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ELECTRIC RAILWAY JOURNAL IN 1913

With this number the ELECTRIC RAILWAY JOURNAL begins its forty-first volume as well as the thirtieth year of its existence, the first number having been published in 1884. The coming year promises to be as important in the development of the industry as any during the past three decades. Precedents will undoubtedly be set in a great many places and in various directions and will have an important bearing on the general economic condition of the industry. These changes will be in part political, in part financial and in part of an engineering character, modifying as they will the ideas current as to the best type of equipment to be used. A review of these several phases of the industry appears in the series of editorials and contributed articles which compose the major part of this issue. They show that the industry is face to face with many serious problems and that every endeavor must be made to solve them. This can be done only if each worker in the field knows what the others engaged in similar work are doing. It is in this weekly exchange of ideas that the ELECTRIC RAILWAY JOURNAL is able to serve the field, and it hopes and expects with its present facilities and long experience to be of even greater value to its readers than in the past.

THE TABLE OF CONTENTS

Beginning with this issue the ELECTRIC RAILWAY JOURNAL recommences the plan of publishing the table of contents of each issue on the front cover. Announcement that this would be done was made last November, and we believe that the change will be generally welcomed by our readers. Two advantages appear prominently as a result of this practice. One is that the reader can quickly obtain, after removing the wrapper from the paper, a summary of the principal articles contained in each issue. We do not expect that every article will prove of interest to every subscriber, but we do try to compile each issue so that every subscriber will find at least some articles in it of use to him, and we believe that most of the subscribers will find most of the articles of use and that a great many will read all of the contents of each issue. Another advantage to the reader from the publication of the table of contents on the front cover is that it renders much more easy the search for a desired article in a previous number before the numbers are permanently bound. It is no longer necessary to open each copy and turn to the table of contents which formerly was published on the first editorial page. A glance at the cover suffices. Finally, the greater space on the front cover allows us to print some explanatory text under the titles of the longer articles, a plan which could not be followed in the restricted space of the table of contents when it was published on the editorial page. As explained last month, the plan involves the financial sacrifice to the publishers of the most valuable space for advertising purposes in the paper, but we believe that the advantages to our readers, already cited, more than outweigh our loss.

OUR STATISTICAL ISSUE

The electric railway industry is growing so rapidly in the design and application of equipment that one actively engaged in the business does not often take time to realize the improvements and changes which are effected in the industry during the short space of one year. The laborers in the field are many, and as the result of their labor, operating conditions and construction conditions change, and we change with them, almost without thought. A breathing space is helpful in progress of this kind if it is utilized for a survey of work recently done, because thereby it is often possible to determine better than in any other way the direction in which improvements are tending. If one does this, he can set himself in the march of progress rather than work counter to it. The first of the year seems to be a particularly proper time for a survey of this kind. This has been the main reason for the publication by this paper of a Statistical Number during the first week of January. As the plan and purpose of our Statistical Number have become better understood it has been possible for us each year to compile more accurately the statistical portion of this number. When we first attempted, a number of years ago, to obtain records of the miles of track built and the number of cars ordered by the electric railways in the country, many companies did not realize the importance of supplying this information. But this year the returns have been from a very large percentage of all of the operating companies in the country, and we believe that the tables this year form the most nearly complete compilation of electric railway statistics ever made under private auspices. For their courteous and prompt attention to our inquiries we wish to thank the operating electric railway companies, for without their co-operation no such record of cars and track as that which we publish in this issue would have been possible.

ELECTRIFICATION ON MOUNTAIN-GRADE DIVISIONS

Following the statistical portion of this number is a series of four signed articles by well-known authorities in the field discussing various phases of electric railway engineering. Among these, Mr. Armstrong considers at length a phase of steam road electrification which is now attracting the serious attention which its importance deserves. We refer to the electrification of mountain-grade divisions of steam roads. This branch of the work, so far as actual installations are concerned, has lagged behind other applications of electric power to heavy traction work, but now it promises to be one of the most important, certainly within the near future. During the past year there has been little change in this country in the matter of steam railway electrification for purely passenger service, except so far as the extensions of existing lines are concerned, and most of these were originally installed because of peremptory factors, such as tunnel service. But in the field especially studied by Mr. Armstrong in this issue the advantages afforded by electrification are entirely different from those in suburban and tunnel service, and if electric power is to win it will do so purely on the merit of economy.

It is a familiar principle of railroading that the capacity of a line is limited by its severest grades. There has been for years a steady tendency to reduce these even at very large expense, yet on many mountain divisions any considerable reduction in grade is almost a physical impossibility. Now, as Mr. Armstrong points out, in many such cases the region traversed is already supplied with electric power from ample stations over a reliable distribution service. Even where such service is not now available, conditions generally permit its establishment in response to demand for electric traction. Second, the experience gained in tunnel and terminal work has actually put in our possession locomotives fully capable of doing mountain work efficiently and well. And, finally, it seems to be perfectly well demonstrated that the electric locomotive is considerably better adapted to meet the requirements of a mountain road than the steam locomotive.

The steam locomotive is undeniably a very remarkable machine, yet it always has to carry its power station upon its back, so to speak, and its capacity is limited by this fact, as well as its inability to produce an even torque at the rims of the driving wheels, so that it affords an opportunity for slipping to begin at certain points in each revolution. Its effective adhesion is therefore disproportionately small compared with the terrific strains due to its weight, and its power of climbing heavy grades with a long train behind it at fair speed is correspondingly diminished. The electric locomotive, with all or nearly all its weight on the drivers, can produce a considerably higher tractive effort with a greatly diminished weight on the track. For instance, Mr. Armstrong's table shows that for equal tractive effort the electric locomotive is likely to weigh something like 40 per cent less than the steam locomotive and is able to haul efficiently its loads at better speed. The capacity of the steam locomotive is, moreover, seriously limited in practice by the difficulty of firing, which, unless high-grade fuel is used, becomes a very serious matter when the output has to be forced. Of course, in mountain service two or even three steam locomotives are frequently used, at a considerably increased cost of operation. But, if convenience dictates, the electric locomotives can also be coupled on considerably easier terms inasmuch as they can divide the load more steadily and are troubled with no difficulties of firing. Further, the electric locomotive is sufficiently efficient to leave comparatively small margin for improvement, so that railroads need not hesitate in the hope that a delay will result in large increase of efficiency.

To offset this it is undeniably true that the steam locomotive is susceptible of considerable improvement. Very little has been done in this country with the use of high super-heat and the efficient application of compounding. The steam consumption of even the best locomotives in regular use is materially greater than one would reasonably expect in a stationary engine of even considerably smaller capacity. This failure in efficiency is due to a complicated set of causes, some of them perhaps unavoidable. The mere fact that, after many years of constant facing of these familiar difficulties and constant effort at improvement, nothing better has been evolved bears witness to the difficulty of the task. The waste of coal in the locomotive owing to its discontinuous use, and with consumption going on all the time, is also a formidable matter.

There seems to be no doubt that the electric locomotive in the mere task of hauling heavy trains over steep grades can beat out the steam locomotive in efficiency, steadiness of service and speed. These considerations ought to enforce its use as a mere matter of operative economy. Probably we shall never get the full advantages of electrification until we can deal with the whole system as a system, because discontinuities, so to speak, in the character of the motive power lead to increased expenses; but Mr. Armstrong has certainly made out a good case for the electric locomotive in mountain service irrespective of the rest of the system.

IMPROVEMENTS OF MOTOR DESIGN

Mr. Storer's account of the changes in motor design that have characterized the growth of electrical railroading is a very timely summary of improvements in practice, Such improvements have been spread over a period of a quarter of a century and have taken place in so irregular a manner that it requires just such a close knowledge of the art as Mr. Storer possesses to group the changes in any systematic manner. Those who remember the original Sprague motors and their immediate successors, to say nothing of the still earlier types, cannot help looking with something of wonderment at the changes which have taken place. Part of these have been due to the great increase in our knowledge of motor design, part of them to the concurrent growth of tramway practice involving great modifications in the rolling stock. The earlier Sprague motors, for example, with their double commutators, flat form and high-speed armatures, did not express the ultimate then existing knowledge so much as they indicated the current necessity for cutting one's coat according to one's cloth. It seemed to be necessary in that early period of exploitation, and doubtless was necessary, to adapt the motor drive to existing rolling stock construction, and many of the early roads were equipped with converted cars. In the attempt

to force the motor into use on its merits the handicap of at once requiring radical changes in rolling stock design seemed too great.

