelled the conclusion that manufacturers and sellers of track welders and welding apparatus of every description were doing quite a brisk business for at least a year past. Ordinarily sales of this class of machinery—of substantial, rugged build, fitting the work for which they were adapted, and therefore almost as long-lived as an ordinary safe—are slow but steady. In fact, a road possessing a welder of the most approved type would frequently be in a position to lease its apparatus or perform the work under contract for other railways, in addition to keeping its own track in condition. A number of improved, simplified welding machines, which expedite and lower the cost of

the work, have also appeared in the market. This, in a measure, stimulated the demand.

Other items for repairing and rehabilitating the general equipment commanded attention, such as rail grinders and supplies, soldering and brazing apparatus, measuring, testing and recording instruments, rail joints, rail bonds and rail bonding outfits, junction boxes, line material, machine and hand tools, splicers, track drills, guy anchors, brackets and crossarms, poles, axle straighteners, car-wheel boring tools, rail-bending and straightening machines, bond testers, brakes, brake systems and brake parts, bell, trolley and register cord, cutting machines, trolley wires, cables, wheel-truing shoes, track scrapers, spikes, bolts, nuts, rivets, tieplates, angle bars, relaying rails, car trimmings, repair shop appliances and many other minor but necessary articles.

In not a few instances second-hand equipment has been eagerly sought, as it represented a lighter investment. This is especially true of motors, converters, controllers and other important parts, not to mention cars, for which the entire country was scoured. If reliable reports may be depended upon, there are few, if any, second-hand passenger cars—motor or trailer—out of service anywhere that have not been purchased by some traction road unable either financially or otherwise to acquire new rolling stock.

The character of the present market is well known to every manufacturer and sales agency of rolling stock, equipment and supplies. Their comments on the situation at times have been more forcible than elegant; for the dearth of regular railway trade has been at so low a state that some of the well-known houses have been seeking business in other fields, with more or less success. It is therefore almost superfluous to add they would welcome the day when the traction railways should again be in position to operate and maintain their respective properties on a high plane, in keeping with their public usefulness and importance.

Not a few roads have been so hard pushed for money that they have been forced to let their property and equipment deteriorate to a considerable extent. Rehabilitation will soon be necessary. Those roads that operate in places where government employees or shipyard workers must be transported will probably be the first to be in a position to make long-needed repairs. Certain it is, however, that there is a large maintenance and replacement market awaiting proper financial conditions.

Car Window Glass Discounts Again Shrink

Orders Filled 100 Per Cent—Factories on Half Time—Deliveries Depend on Restrictions

Another slight advance was made in car window glass on Feb. 11 and is now the ruling figure. The previous increase of 15 per cent, effective as of Feb. 7, was announced in the *ELECTRIC RAILWAY JOURNAL* of Feb. 23. Shortly afterward the Fuel Administrator had a survey made of the glass industry, which showed that production during the year probably would far outstrip the demand. To conserve fuel the manufacturers were ordered to curtail their production 50 per cent, and the factories are operating on that basis.

As a rule car window glass is sold through the jobber, who for some time had been expecting higher prices. They therefore advised purchasing agents to cover their immediate requirements and estimated wants for next season as soon as possible. Following this discounts shrunk, varying with point of shipment, quotations being f.o.b. plant. Car windows are nearly all of the grade known as double strength AA, on which the manufacturer's discounts are now 71 per cent off list for first quality and 80 per cent on second quality. Orders are filled 100 per cent, but deliveries are subject to embargoes and the necessary priority certificate for shipments coming through the consignee.

Railway Costs Higher in the Far West

Pacific Roads Unable to Take Advantage of Market Conditions—Freight Situation Burdensome

While it is well known that prices have advanced to an extent never before experienced, that deliveries have never been known to be worse, these conditions apparently are not the same throughout the country. The situation in these respects on the Pacific Coast are particularly severe, according to advices from the San Francisco representative of the *ELECTRIC RAILWAY JOURNAL*.

Electric railways of the Pacific Coast have to meet several costs which do not appear in the operating expenses of systems in Eastern cities. One of the most serious of these is the disadvantage when purchasing material and equipment of being unable to take advantage of market conditions. The Eastern road, through close touch with

manufacturing conditions, can usually buy to advantage by getting its orders in when prices are low. Western roads have always been under a disadvantage in this regard because of the necessity for placing orders at long range, but now with terms of delivery much longer than before, the disadvantage is increased.