One was, too, in the period of many inventions in the hands of many companies, so that good things could not be readily utilized, and important improvements in design were temporarily bottled up. For example, in the very early period of electric railway construction, when armatures hand-wound like a ball of twine with overlapping layers were the order of the day, the admirable Eichemeyer formed coil, designed so that each coil could be wound and inserted independently of any other, began a movement which led to modern electric railway motor design. Another most important improvement, made some twenty years ago, was the adaptation of multi-polar construction to railway practice, leading to types of single-reduction motors, different only in detail from those still commonly used. Many of the details, however, providing for ready access to the parts, suitable insulation and greater mechanical security were necessary before the electric road could settle down to safe and regular practice. The coming of the carbon brush at the beginning of this period was perhaps the most important single detail which made for the improvement of motor practice.

For nearly a decade these improvements went on working steadily toward modern conditions, although it must not be forgotten that sporadic efforts were very early made in the direction of single-reduction gear and even gearless motors. Meanwhile the unquestioned success of the electric railway had created a demand for and forced the manufacture of rolling stock more suitable for the powerful driving mechanism and with more room to accommodate the necessary motors. This of itself produced a steadily increasing improvement in motor design, at first so hampered for lack of space.

During the last decade the path of change has been mostly in the direction of still further refinement of electrical and mechanical design, particularly the latter. From the electrical standpoint motors did not change rapidly, but their reliability was enormously increased by judicious changes in details. The most important change in motor design in recent times has undoubtedly been the adoption of the interpole construction, the inception of which goes back considerably beyond the modern period. With this has come practical immunity from many of the commutator difficulties once most formidable, and, what is of vastly greater importance, it has made comparatively easy the production of motors for higher voltages than those which have heretofore been common.

This is not perhaps an important matter in general tramway progress, but it is of vital significance with respect to the development of heavy electric traction. Just why it should have taken so long to bring to fruition the commutating-pole idea it is very difficult to say, but its time has now come, bringing a new power of usefulness to the electric motor in large work. Incidentally the commutating pole has made easy a return to field commutation as an important auxiliary in variations of speed. Tried at the very beginning of electric traction, it passed completely out of use, to return again now, with added possibilities. What the future of traction motor design is to be now depends very largely on the general trend of electric railway practice. For existing circumstances it has settled down into somewhere nearly standard form, yet demands for greater power, or higher speed, or increased voltage, will inevitably result in still further changes, the data for which are fortunately already at hand.

PROGRESS IN POWER TRANSMISSION

Another review in the series of articles on technical developments during 1912 appearing in this issue is contributed by Dr. Louis Bell and relates to the progress in electric power transmission during the year. This is a subject of growing importance because of the increasing interest apparent in the distribution of electric power for all purposes in a district from one or a chain of central power stations. Another fact which imparts special interest to the subject is the close relation which has always existed between the kind of electrical energy employed for transmission, especially the frequency used, and the type of motor which could best utilize that energy when obtained from the trolley wire. But this correlation, according to Dr. Bell, is not so imperative as was formerly the case. The development of the interpole rotary converter, by which it is possible to produce direct current from a fifty-cycle and sixty-cycle transmission system without the use of motor generators, now permits a wider choice of systems of motive power, and Dr. Bell intimates that further improvements are probable by which the mercury converter will make conversion of alternating current to direct current for railway purposes still more easy and greatly extend the possibilities of direct-current railways.

In the problems directly concerned with long-distance power transmission there has been notable advance during the past year. The suspension type of insulator established a new era in this field of electrical endeavor, and transmission voltages are increasing as a direct consequence. The maximum so far reached in this country for commercial purposes is 140,000 volts, the potential employed on the lines of the Au Sable Electric Company in Michigan, but this year 150,000 volts will probably be used on the lines of the Pacific Light & Power Corporation now under construction. These figures represent double the voltage employed in commercial service less than five years ago, and with the improvements to be expected in insulators as regards their ability to withstand puncture, the limit may be still further increased.

Dr. Bell sounds a note of warning in regard to the character of pole transmission lines often erected and suggests that a modified form of "A" steel structure for intermediate supports, with anchor towers at intervals, would be more durable and in many cases no more expensive than many existing structures. Interruptions to the service of electric transmission lines are exasperating under all conditions, but are particularly so when the power is used for railway purposes, and they should be guarded against at all hazards. A few more dollars spent on insuring the continuity of supply by increasing the stability of the transmission line might often eliminate the necessity for reserve steam stations with their expensive charges for maintenance and upkeep.

THE DEVELOPMENT OF POWER P LANTS

Prof. Norris' discussion of recent movements in power plant design furnishes striking evidence of refinements of engineering design. Speaking broadly, recent changes have not been radical, but they betoken a steady movement forward, particularly in the direction of larger units and their more efficient utilization in following the load curve of the plant. Among the conspicuous recent tendencies may be found that toward the use of horizontal turbo-generators, a tendency largely due to the increasing difficulty of carrying the necessary weights for big units on a step-bearing. A considerable proportion of the recent large plants are utilizing the horizontal turbine, despite the loss in floor space. However, since it is commonly true that the theoretical gain in floor space by the use of vertical machines is seldom or never utilized to anything like its full extent, this loss is far from striking. Greater than this in importance, and marking perhaps the most notable line of improvement in power station practice, is the tendency toward using bigger boiler units under more efficient conditions of combustion.

In locations where good feed water is available, making the use of large units desirable, boilers of relatively trivial capacity have been obstinately continued in use long after the prime movers have been brought to suitable output. The ordinary big turbo-generator with its attendant army of boilers reminds one of nothing so much as of Gulliver being fed by the Liliputians. Not only is the plant of small boilers expensive to house and install, but it leads to needless complication in the piping and auxiliaries, and also to decreased economy in operation from almost every standpoint. The tests of the huge Detroit boilers last year showed the gain to be made in using large steam-producing units.

Just how far actual increase in dimensions may be advisable is a subject upon which engineers differ, but the advantage of units of greatly enlarged output admits of no dispute. All the arguments of the ultra-conservative in favor of small boiler units apply with equal force and very little change of wording to small engines and small dynamos. The main question just now is how far the demand for great evaporative power in a single unit should be met by increased ratings for the present units rather than by increased dimensions. The use of forced draft, as exemplified by some recent plants noted by Professor Norris, is one way out of the difficulty, and this line of advance will doubtless be pushed to its economical limit along with increase of size. Ultimately we shall certainly have very large boilers worked intensively during the period of heavy load, but the improvement will be one of gradual and tentative growth.

As regards the dynamo room the movement toward bigger units goes steadily on. With it has come the need for increased protective measures to gain greater security. Perhaps the most important of these is the use of reactance coils, exterior to the machines, to avert the danger of heavy short circuits. Such devices are in themselves undesirable and interfere with regulation, yet they serve a useful purpose in time of need. The thing most effective would be a coil of which the reactance would increase very rapidly as the current neared the danger point, and such a coil may perhaps be worked out in due season. The increase in underground distribution at high tension has brought added responsibilities, and Professor Norris has considered several interesting details of recent practice in the care of cables. With respect to the electrical generators for large stations, the effects of increased output on design are being keenly felt, and in particular the problem of disposing of the heat has been growing steadily more serious. When with high rotative speeds the output per unit of bulk increased, the limit of capacity came to be the heating, and the old battle of the squares and cubes was on again. Today the struggle is on the field of forced ventilation, and the designer may even be driven to refrigeration as the combat deepens.

PROGRESS IN CAR DESIGN DURING 1912

The development of car design during the past year has been marked by extreme radicalism on the part of designers of cars for city service. In fact, no period in the history of street railways has seen so many startling innovations. The modern stimulus in car design for city service may be said to have begun with the successful demonstration of the pay-as-you-enter car which was originated in Montreal and was shown first in the United States at the Columbus convention in 1906. The prepayment plan may now be considered as a permanent feature of city car design. The developments in 1912 have been in the extension of this principle to center entrances, with an increase in accessibility of the car, greater attention to safety features and renewed interest in one-man cars.

Early in the past year came first the New York "stepless" car with a body hanging near the ground between the trucks, and then in rapid succession the low center-entrance cars of Brooklyn and Washington and the center-entrance, end-exit car of San Diego. These were accompanied by the "low-floor" car of Pittsburgh, in which 24-in. wheels and small motors eliminated one step and reduced the weight to an unprecedented figure. As soon as the success of the low-level cars of New York and Pittsburgh was assured, the trial of double-deck cars based on these designs became almost obvious, and during August cars of this type were placed upon the street almost simultaneously in the two cities. In the meantime also the near-side principle, developed during 1911, had been applied to one-man cars, thus supplying a need for light traffic service which had existed since the bobtail horse car disappeared from our city streets with the dawn of the electrical era.

During 1912 also there has been under construction and trial the most extraordinary development of all, the "articulated" car of Boston, consisting of two old single-truck cars set end to end and flexibly connected by a low-hanging vestibule with center side doors giving access to the car from the street. Last among the radical designs of the year came the storage battery "stepless" type, a four-wheeled car without a truck frame and of extremely light weight.

With one exception, all of the center-entrance cars were developed primarily to provide easier access for passengers by a reduction in step heights, with the exceedingly important indirect benefit of decreasing the time of passenger interchange, thus permitting faster schedule lines. Most of

the cars mentioned have received the practical indorsement of repeat orders, thus demonstrating the practicability of their obvious advantages—namely, increased seating capacity, greater accessibility of all seats and increased safety of operation.

The articulated car, of which there is yet but one in use, is primarily adapted to the rebuilding of old equipment. This, in fact, makes it of especial interest, as it provides an answer to the question arising many times during the year as to what disposition could be made of old rolling stock rendered obsolete by the introduction of the new types. For this reason it is to be hoped that the designers will make every effort to develop the idea thoroughly, as its practical success would be a boon to the industry. The double-deck designs of New York and Pittsburgh also have not apparently arrived at the stage where their designers are sufficiently certain of their future to duplicate them in considerable numbers. The Pittsburgh car, however, has been reported from that city to be a thorough success for handling crowds going to parks or games and caring for rush-hour traffic from factories, and a duplicate of the New York car has been ordered for trial in Columbus, Ohio. Both double-deck cars are, of course, of very recent construction, and the opportunity for trial has been limited. This, together with the revolutionary character of the designs, has undoubtedly influenced the designers of both cars in adopting an ultra-conservative policy. During the coming year, however, there is no doubt that the question of the practicability of the double-deck principle in this country will be finally settled.

After the wealth of new designs for city cars, the developments in the field of cars for interurban service and for heavy electric traction seem to be minor in character. The steel cars of the Cambridge Subway probably show a greater divergence from generally accepted standards than any of the other large cars of the year. They are equipped with three side doors, and the usual platforms, bulkheads and platform doors have been eliminated. One of the doors is located at the center of the car, and the other two are approximately over the trucks. This arrangement divides the car into four sections and gives, in the longer car, the same effect as that produced by the center entrance so prominent in the new designs for city service.

In general, the use of steel for car bodies has shown a marked increase. All except two of the new types of city cars have depended upon the girder effect of the side sheathing between belt rail and sills to support the load, the strains being carried around the doorway by heavy reinforcement, and it is manifest that this construction is to be perpetuated. In fact, with the existing demand for lightweight cars, such a form of steel construction seems to be obligatory, as the low records for weight established during the year were obtained through its use. For the same reason it would seem that the adoption of wheels of small diameter should soon become general in slow-speed service, as their practicability has been very thoroughly demonstrated.

Progress in the design of equipment has been signalized by the introduction on a large scale of multiple-unit control on the Public Service Railway, where for some months past train operation has been carried on during rush hours. The use of this means for reducing traffic congestion has resulted in the development of several new designs for trail cars with center entrances and small wheels, along the lines of the successful Pittsburgh trailers of 1910. In two cases the opportunity for single-end operation has permitted the trailer to be made with the novel arrangement of a door on one side only, the other side of the car containing an unbroken line of seats.

Summed up, the developments of the past year in city car design have been along the lines of improving the entrance and exit facilities and increasing the safety of operation, and in construction toward the greater use of steel. With the exception of the one-man prepayment car, the improvements have been largely for the benefit of the larger city systems, and in the smaller communities, especially where lack of street paving necessitates the stopping of cars with the entrance opposite the cross walk, it is not likely that the center-entrance types will find favor for their loading facilities alone, although they may be adopted in some such localities on account of other advantages such as light weight and freedom from accidents.

WAY AND BUILDINGS

A review of the progress made by departments of way and structures on electric railways during the past year shows that although improvements in the methods employed and the materials used have not been as marked as in the other departments of the industry, much has been done along the line of refining methods, testing materials and improving the design of different roadway appliances. The few extensions made to existing lines, as compared with former years, have permitted more exhaustive study of the characteristics of old track and roadway under operating conditions. The net result of this has been extensive rehabilitation along more scientific lines.

Various types of track construction in paved streets have been employed, but as a general rule permanency has been the ruling factor in the selection of materials used. In almost all new track work great care has been exercised to produce a permanent track surface. Some roads have employed a solid mass of concrete to do this, while others have used crushed stone ballast, either rolled in place with a road roller or else repeatedly tamped until a true, permanent surface is obtained, the track being left open while traffic passes over it. In one instance the usual practice did not obtain, but a combination of crushed stone and concrete was employed. This consisted of a concrete slab laid on the subgrade, a layer of crushed stone directly under the ties and a second layer of concrete over these two. In all cases the best results have been secured where drainage has received careful consideration.

In selecting ties similar precautions have been observed to obtain permanency. Steel and treated ties have been employed almost universally for both city and interurban railway track. Examination of track built in recent years in Chicago, where various kinds of treated ties were employed, developed the new and interesting fact from the electric railway standpoint that ties treated with zinc chloride would practically destroy a screw spike after three years' service. This destruction was attributed to a gal-

vanic action taking place in the presence of moisture and the zinc chloride.

Rail and joint composition is receiving more and more attention. The specifications for recommended practice, as presented by the committee on way matters to the American Electric Railway Engineering Association, have been followed by engineers giving special attention to this subject. High-carbon rail with the addition of a small percentage of titanium to its composition appears to be most favored. Both girder-grooved and T-rail are being used with considerably more of the latter for track in paved streets than heretofore. The satisfactory results obtained by several large companies experimenting with T-rail have been largely responsible for its general adoption. In this connection the decision rendered during the year by the Connecticut Public Utility Commission is interesting. It was to the effect that T-rail is less objectionable in paved streets than formerly because automobiles, which constitute an increasingly larger proportion of the street traffic, have no difficulty in crossing the head of the T-rail. Hence the commission agreed to its continuance and the extension of its use in such a large city as New Haven.

Considerable progress has been made along the line of improved rail joints, the welded and riveted types being favored. The low percentage of failures reported by different companies demonstrates the practicability of these types. Welded joints are being installed by several processes, including the Goldschmidt thermit, the Lorain electric welds, oxy-acetylene and electric-arc welds. In several instances a combination of the riveted joint and the welded joint has given very satisfactory service.

With the more permanent types of track construction in streets, longer life is being obtained from all classes of pavement. The creosoted wood block and asphaltum are growing in favor, and a new method of combining brick and wooden keys for fillers is attracting considerable attention in the Eastern States. In some instances engineers have gone so far as to pave between the rails with asphalt or solid concrete, considering that the excellence of the present track construction warrants a pavement which requires a higher cost for renewal. The question of a proper filler for block paving has attracted considerable attention, but no definite conclusions have been reached, grout, asphaltum and sand being used largely.

Rail corrugation and the reasons for it have received much attention. Reports from abroad would indicate that this mysterious phenomenon may be solved by special rail design, such as one with a slotted web or a double web, as used in Gothenburg, Sweden. A tentative report by a British committee recommends that the composition of the rail be changed to include a relatively high percentage of manganese, carbon and silicon, which would make it hard and tough.

In this country the introduction of several types of rail grinders for removing corrugations economically has had considerable bearing on investigation of this subject. Engineers have satisfied themselves of the fact that corrugations exist and the best way to eliminate them, for the present at least, is to remove them by grinding. Recently a new method of increasing the life of rail, particularly on curves, has been considered by steam roads. This is by lubricating wheel flanges, which, while it does not reduce braking power as might be expected, increases the life of rail on curves from one to two and one-half years.

First-quality construction has not been confined wholly to the track in city streets but has governed the construction and renewals on interurban lines. Practically all roads are making tie renewals with treated timber, the creosoted oak ties being favored largely. In several instances longleaf yellow pine has been employed with the addition of tie plates to prolong their mechanical life. Screw spikes have not been used extensively except in track in pavement, satisfactory results being obtained from ordinary spikes. We believe, however, that they will come into extensive use on interurban lines in a few years as will tie plates also, if the engineer hopes to secure a mechanical life of a tie equal to its physical life.

Drainage has received proper attention in the way of extensive ditching in preparing track for winter and the installation of farm drain tile in wet cuts. Both tend to lengthen the life of the ballast and improve track conditions generally. The narrow roadbed has been abandoned for one of sufficient width to give an ample ballast shoulder on embankments, as well as wide ditches in the cuts. Very little temporary construction has been employed in bridges and culverts on new interurban lines as its high maintenance cost on existing lines has been thoroughly established. This experience also has resulted in the replacement of old temporary structures with concrete and steel, which will ultimately mean that the engineers' attention may be turned entirely to that part of a roadbed above the track subgrade.