Another item is the difference in terms. Bills are usually rendered with cash discounts for ten or thirty days from date of invoice. If the shipment is to a road in the Far West it may now be anywhere from one to four months before the consignment is received. Thus, in order to take advantage of the discounts, payment must be made long before the equipment arrives.

The higher freight rate on l.c.l. shipments makes it desirable to get together carload lots to secure the lower rates whenever possible. This tendency has been an additional reason for carrying a comparatively large stock of extras where such long delays are experienced in getting deliveries from the East. When this is necessary to insure dependability of service the capital tied up thereby of course must be charged to operating expenses.

Such points as these, considered collectively, constitute a considerable financial burden, and are looked upon by western roads as more than offsetting the climatic advantage which they have over eastern roads in the matter of operating conditions.

taken on contract for six months or a year, are now greatly restricted for the immediate future. The market situation is constantly fluctuating and is described as too uncertain. Raw material, while in fair supply, is none too ample. Potash, an essential ingredient from several points of view, is a bothering proposition, as almost the entire world's supply came from Germany, which is now completely cut off. A domestic substitute is being developed, but as yet the quantity is comparatively small and, to quote an authority, not altogether to be depended upon. Eventually this will no doubt be remedied. Potash is therefore on a high price level. Linseed oil, another important base, is appreciating in cost continually. Transportation and other prime contributing conditions are playing havoc with this line. Labor scarcity has resulted in factory production being curtailed somewhat. Under these circumstances manufacturers advise that traction companies anticipate their wants as far as possible in order to avoid the predicted inevitability of still higher prices.

Deliveries, with embargoes yet in force, are mentioned with reservations. Shipping dates, providing cars can be obtained, may be arranged; but the arrival of goods at destination, even with more favorable weather, cannot be guaranteed, and doubtless a priority order may be a requisite in addition, excepting to nearby points of factory. Besides, a great many paints are not carried in stock, because they deteriorate by the very nature of their composition, and therefore time must be allowed for manufacturing. On deliveries one manufacturer said he had had three cars of paints coming into New York from the Middle West since Jan. 14, and they were still in transit; also a shipment from Philadelphia that took three weeks to arrive. Local trucks that normally cost \$8 a day now command \$12. It is therefore declared that these items must necessarily figure in the ultimate cost of the merchandise.

Varnish and Paint Prices Advance

Increases Due to Rising Cost of Raw Material—Railway Enamel Is Growing in Favor

Varnish and paint manufacturers who specialize in railway paints and varnishes declare the field to be one in which specialization is necessary. Nevertheless, they are enthusiasts, even to the chemists, compounders and experts, on the proposition. As one of the many well-known manufacturers says, "No field of endeavor has greater need for specialization than the manufacture and use of railway and electric railway paints and varnishes. In no branch of the business does the chemist and his testing experts meet with more variable and exacting conditions. Every conceivable kind of surface must be protected or beautified, or both. Furthermore, this endless variety of surfaces must be prepared to withstand the gruelling of severe travel and exposure."

Late winter, early spring and the fall are the usual buying seasons, because it is the time of the year when more cars are re-shopped than any other. Some advance orders for the needs of several important electric railway properties have already been booked. Manufacturers and sales agencies anticipate a greater year than in 1917, which was the best on record in volume and values. Prices have increased from Jan. 1 to Feb. 1 from 10 to 25 per cent. In a year to a year and a half prices of paints and varnishes have advanced over 100 per cent. The basic materials, such as white lead, linseed oil, potash, etc., have been on the upward trend for a long time, and are still tending in that direction.

In addition to the regular list of varnishes and paints called for from the priming to the finishing coats, a new compound has come into use within the last three or four years. This is known as a railway enamel, and is made and sold under different names by all the leading manufacturers. As one firm explains, "railway enamel is the crowning achievement of the combined efforts of expert painters to produce a finishing enamel." It is known as a full-oil enamel. No gums enter into its construction. This insures it against

eventually becoming brittle and then cracking.