It is with considerable pride in the industry that we point to the progress in building construction during the past year. We believe that not a single carhouse, repair shop, substation or power station of any importance has been built which did not embrace every precaution and appliance for the reduction of fire hazard. When the building conformed to the principles of fireproof construction throughout, the addition of a sprinkler system, hose outlets and other fire-protective apparatus was included to reduce the risk on the contents, which cannot be made absolutely fireproof. The general shop layout has been receiving considerable attention with a view to reducing lost motion and at the same time meeting the requirements of insurance underwriters.

The year just passed represents an era of marked progress along economical lines so far as way and buildings are concerned. Greater efficiency in service will result without doubt, but the acme of improvement has not been reached. There is room still for great advancement in the selection of the materials going to make up the track and roadway, the buildings and structures. The introduction of motor-driven tools, concrete mixers and electric shovels and other labor-saving devices is doing much toward reducing the cost of new track as well as the rehabilitation of the old. Upon the head of the way and building department of any company depends to a large extent the safety and economy of operation, as well as the maintenance of the physical excellence of the property. He must, therefore, lend an ear to the profitable experiences of his colleagues in the industry, and all must work together for the benefit of the whole.

BLOCK SIGNALING ON ELECTRIC RAILWAYS

During the past year the practicability of block signaling for electric railways has become an established fact, and the problem which the subject presents is no longer that of durability or of commercial possibility, but is instead one of standardization and selection from among the numerous types of apparatus existing to-day. Considering the fact that the whole matter of block signals on electric railways is one to which serious attention has been devoted for only two years, it is not surprising that no immediate possibility exists for standard arrangement or even for standard details of construction. On the other hand, the serious attention which is being paid to this subject by many of the electric railways through the national association is certain to exert a strong tendency at least toward the development of standard aspects.

While the standardization of apparatus will unquestionably reduce costs, the necessity for uniform signal aspects is actually of greater importance, especially as uniformity in this respect can be accomplished with vastly greater ease at the present time, when the installation of automatic signals on electric railways is only just beginning, than at some later time when large and important roads are fully equipped with widely different types. This necessity is shown even to-day in cases where, through operating agreements, several interurban roads are using the same tracks. Each road may be using a different signal aspect on its own track so that motormen are hampered by the fact that they have to think in totally different terms at different portions of the route. In consequence of this demand for standardization the upper-left-hand quadrant, three-position arrangement for semaphores has already been approved by the electric railway associations.

The year has been characterized by a remarkable growth of sentiment in favor of light signals in which the semaphore arm, practically standard upon steam railroads, is replaced by colored lenses so illuminated as to be visible even in the brightest sunlight. A number of such installations have been made during the year, and although the semaphore arm still appears to be considered as the most reliable indication from the standpoint of arrestive effect, the decreased first cost of the light signal, estimated to be in some cases as much as 30 per cent lower than the semaphore, together with the decreased maintenance due to the absence of moving parts, is a good indication that it will be subject to a still wider adoption during the next few years.

Of the different methods of control for signals, the continuous track circuit has maintained its leading position among the installations on high-speed lines. This may be partly due to conservatism in following a method so universally used by the steam railroads, although one of the advantages claimed for it, namely, that it indicates broken rails, can hardly be said to apply with much force to electric railways. It has, however, a somewhat similar advantage in this case in that it indicates defective bonding by the failure of the signals to clear. The thoroughly demonstrated reliability of the track circuit through many years of experience naturally cannot be denied, and it was undoubtedly this feature which influenced the joint committee on block signals of the Engineering and Transportation & Traffic associations at the Chicago convention in recommending for high-speed interurban service the use of continuous track circuit control. The fact that this recommendation was not accepted by the association in convention was an interesting occurrence indicative of the desire of the delegates to be left free either to accept new devices or else to await the development of systems not then sufficiently tried out.

Of the comparatively recent innovations, a great deal of attention has been paid to dispatchers' systems, although the number of such installations is hardly comparable with the older track circuit types. On the Piedmont Traction Company's lines a selector system controlling semapore blades has been installed to enable the dispatcher to stop trains for orders which are transmitted by telephone boxes attached to each signal mast. The Indianapolis & Cincinnati Traction Company has installed, as the other extreme, an exceedingly complete type in which connection between the dispatcher and the train is made at short sections of third-rail through a shoe on the car. By means of this connection the dispatcher can illuminate either a red or a green lamp in the cab of the train in accordance with his desire to stop the train or let it proceed, although an ingenious interlocking system prevents him from letting two trains proceed against each other. As it is reported that this system can be installed at a moderate cost, its action has been watched with considerable interest.

Various forms of the trolley contact system have been installed on a number of railways throughout the year, as their very greatly reduced cost offers a strong incentive to their installation. In addition, the possibility for introducing a car-counting device by giving the contactor a directional sense makes this system of unusual advantage where permissive signals, allowing cars to follow each other into the same block, are desired. Permissive blocking, however, except for very low speeds, seems to have been regarded with decreasing favor during the past year.

Little has been done with automatic stops in addition to that discussed in these columns a year ago. On the Illinois Traction System a device has been developed by which the air brakes are applied in case a car runs past a home signal set at stop. Such a device is of undoubted value as it stands. On the New York, Westchester & Boston Railway the future necessity for automatic stops was considered to be such a certainty that the signal system was laid out in a manner which would permit them to be installed at any time, the overlaps to be effected by additional signals being interpolated where necessary along the line.

The important legislative action of the year in regard to block signaling developed through an enactment of the General Assembly of Indiana. This law became effective on Jan. 1, 1912, and placed with the State Railroad Commission power to compel the introduction of approved block signals on the railways of Indiana which had sufficient traffic or were surrounded by such conditions as to make block signals necessary. The results of this action seem to have been remarkably satisfactory. The Railroad Commission has been working in perfect accord with the electric railways of the State, and a very marked increase in mileage of interurban lines protected by signals has resulted during the year. It is estimated that 18 per cent of the total electric railway mileage is now being equipped, and it is ex-

pected that all lines coming within the scope of the enactment will be equipped within three years.

Of the large single-track installations made during the year, that of the Washington, Baltimore & Annapolis is probably the most interesting. On this road the customary preliminary sections are omitted and each block is made self-contained, extending the full distance between sidings. Light signals set about 1000 ft. inside of the home semaphores take the place of the preliminaries, and all home signals are approached under control. The home signals at each end of the block are controlled by the whole block, but the light signals are controlled only by two-thirds of the block length at the opposite end of the block. As each block is a unit, the movements of a car in one block do not affect those in the next one, and cars need be spaced no more than one block apart. In case two opposing trains pass home semaphore signals at the same time, they will be stopped by the light signals, which will not clear until one train has backed out of the block. As this installation is the first of its kind, the results of its operation should be watched with interest.

Judging from the interest displayed in the matter during the past year, there is no doubt that the subject of signals will remain a leading one during 1913. In fact, it is likely that wherever funds are available for signals some one of the many forms now available will be installed, not only for the additional safety which they afford, but also to accelerate operation on lines of dense traffic.

THE ELECTRIC RAILWAY SITUATION

So far as the gross volume of business is concerned, the electric railways of the country generally enjoyed a satisfactory year in 1912. The well-known characteristic of these properties is that, as a rule, unless extraordinary conditions interfere, they show a fair rate of increase in gross revenue from year to year. The degree in which this characteristic is manifested is affected of course by fluctuations in the population and volume of business in each locality; but the normal changes in population and business are increases, and to the street railway this means a larger total of possible riders and a larger amount of work to which employees must travel each day. The exceptions among the electric railway companies to the conditions thus set forth are found in districts which are highly sensitive to changes in the general business situation, such as mining localities and some of the iron and steel districts, and also in those occasional instances where strikes among the employees of the railway itself or catastrophes disarrange the expected order of affairs. The spurt in general manufacturing and commercial lines in 1912, which occurred in spite of the impending presidential campaign, was an advantage to the electric railway companies.

The factor of gross business, however, is not the solitary index of electric railway fortune. Increased volume of business has been handled by many companies at a greater expense for operation. Higher costs of labor and materials affect the companies in two ways. They increase the cost of investment and hence the fixed charge for additions to the property, and they increase the daily outlay which has to be made and charged to operating expenses in order to keep the cars in operation. There are only two ways in which this rising tide of expenses can be met. One is by increase in the rate of fare. That is not open now to most of the companies, because they operate under fixed franchise terms. The other way is by increase in the density of traffic, and it is through this means that each company tries to improve its position.