This railway enamel, now coming into more general use, is admitted by car builders, managers of railway repair departments and practical car painters, not to mention paint manufacturers of repute, as wearing longer than other finishing varnishes. Besides, its employment reduces the cost of material to a minimum. Still more important, in the matter of time in applying the various coats, including rubbing and finishing varnishes, a saving of 50 per cent is effected. The quality, the makers assert, is as good if not better than the average high-grade car varnish. As an evidence of its popularity one manufacturer may be cited as having sixteen standard car body colors, and, it is presumed, others are equally well provided. Some are known as traction orange and green, interurban green, etc. At any rate, reports bear out the assertion that many electric road superintendents of rolling stock consider this enamel one of the best finishing products in point of appearance, service and wear, under all weather conditions, that has been introduced in years. The leading railway lines in the New York district are heavy buyers of the specialty.

Managers of the car-painting departments of several of the larger companies are in the habit of buying colors and making up their own finishing enamels. This has its advantages, but the great majority of the companies purchase their supplies ready mixed. Some of the important properties buy in bulk; that is, in barrel lots. One manufacturer with wide experience stated, however, that it was a peculiarity of the traction companies to provide for their requirements in five-gallon can lots. The ultimate quantity was about the same as if buying by the barrel, simply the can package seemed to appeal to this class of buyers.

Quotations were not being made very far ahead. On clear varnish one company has accepted a few orders at six months' delivery. Colors, customarily

Rolling Stock

Aberdeen (S. D.) Railroad recently obtained a new snowplow.

Aurora, Elgin & Chicago Railway, Aurora, Ill., recently purchased six cars from the Cincinnati Car Company, to be used for city and short interurban system runs.

Columbus Railway, Power & Light Company, Columbus, Ga., through Howard W. Clapp, general superintendent, advises that it "is not purchasing any new car equipment at this time." The report referred to appeared in the ELECTRIC RAILWAY JOURNAL of Feb. 23.

Cleveland (Ohio) Railway has been supplied with twenty-five trail cars, mounted on Brill 67-F trucks, built by the G. C. Kuhlman Company, Cleveland. Total passenger capacity, standing and seated, 130.

State Belt Electric Street Railway, Pen Argyl, Pa., which finished 15 miles of trackage from the Wind Gap to Stroudsburg, Pa., during 1917, had four interurban cars recently shipped from the J. G. Brill Company, Philadelphia. The cars have Brill 27-M, C.B.2-x trucks, 6-ft. wheelbase and 33-in. wheels, and are constructed with all-steel framing and sheathing. Mahogany is used for the interior finish, including all doors, sashes and moldings. Seating capacity, forty-six.

Philadelphia (Pa.) Rapid Transit Company, which recently ordered 100 new cars from the J. G. Brill Company, as referred to in the *ELECTRIC RAILWAY JOURNAL* of March 9 and previously, furnishes the appended specifications. The order was assumed as coming through the Emergency Fleet Corporation.

| | |
|-----------------------------------|--------------------------------|
| Number of cars..... | 100 |
| Name of road..... | Philadelphia R. C. Co. |
| Date order was placed..... | Feb. 1, 1918 |
| Date of delivery..... | Commencing 90 days |
| Builder of car body..... | The J. G. Brill Co. |
| Type of car..... | Closed passenger |
| Seating capacity..... | 48 |
| Weight (total)..... | 44,000 lb. |
| Bolster centers, length..... | 21 ft. 0 in. |
| Length over bumpers..... | 45 ft. 6 in. |
| Length over vestibule..... | 44 ft. 6 in. |
| Width over all..... | 8 ft. 6 in. |
| Height, rail to trolley base..... | 11 ft. 8 in. |
| Body..... | Semi-steel |
| Interior trim..... | Cherry |
| Headlining..... | Nevasplit |
| Roof..... | Arch |
| Air brakes..... | General Electric |
| Axles..... | Valley steel heat treated |
| Bumpers..... | Brill channel iron |
| Car trimmings..... | Brass (Brill) |
| Conduits and junction boxes..... | General Elec. |
| Control, type..... | G. E. P. C. |
| Couplers..... | Tomlinson air and electric |
| Curtain fixtures..... | Forsyth No. 88 and Rex rollers |
| Curtain material..... | Pantasote |
| Designation signs..... | Hunter illuminated |
| Door operating mechanism..... | National-Pneumatic |
| Fenders or wheelguards..... | H-B Life Guards |
| Gears and pinions..... | Tool Steel Gear Co. |
| Hand brakes..... | National Staffless |
| Heaters..... | Peter Smith Electric |
| Headlights..... | Ohio Brass Co. |
| Journal boxes..... | Brill |
| Lightning arresters..... | General Electric |
| Motors..... | 4 General Electric 247-C |
| Motors..... | Inside |
| Paint..... | Brill Standard |
| Registers..... | International R-7 |
| Sanders..... | Air—Ohio Brass Co. |
| Sash fixtures..... | Edwards |
| Seats, style..... | Longitudinal |
| Seating material..... | Cherry |
| Springs..... | Brill |
| Step treads..... | Universal |
| Trolley retrievers..... | Ohio Brass Co. |
| Trolley base..... | Wasson |
| Trucks, type..... | Brill 77E1 |
| Ventilators..... | Garland C-2 Honeycomb |
| Wheels..... | 33-in. rolled steel |
| Tail lights..... | Nicholas-Lintern |
| Slack adjusters..... | Anderson |
| Side bearings..... | Perry |
| Outer plates..... | Brill oil retaining |