There is one more respect in which the relations of all the companies and the communities they serve are very similar now or are rapidly becoming so. Regulative policies of the advanced types found in the New York and Wisconsin laws, with some modifications influenced by local conditions, are succeeding the old relations between the companies and the states and are still raising new problems or old problems in new clothing for the industry to solve. These problems are vital in character and strike at the foundations on which the industry rests. They concern the capitalizable values of the properties, the rates of fare on which the revenues are based and the inviolability of the franchise contracts on which the companies have relied in their sales of securities to bankers and on which the bankers have relied in their purchases and their re-sales to the general public. The new policy of regulation usually regards it as its duty to concern itself with one or more of these serious problems. In some notable instances, however, the regulative bodies have given more attention to questions of service than to those affecting values or rates. That is to say, these bodies in some cases have not considered that they were required, either as a matter of public policy or as a matter of obedience to the law, to analyze existing capitalization in its relation to the property represented or to disturb existing rates, but have exerted a powerful influence toward the improvement of service. Where this course has been followed conspicuously by one conscientious commission, although there has been a manifest effort not to disturb existing securities at the price of sacrifice to individual holders, the terms of issue of additional securities have been safeguarded carefully.

The interests of all of the companies are bound together closely so far as the broad questions of regulation, valuation and rate of fare are concerned, but the real settlement of the problems must be made necessarily with a single commission or a single community in the case of each company. In other words, these problems become individual and must be dealt with as such by each company acting for itself. Local conditions differentiate one case from another. During the last year the problems have been defined sharply and prominently in several cities. A statement of the conditions existing in several of these places, which have been conspicuously before the industry, illustrates what is found in other cities in smaller degree.

In New York the greatest pending development of importance to the industry is the construction of new subway and elevated rapid transit lines proposed by the Interborough and Brooklyn rapid transit companies. Negotiations between the city authorities and the companies have been very tedious, and the long delay in final settlement has been costly to the city. But actual progress in subway construction is being made now, and the last details of operating contracts will undoubtedly be settled in the course of time. The condition of financial chaos into which the principal surface properties were thrown when receivers were

appointed for the Metropolitan system in 1907 has not yet been entirely cleared up, but the steps which remained to be taken during 1912, and those which had to go over unsettled until the new year, 1913, are very slight compared with those that were precipitated upon the community when the receivership was announced over five years ago. The withdrawal by the New York Public Service Commission, First District, of its order for the amortization of that part of the securities of the two principal surface companies which it claimed was in excess of the fair value of the properties has removed one cause of litigation and contention between the commission and the companies under its jurisdiction.

In Chicago the elevated and surface companies are engaged in negotiations for consolidation. Their relations toward each other, their capital values and the entire program of future transit development for the city of Chicago are bound up in the outcome of the negotiations. In spite of divided ownership of the surface properties the city has tried to secure a measure of through routing on surface lines between the three principal sections of the city. The four separately operated elevated companies use a common loop terminal in the business district but do not interchange traffic. It is now proposed to combine with one ownership for all the existing properties a definite program to meet future transit needs. At the same time that these negotiations are progressing one of the companies has been engaged in a controversy with its trainmen in regard to wages and the other companies are being confronted by similar issues.

In the State of Ohio two of the cities have problems that were not settled in 1912. Toledo has witnessed the remarkable and wholesome spectacle of a reorganization which included no arrangement for delay until a satisfactory contract for renewal of franchise could be closed with the city. In Columbus the company is going ahead to fulfil an extraordinary provision in its franchise providing for a reduction in the rate of fare as the gross earnings increase. This provision is operative without the slightest regard for the question of whether the operating expenses increase or decrease, and it is an illogical requirement. The questions arising in these two cities involve important issues for the attention of the companies during the coming year.

The companies in other cities have problems, a few of which may be mentioned. In San Francisco the city is developing a new basis for franchise contracts. The city of Cleveland is still continuing its rigid control of the street railway and restricting the service so as to keep a low rate of fare. In Buffalo a plan of financial reorganization has been completed which will be made effective. The valuation of the properties in Kansas City is part of an attempt to reach a franchise settlement. Los Angeles has an elaborate program for the regulation of its public utilities. The Detroit situation is still unsettled. In St. Louis a commission appointed by the Municipal Assembly has made an investigation of the finances and service of the local railway. The Milwaukee company has carried to the courts an order of the State commission directing reduction in the rate of fare. In Philadelphia progress has been made in the settlement of some of the difficulties with which the system has been beset for years, the city service has been vastly improved and the city of Philadelphia is conducting an exhaustive investigation into the best means for introducing rapid transit within its "metropolitan district."

On the part of the public the program for the coming year includes further extension of regulative commissions. Commission bills will be introduced in several of the states whose legislatures meet. The movement in this direction in Illinois has been met by a counter movement having for its object home rule of public service corporations in each city. The principle of this movement appears to be a popular one, and either in Illinois or elsewhere it will have some influence on the design of the public machinery for regulation. The desire for regulation on the part of the public has not diminished, but we believe there is a better understanding in at least several of the commissions of the real difficulties under which the companies labor in these times to protect the investment, to make a good return thereon and to provide adequate service.

ELECTRIFICATION PROGRESS IN EUROPE

In Europe the past year will be remembered as marking a notable advance in the attack on the steam locomotive, because the present electrification projects, either approved or practically sure of approval, have assumed vast proportions in comparison with the small experimental sections of earlier years. The experience derived from the pioneer work, in Italy and Germany particularly, has made the question of the reliability of electrical equipment a dead issue, and the progress of steam railroad electrification in Europe is now more a matter of economics than of design.

So far as systems are concerned, England appears to be the only country where high-tension direct current is being considered at present with great favor for trunk-line conditions. On the Continent the single-phase system, with a trolley potential of 10,000 volts to 15,000 volts and a frequency of fifteen to sixteen and two-thirds cycles, has been adopted by Germany (Prussia, Bavaria and Baden), Austria, Sweden and Switzerland. The French are now experimenting with single-phase equipment, and even Italy, which has expressed such satisfaction with its three-phase Valtellina and Giovi lines, appears willing to take advantage of the progress of single-phase equipment as demonstrated on the Prussian State Railroads. It is understood that, in line with this broad attitude, the 18.6-mile section of the Italian State Railways between Turin and Pinerolo is soon to be supplied with a single-phase outfit, the behavior of which may possibly decide whether single-phase or three-phase shall be the standard for future electrifications. It is significant, furthermore, that the engineers of the largest two electrical firms of Europe favor single-phase equipment for all heavy high-speed railroading. The importance of the various European electrifications is not to be gaged by the total horse-power capabilities required, which are small in comparison with American trunk line installations, like the New Haven, but rather by the fact that they are intended to form parts of great arteries of Continental traffic.

The enthusiasm which foreign engineers and railway officials are showing for electrification may be a surprise to those who are familiar with the conservatism of Europe in other matters, but this anomaly may be explained by the

fact that the traffic and economic conditions which favor electrification are more numerous in Europe that they are in America. Switzerland, for instance, offers an ideal set of conditions for electrical railroading, inasmuch as electric operation of the numerous mountain tunnel railways will make tourist travel more agreeable than ever, while the large amounts of money which now leave the country to pay for high-priced fuel will be diverted to the development of home water-powers. On many Continental lines electrification offers the cheapest way of increasing the capacity of congested trunk railways and the opportunity of exploiting water-power sites or low-grade fuels which are not suitable for locomotives. One other excellent economic reason for the choice of electrical equipment on the large systems is that the steam locomotives need not be scrapped but can simply be diverted to branch lines from time to time, while the cars require but few radical changes for use with electric locomotives. For these reasons European engineers have always looked upon electrification as something much more than a terminal proposition, a fact which accounts in large measure for their choice of high-tension overhead systems from the beginning. In general, also, the electrification of European lines is not accompanied by the radical and costly right-of-way changes which have characterized American installations.

A summary of the work under way at this time shows that Germany and Switzerland are far in the lead. Following the initial installation of the Dessau-Bitterfeld section of the Magdeburg-Halle-Leipzig line, as described at length in previous issues of this journal, the Prussian State Railroads have begun the electrification of the Lauban-Königszelt trunk lines and branches to cover 253 miles of single track. Five motor cars and forty-four out of seventy-two locomotives have already been ordered, with the expectation that the first section, Königszelt-Dittersbach, will be in operation late this year and the complete installation by 1915. Energy will be purchased at the high-tension busbars of a new, privately owned power station at 0.69 cent per kw-hr. The other great project of the Prussian State Railroads —namely, the Berlin Stadtbahn and suburban connections— is being delayed by interests that assert that larger steam locomotives will meet the problem of handling the increased traffic. The Prussian Chamber of Deputies has been advised, however, that under the very best conditions steam locomotives would not permit more than thirty-two trains an hour with a maximum of 19,500 seats, compared with forty electric trains during the same period with 25,400 seats. Offers have already been received from private companies to supply energy to the Stadtbahn at 0.8 cent to 0.95 cent per kw-hr. Other German work includes the Wiesental line of the Baden State Railways, on which trial runs were commenced late in 1912, and the contract for the electrification of the Reichenhall-Freilassung division of the Bavarian State Railways.

The most interesting work now under way in Switzerland is the Loetschberg line, which forms a continuation of the famous Simplon Tunnel from Italy. This line, which will be opened in the summer of this year, will receive thirteen single-phase locomotives, each carrying two 1250-hp motors and capable of handling 300-ton trains at a constant speed of 31 m.p.h. These locomotives will be the largest in Europe. The St. Gotthard tunnel, which constitutes the other great highway between Italy and Switzerland, is next in line for an electrification which would cover the distance of 93 miles between Chiasso and Lucerne. The time for the St. Gotthard work is considered opportune as most of the present locomotives require early replacement. At any rate, the water-power concessions have already been bought by the federal authorities.

Th principal three-phase electrifications in Italy are the original Valtellina 67-mile railway and the new Giovi Pass 13-mile division. The next three-phase electrification is that of the Mont Cenis-Freyus tunnel on the Turin-Modane line. In Austria the electrifications like those of the Vienna-Pressburg and St. Pölten-Mariazell lines and the Mittenwald Railway are outside the trunk-line pale. However, the Austrian State Railways have already made study of electrifiction possibilities for 614 miles of route, and the Attnang-Puchheim-Stainach-Irdning division, comprising 66.34 miles of route, has been recommended for early equipment.

As yet no extensive trunk-line work is in operation in France, but at this time the French Southern (Midi) Railway has several single-phase locomotives on trial at Villefranche, and thirty 500-hp four-motor cars are on order for service over 175 miles of single track covering the main line between Pau and Montrejean as well as intermediate branches. The western division of the French State Railways has recently ordered 130 d.c. motor cars for use on its Paris suburban lines, while the Paris-Lyons-Mediterranean Railway is experimenting with permutator locomotives. As for Scandinavia, the 93-mile Kiruna-Riksgränsen line of Sweden has already been described in these columns, while Norway is still without high-speed a.c. railways, although the government engineers have expressed their approval of single-phase. The ample water powers in both of these countries make the outlook for extensive electrification, and even for new lines, very encouraging.

In conclusion, it is gratifying to note the activity in electrification of the steam lines in and about London. The London, Brighton & South Coast Railway will soon take in hand its important suburban lines, and estimates are also being prepared for the electrification of the main line to Brighton. The Midland Railway, which has been operating 8.5 miles of single-phase route on its Heysham-Morecambe-Lancaster line, has not announced any additions or other changes. On the other hand, the London & South Western Railway and the London & North Western Railway have decided to use 600-volt direct current on their converted suburban lines, thereby making it possible for them to operate in connection with the London underground system. The first South Western electrification will involve the conversion of 73 miles of single track with a further 173 miles of single track later on, while the London & North Western Railway is planning to electrify 79 miles. The results of the high-tension d.c. experiments of the Lancashire & Yorkshire Railway are being awaited with interest by English engineers, as it is appreciated that some form of high-tension distribution will be necessary when the d.c. electrifications mentioned are extended beyond the suburban zone of London.

Electric Railway Rolling Stock Ordered in 1912

Number, Type, Length and Builder of All Cars Ordered by Electric Railways, Compiled from Official Returns Made by Railway Companies and Car Builders

The accompanying table shows in detail the number of cars ordered by electric railways in the United States and Canada during 1912. The total number of cars of all kinds ordered was 6001, which is an increase of 1968, or 49.4 per cent, over the number ordered in 1911. As in previous years the table has been compiled from the orders for rolling stock noted from week to week during the year in the rolling stock column of the ELECTRIC RAILWAY JOURNAL, from returns made by the railway companies and from reports received from car builders. No claim is made that the record is complete. Every effort was made to secure returns, and those from car builders were checked up against those from railway companies, but a few companies did not reply in time so that their data could be included.

The number of cars ordered, classified according to the service in which they are used, is given below:

	1908	1909	1910	1911	1912
Passenger cars, city	2208	2537	3571	2884	4531
Passenger cars, interurban	727	1245	990	626	783
Freight and miscellaneous cars	176	1175	820	505	687
Total	3111	4957	5381	4015	6001

It will be seen from the table that a great many city cars ordered during 1912 were of the prepayment type. A special enumeration is not made of the prepayment cars because this type is almost universal now in new city cars ordered. Prepayment cars are indicated by an asterisk (*) in the table.

Interurban passenger cars showed an increase of 25.1 per cent over the totals of 1911. The figures for interurban cars include orders for subway and elevated equipment.

The number of electric locomotives ordered was sixty-five, as against eighty-one in the preceding year. The New York, New Haven & Hartford Railroad ordered twenty-four locomotives for passenger and freight service.

Among the striking features of rolling stock orders last year was the spread of the near-side car. Of this type the Philadelphia Rapid Transit Company ordered 950 cars, the International Railway, Buffalo, 316 cars, and the Chicago City Railway 125 cars. The one-man near-side car was also developed. Cars of this type were ordered by the International Railway, the Illinois Traction System and the Fort Wayne & Northern Indiana Traction Company.

Another striking development in rolling stock was the introduction of the center-entrance car. Large orders of this type included one from Brooklyn for 100 cars, one from New York City for 175 cars and one from Los Angeles for 36 cars.

In addition to the rolling stock listed below, there have been large sales of gasoline motor, gasoline-electric and storage battery cars for branch lines and suburban service on steam railroads. The McKeen Motor Car Company received orders from steam railroads for fifteen gasoline motor cars for the United States and five cars of that type for Australia. The General Electric Company built twenty gasoline-electric cars for steam railroad service. Of a total of forty-nine storage battery cars built by the Federal Storage Battery Car Company eleven cars were for steam railroad service in this country and nineteen cars were built for export to Cuba, Australia and Panama.