Capital Traction Company, Washington, D. C., mentioned in the *ELECTRIC RAILWAY JOURNAL* of March 2 as being in the market for rolling stock, on March 12 placed an order with the J. G. Brill Company for twenty 44-ft. closed passenger cars.

Omaha, Lincoln & Beatrice Railway, Lincoln, Neb., has had recent shipments of new cars from the American Car Company, St. Louis, Mo. The cars are of the pay-within type, mounted on Brill double-motor 7-E-1 trucks, equipped with 24-in. wheels with a seating capacity of forty. The framing is of composite steel and wood.

Cumberland County Power & Light Company, Portland, Me., has been furnished eight double-truck, center-entrance trail cars by the Wason Manufacturing Company, Springfield, Mass. The trucks are of the Brill 53-F type, with a wheelbase of 5 ft., and 22-in. wheels. The bodies are framed and sheathed in steel and are of the stepless type.

Murphysboro & Southern Illinois Railway, Murphysboro, Ill., having completed its 8-mile line between Murphysboro and Carbondale, commenced operation with an initial equipment of handsome cars built by the American Car Company, St. Louis, Mo. The rolling stock is double-end operated, steel-frame cars for straight passenger service, with a seating capacity of fifty. The cars are mounted on Brill 27-M. C.B. high-speed trucks, and have a toilet and motorman's cab at one end in diagonally opposite corners. The wheelbase of the trucks is 6 ft., with 33-in. wheels.

Wheeling (W. Va.) Traction Company has taken over the Steubenville, Wellsburg & Weirton Railway Company, Wellsburg, W. Va., and has placed orders for fifty-two new all steel pay-as-you-enter cars, to cost \$200,000. The new cars will replace the rolling stock recently destroyed when the Bay Island carhouses were burned. Twenty-nine of these cars will replace those lost in the fire. Fourteen will arrive within the next thirty days and the remainder in at least four months. Contracts for construction and delivery of the rolling stock have been awarded to the Jewett (Ohio) Car Company and the Cincinnati (Ohio) Car Company. Twenty-three cars will be added to the present

number owned and operated by the company. Their seating capacity will vary from fifty-two to seventy and the cost per car from \$12,000 to \$14,000.

Trade Notes

Third Avenue Railway, New York, N. Y., has placed an order with the Gurney Ball Bearing Company, Jamestown, N. Y., for 150 radio-thrust bearings which are to be used on the journal boxes of the storage battery and low level cars.

Electric Railway Improvement Company, Cleveland, Ohio, is planning to give practical demonstrations of efficient rail bonding and arc welding with its portable welder and portable rheostat at the National Railway Appliances Association exhibit, to be held at the Coliseum, Chicago, March 18-21.

Drew Electric & Manufacturing Company, Indianapolis, Ind., has appointed the Northern Electric Company, Ltd., exclusive agents for Drew electric railway, light, power, gas and mine haulage material and specialties in Canada and Newfoundland. The Northern Electric Company will carry a complete stock of the Drew line in Canada for the benefit of its electric railway customers. The head office of the Northern Electric Company is at Montreal; branch houses are maintained in Montreal, Halifax, Ottawa, Toronto, Winnipeg, Regina, Calgary and Vancouver.