Purchaser	*No.*	*Class*	*Length*	*Serv.*	*Truck*	*Builder*
Albany (Ga.) Transit Co.	5	Closed	18–0	City	Brill	American
Algiers Ry. & Ltg. Co.	3	Closed	18–0	City	Balt.	Cincinnati
Allen St. Ry.	2	Closed	25–4	Int.	Brill	Brill
Alt. Jack & Peoria Ry.	4	Closed	48–1	Int.	M'G.C.	McGuire–C.
Ardmore & Llanerch St. Ry.	2	Closed	52–0	Int.	Bald.	Jewett
Arkansas Valley Inter. Ry.	3	Closed	46–0	Int.	St. L.	St. Louis
	2	Trail	40–0	Int.	St. L.	St. Louis
	1	Work	40–0	Int.	St. L.	St. Louis
	1	Flat	36–0	Int.	St. L.	St. Louis
Aroostook Valley R. R.	2	Closed	43–0	Int.	Brill	Wason
Athol & Orange St. Ry.	10	Open	30–0	Int.	Tay.	Wason
	4	Closed	25–0	Int.	Tay.	Wason
Atlantic Coast Elec. Ry.	3	Open	42–0	Int.	Brill	Brill
	3	Closed	28–0½	Int.	Brill	Brill
Auburn & Syracuse Elec. R.R.	3	Closed	20–0	City	....	Kuhlman
Aurora, Elgin & Chicago R.R.	1	Express..	50–0	Int.	....	Jewett
	5	Gondola	41–6	Int.	Press	Pressed St.
Bangor Ry. & Elec. Co.	3	Open..	....	City	.....	Laconia
Bay State St. Ry.	12	Open	31–0	City	St. L.	St. Louis
	8	Open	25–6	City	St. L.	St. Louis
	30	Closed	28–0	City	St. L.	St. Louis
	3	Express	....	Int.	St. L.	St. Louis
	1	Flat	....	Int.	....	Laconia
Beech Grove Trac. Co.	1	Closed	44–0	Int.	M'G-C.	McGuire-C.
Bent. Har.-St. Joe Ry. & Lt. Co.	3	Closed	34–8	City	M'G.C.	McGuire–C.
Berkshire St. Ry.	4	Closed	28–0	City	Std.	Wason
	5	Express	32–8	Int.	Std.	Wason
Berlin St. Ry.	1	Open	....	City	Lac.	Laconia
Berlin & Waterloo St. Ry.	2	Semiconv.	31–10	City	Brill	Preston
Billings Trac. Co.	1	Stor.Bat.	18–0	City	Brill	Brill
	3	Stor.Bat.	....	City	Fed.	Federal
Birm., Ensley & Bess. Ry.	20	Closed	45–1	Both	Brill	Brill
Birmingham Ry. Lt. & Pwr. Co.	9	Closed	33–6	Sub.	M'G-C.	McGuire-C.
	17	Trail Pass.	44–6	Sub.	M'G-C.	McGuire–C.
	1	Express	34–0	Sub.	Co.	Co. Shops
	4	Ballast	32–0	Sub.	Co	Co. Shops
Boston Elevated Ry.	35	Closed*	48–2½	City	Tay.	St. Louis
	40	Closed*	48–2½	City	Tay.	Laconia
	20	Closed	69–2½	Sub.	Brill	Laconia
	2	Crane	50–0	Int.	Brill	Russell
	1	Wreck	54–0	Int.	Brill	Russell
Boston, Rev. Beach & Lynn R.R.	1	Stor.Bat.	....	Sub.	Fed.	Federal
Boston & Worcester St. Ry.	6	Express	40–0	Int.	Std.	Osg-Brad.
British Col. Elec. Ry. Co., Ltd.	65	Closed*	30–0	City	Pres.	Preston
	22	Closed	40–0	Int.	St. L.	St. Louis
	1	Cl.St'pl'ss	34–0	City	Brill	Brill
	35	Semiconv.*	30–1	City	Brill	Brill
	15	Closed	....	City	....	Co. Shops
	6	Closed	40–0	Int.	St. L.	St. Louis
	1	Closed N-S.	34–1⅜	City	Brill	Brill
	4	Bag Ex..	54–0	Int.	Std.	Niles
	70	Frt.Box	41–0	Int.	Seat.	Seattle
	45	Frt.Flat	41–0	Int.	Seat.	Seattle
	6	Dump	28–0	Int.	H.-O.	Hart-Otis.
	2	Snow-swp.	28–0	Int.	Otta.	Ottawa
	5	El.Locos.	33–0	Int.	Bald.	Westingh.
Brooklyn Rapid Transit Co.	1	Closed C-E.	45–6	City	Std.	Standard
	100	Closed C-E.	45–6	City	Brill	Brill
	2	Sweeper	23–7	City	Rus.	Russell
Buffalo & Lake Erie Trac. Co.	1	Sn.-plow	30–0	Int.	Rus.	Russell
Burlingame Elec. Ry.	1	Stor. Bat.	....	City	Fed.	Federal
Butte, Ana. & Pac. R. R.	2	Elec. Loco.	38–0	Pass.	A. L.	Gen. Elec.
Butte Elec. Ry.	4	Closed	28–0	City	Co.	Co. Shops
Calgary St. Ry.	6	Closed*	41–6	City	Brill	Preston
	12	Closed	41–6	City	Brill	Ottawa
	12	Closed	46–6	City	Brill	Ottawa
	6	Trail Pass.	44–0	City	Brill	Ottawa
	1	Sweeper	24–0	City	. . .	Ottawa
	1	Sprinkler	24–0	City	Brill	Preston
	1	Sight-see'g	....	City	....	Preston
Cape May, Del. Bay & Sewell's Point R. R.	2	Stor.Bat.	18–3	City	Brill	Brill
Capital Trac. Co.	5	Semiconv.*	30–8	Sub.	Std.	Cincinnati
	50	Semiconv.	28–4	City	Brill	Jewett
Carolina Pwr. & Lt. Co.	2	Semiconv.	20–8	City	Brill	Brill
Carolina Trc. Co.	1	Stor.Bat.	....	City	Fed.	Federal
Cedar Rap. & Mar. City Ry.	2	Closed	21–4	City	Co.	Co. Shops
	1	Sweeper	28–3	City	M'G.C.	McGuire–C.
Central California Tr. Co.	5	Express	36–0	Int.	Hol.	Holman
Central Park, North & East River R. R.	1	Stor.Bat.	....	City	Fed.	Federal
Cent. Ill. Pub. Serv. Co.	1	Cinder	.....	Int.	M'G.C.	McGuire–C.
Central Pennsylvania Tr. Co.	6	Semiconv.*	25–0	City	Brill	Brill
Charleston Cons. Ry. & Ltg. Co.	5	Semiconv.*	20–8	City	Brill	Cincinnati
Charleston Int. R. R.	2	Closed*	48–9¾	Int.	Std.	Jewett
Charlotte Elec. Ry.	3	Closed*	....	Int.	....	Cincinnati
Chattanooga Ry. & Lt. Co.	10	Closed*	28–8	City	Brill	Cincinnati
Chicago City Ry.	125	Semiconv. N.-S.	34–1⅜	City	Brill	Brill
Chicago & Oak Park Elev. R.R.	1	Fire-ftg.	25–0	Elev.	....	Co. Shops
Chicago Railways	1	Oil	45–2	City	St. L.	Co. Shops
Chillicothe Elec. R. R., Lt. & Pwr. Co.	2	Closed*	40–0	City	Brill	Kuhlman
Chippewa Valley Ry. Lt. & Pwr. Co.	3	Closed*	22–0	City	M'G-C.	McGuire–C.
Cincinnati Trac. Co.	26	Closed*	33–0	City	Brill	Cincinnati
Citizens' Trac. Co.	8	Closed*	21–0	City	St. L.	St. Louis
City & Suburban Ry.	1	Semiconv.	25–6	City	Brill	Brill
Cleveland Const. Co.	1	Work	20–0	Int.	M'G.C.	McGuire–C.
Cleveland Ry.	1	Cl. C-E.	45–4	City	Brill	Kuhlman
	200	Trail Pass.	48–0	City	Brill	Kuhlman
	2	Sweeper	22–3	City	M'G-C.	McGuire–C.
Columbia Ry Gas & Elec. Co.	2	Closed*	39–0	City	Brill	Co. Shops
Columbus, New Albany & Johnstown Trac. Co.	1	Comb.	50–0	Int.	M'G-C.	McGuire–C.
Columbus Ry. & Lt. Co.	10	Closed*	28–8⅜	City	Brill	Kuhlman
Conestoga Trac. Co.	4	Open	28–0	City	Brill	Brill
	3	Closed	30–8	Int.	Std.	Cincinnati
	1	Com. & Pl.	45–0	Both	Std.	Cincinnati
Connecticut Co.	1	Express	40–0	Int.	Std.	Osg-Brad.
	2	Elec.Loco.	31–8	Switch	Bald.	Westingh.
	4	Dump	10–0	City	Was'n	Wason