Interborough Rapid Transit Company, New York, N. Y., is making inquiries for 10,000 tons of rails for 1919 shipment. David W. Ross, vice-president in charge of contracts and supplies, informed the *ELECTRIC RAILWAY JOURNAL* that the company had an ample supply of rails for 1919 requirements, but it was the practice to keep its stock up to an established standard of quantity, and the inquiry was sent out to ascertain whether deliveries could be guaranteed for next year. The negotiations only covered the needs of the subway and elevated systems, and did not include those of the New York Railways Company, the surface lines which the company controls and operates.

RAILWAY MATERIALS

| | March 6 | March 13 |
|---|----------------|----------------|
| Rubber-covered wire base, New York, cents per lb. | 30 | 27-30 |
| Weatherproof wire (100 lb. lots), cents per lb., New York | 28¼ to 34¼ | 28¼ to 34¼ |
| Weatherproof wire (100 lb. lots), cents per lb., Chicago | 33.42 to 38.35 | 33.42 to 38.35 |
| Rails, heavy, Bessemer, Pittsburgh | \$55.00 | \$55.00 |
| Rails, heavy, O. H. Pittsburgh, per gross ton | \$57.00 | \$57.00 |
| Wire nails, Pittsburgh, per 100 lb. | \$3.50 | \$3.50 |
| Railroad spikes, 9/16 in., Pittsburgh, per 100 lb. | \$3.90 | \$3.90 |
| Steel bars, Pittsburgh, per 100 lb. | \$5.00 | \$5.06 |
| Sheet iron, black (24 gage), Pittsburgh, per 100 lb. | \$4.85 | \$4.90 |
| Sheet iron, galvanized (24 gage), Pittsburgh, per 100 lb. | \$5.80 | \$5.80 |
| Galvanized barbed wire, Pittsburgh, cents per lb. | \$4.35 | \$4.35 |
| Galvanized wire, ordinary, Pittsburgh, cents per lb. | \$3.95 | \$3.95 |
| Cement (carload lots), New York, per bbl. | \$2.25 | \$2.25 |
| Cement (carload lots), Chicago, per bbl. | \$2.31 | \$2.31 |
| Cement (carload lots), Seattle, per bbl. | \$2.65 | \$2.65 |
| Linseed oil (raw, 5 bbl. lots), New York, per gal. | \$1.43 | \$1.53 |
| Linseed oil (boiled, 5 bbl. lots), New York, per gal. | \$1.44 | \$1.54 |
| White lead (100 lb. keg), New York, cents per lb. | 10 | 10 |
| Turpentine (bbl. lots), New York, cents per gal. | 45½ | 44½ |

NEW YORK METAL MARKET PRICES

| | March 6 | March 13 |
|--|---------|----------------|
| Copper, ingots, cents per lb. | 23½ | 23½ |
| Copper wire base, cents per lb. | *27 | 26.25 to 26.75 |
| Lead, cents per lb. | 7¼ | 7¼ |
| Nickel, cents per lb. | 50 | 50 |
| Spelter, cents per lb. | 7.75 | 7.75 |
| Tin, Straits, cents per lb. | *85.00 | *85.00 |
| Aluminum, 98 to 99 per cent, cents per lb. | †32 | †32 |

OLD METAL PRICES—NEW YORK

| | March 6 | March 13 |
|---|---------|----------|
| Heavy copper, cents per lb. | 22 | 22 |
| Light copper, cents per lb. | 19½ | 19½ |
| Red brass, cents per lb. | 18 | 18 |
| Yellow brass, cents per lb. | 13 | 13 |
| Lead, heavy, cents per lb. | 6 | 6 |
| Zinc, cents per lb. | 5½ | 5½ |
| Steel car axles, Chicago, per net ton. | \$42.41 | \$42.41 |
| Old car wheels, Chicago, per gross ton. | \$42.41 | \$42.41 |
| Steel rails (scrap), Chicago, per gross ton. | \$30.00 | \$35.00 |
| Steel rails (relaying), Chicago, per gross ton. | \$35.00 | \$60.00 |
| Machine shop turnings, Chicago, per net ton. | \$17.00 | \$17.00 |

*Nominal. †Governmental price in 50-ton lots, f.o.b. plant.