Purchaser	No.	Class	Length	Serv.	Truck	Builder
Connecticut Valley St. Ry.	3	Closed	30–0	Int.	Tay.	Wason
	1	Express	40–0	Int.	Tay.	Co. Shops
County Trac. Co.	20	Closed*	45–0	City	M'G-C.	McGuire–C.
	1	Work	45–0	Both	M'G-C.	McGuire–C.
	1	Sweeper	....	City	M'G-C.	McGuire–C.
	1	Sprinkler	29-6	City	M'G-C.	McGuire–C.
	3	Dump	....	City	M'G.C.	McGuire-C.
Cumberland (Md.) Elec. Ry.	3	Open	22–0	City	Brill	Brill
	3	Closed	22–0	City	....	Brill
Cumberland (Pa.) Ry.	1	Stor.Bat.	50–0	City	....	Federal
Dallas Elec. Corp.	13	Closed*	26–6	City	Brill	St. Louis
	1	Work	....	Int.	....	St. Louis
Dallas-Southern Tr. Co.	6	Closed	34–6	Sub.	Brill	Osg.-Brad.
	1	Baggage	45–0	Int.	Brill	Osg.-Brad.
Davenport & Muscatine Ry.	8	Closed*	20–1	City	Brill	American
	1	Sn.-Plow	....	Int.	M'G-C.	McGuire–C.
DeKalb-Sycamore Int. Ry.	1	Closed*	28–10	City	....	American
Denver City Tram. Co.	2	Closed	44–0	City	Brill	Woeber
	6	Closed	44–0	City	Brill	Woeber
Des Moines City Ry.	25	Closed*	28–10	City	Brill	American
	2	Sweeper	28–3	City	M'G-C.	McGuire–C.
Detroit, Monroe & Toledo Short Line Ry.	4	Closed	45–10½	Int.	Std.	Niles
Detroit United Ry.	2	Closed,	36–3	Int.	Bald.	Niles
	8	Closed	41–10½	Int.	Std.	Niles
	100	Closed*	23–2	City	Dup.	American
	50	Closed*	31–4	City	Std.	Kuhlman
	5	Express	41–5½	Int.	Std.	Niles
	5	Work Tr.	38–0	Both	R.W. & Fdy.	Russell Wheel & Fdy.
	15	Work Fl.	28–0	Both	R.W. & Fdy.	Russell Wheel & Fdy.
	1	.....	48–0	Both	Std.	Co. Shops
	1	Supply	49–10	Int.	Std.	Niles
	1	Loco.Cr.	23–0	City	Ind.W.	Ind. Iron Wks.
	1	Con.Mix.	12–7	City	Dup.	Co. Shops
Dominion Pwr. & Trans. Co. Ltd.	12	Closed	21–0	City	Tay.	Preston
	15	Closed	30–0	City	Brill	Preston
Dover, Somersworth & Roch. St. Ry.	2	Semiconv.	39–0	City	....	Laconia
Eastern Texas Trac. Co.	9	Closed	56–0	Int.	M'G-C.	Jewett
	1	Express	50–0	Int.	M'G-C.	Jewett
Eastern Transit Co.	3	Semiconv.*	20–8	City	...	Brill
East St. L. Col. & Waterloo Ry.	2	Sn.-plow	....	Int.	Rus.	American
	1	Bag.-Ex.	42–6	Int.	Brill	American
East St. Louis & Sub. Ry.	1	Closed	50–0	Int.	St. L.	St. Louis
	2	Sprinklers	29–6	City	M'G.C.	McGuire–C.
Edmonton Radial Ry.	35	Semiconv.*	33–3	City	Std.	Preston
	15	Semiconv.*	30–6	City	St. L.	St. Louis
	1	Work	40–0	City	M'G-C.	McGuire–C
	1	Dump.	33–6½	City	Can.	Canadian
Elkins Elec. Ry.	1	Comb.	40–0	Int.	St. L.	St. Louis
Elmira Wtr. Lt. & R. R. Co.	8	Semiconv.*	33–0	City	Std.	Cincinnati
El Paso Elec. Ry.	12	Closed	29–0	City	St. L.	St. Louis
Ephrata & Lebanon St. Ry.	2	Stor.Bat.	....	City	Fed.	Federal
Escanaba Trac. Co.	1	Flat	42–0	Special	M'G.C.	Co. Shops
Evansville Rys.	3	Comb.Pas. & Bag.	50–0	Int.	Brill	American
	1	Ex.-Bag.	45–0	Int.	Brill	American
Fargo & Moorhead St. Ry.	1	Sweeper	26–0	Int.	M'G-C.	McGuire-C.
Fonda, Johns. & Glov. R. R.	2	Closed	41–8	Sub.	Tay.	Jones
	1	Work	27–0	Line	Tay.	Co. Shops
Fox & Illinois Union Ry.	1	Express	36–0	Int.	M'G.C.	McGuire–C.
	2	Closed	48–0	Int.	M'G.C.	McGuire–C.
Ft. Dodge, Des Moines & Southern R. R.	2	Closed	40–0	City	Std.	Jewett
Ft. Wayne & No. Ind. Trac. Co.	19	Closed*	21–0	City	Curtis	Cincinnati
	17	One-man	21–0	City	Brill	Brill
	4	S-C N-S	34–1⅜	City	Brill	Brill
Freeport Ry. & Lt. Co.	1	Sweeper	28–3	City	M'G-C.	McGuire–C
Fresno Trac. Co.	4	Closed*	42–8	City	Jewett	Jewett
Galt, Pres. & Hespeler St. Ry.	2	Closed	43–5	Sub.	Bald.	Preston
Galveston-Houston Elec. Co.	4	Closed	53–0	Int.	St. L.	St. Louis
Gary & Int. Ry.	1	Elec. Loco.	....	Int.	M'G.C.	McGuire–C.
	8	Closed	44–0⅜	City	M'G.C.	McGuire–C.
Geary St. Munic. St. Ry.	43	Closed*	48–0	City	Brill	Holman
Geneva & Auburn Ry.	1	Sn.-plow	36–4	Int.	Bald.	Co. Shops
Goshen, So. Bend & Chi. Ry.	6	Express	50–0	Int.	M'G.C.	McGuire–C.
	2	Closed	56–0	Int.	M'G.C.	McGuire–C.
Grand Junction & Grand River Valley Ry.	2	Closed*	26–0	City	Bald.	Southern
	1	Express	40–0	Int.	Brill	Woeber
Grand Rapids, Grand Hav. & Musk. Ry.	1	Closed	52–7½	Int.	Bald.	Niles
	1	Comb.	52–7½	Int.	Bald.	Niles
	3	Express	46–1½	Int.	Bald.	Niles
Grand Rapids Ry.	10	Closed*	28–0	City	Brill	Cincinnati
Granite City Ry.	4	Closed	22–0	City	M'G-C.	Jones
Greenville, Spartanburg & Anderson Ry.	5	Elec.Loco.	35–0	Freight	Bald.	West.
Guelph Radial Ry.	1	Sweeper	26–6	City	M'G-C.	Preston
	1	Sweeper	28–3	City	M'G'C.	McGuire–C.
Hagerstown & Clearspring Ry.	4	Closed	28–0	City	St. L.	St. Louis
Halifax Elec. Tram. Co.	4	Closed	21–0	City	Co.	NovaScotia
	1	Sweeper	28–3	City	....	McGuire–C.
Helena Lt. & Ry. Co.	1	Semiconv.	28–10½	City	Brill	American
Hillsboro Ry.	2	Closed	30–0	City	M'G.C.	McGuire–C.
Homest. & Mifflin St. Ry.	1	Open	21–0	City	M'G-C.	St. Louis
	1	Closed	21–0	City	M'G-C.	St. Louis
Houston Elec. Co.	14	Semiconv.*	26–6	City	Std.	St. Louis
	1	Work	33–0	City	Std.	Co. Shops
	4	Ballast	33–0	City	Rodg.	Rodger
Hueneme, Malibu & Port Los Angeles Ry.	1	Gas.Mot.	....	Int.	Co.	Co. Shops
Hull Elec. Co.	6	Semiconv.*	38–0	Both	Brill	Ottawa
Hummelst'n & Camp. St. Ry.	2	Semiconv.*	30–8	City	Brill	Brill
	1	Sweeper	....	Both	....	Brill
Idaho Trac. Co.	3	Closed	42–0	City	St. L.	St. Louis
	12	Ballast	36–0	Int.	Rodg.	Rodgers
Illinois Central Elec. Ry.	2	Comb.	47–2½	Int.	Brill	American
Illinois Trac. System	10	Closed	....	Int.	St. L.	St. Louis
	1	Closed	57–0	Int.	Curtis	St. Louis
	3	Closed	41–0	City	St L.	St. Louis
	11	One-man*	20–0	City	St. L.	St. Louis
	8	Trail.	57–0	Int.	St. L.	St. Louis
	1	Observ.	....	Int.	St. L.	St. Louis
Illinois Trac. System	1	Sleeper	....	Int.	St. L.	St. Louis
	50	Frt. Box	40–0	Int.	H&B	Has. & Bar.
	75	Gondola	40–0	Int.	H&B	Has. & Bar.
	25	Ballast	40–0	Int.	H&B	Has. & Bar.
Ind., Col. & East. Tr. Co.	50	Closed*	33–0	City	Brill	Cincinnati
Indianapolis Trac. & Term. Co.	25	Closed	33–2½	City	Std.	Cincinnati
International Ry.	10	Closed	....	City	St. L.	St. Louis
	200	Closed N-S	34–1⅜	City	Brill	Kuhlman
	103	Closed N-S	34–1⅜	City	Brill	Brill
	13	Cl. N-S*	21–2	City	Brill	Brill
	4	Sweeper	28–3	City	M'G.C.	McGuire–C.
Interurban Construction Co.	4	Closed	56–0	Int.	M'G-C	McGuire–C.
	1	Express	48–0	Int.	M'G-C.	McGuire–C
	1	Flat	36–0	Int.	St. L.	St. Louis
Interurban Ry. Co.	1	Express	45–0	Int.	M'G-C.	McGuire–C.
	1	Work	42–0	Int	M'G-C.	McGuire–C.
	1	Work. Tr.	32–0	Int.	M'G-C.	McGuire–C.
	1	Line	40–0	Int.	M G-C.	McGuire–C.
Interurban Ry. & Term. Co.	3	Excursion	50–0	Int.	Std.	Cincinnati
Iowa City Elec. Ry.	2	Closed	22–0	City	M'G-C.	McGuire–C
Iowa Ry. & Lt. Co.	2	Sweeper	28–3	City	M'G.C.	McGuire–C.
Ironwood & Bessemer Ry. & Lt. Co.	2	Closed	40–0	Int.	M'G-C.	Brill
Jackson Ry. & Lt. Co.	4	Semiconv.*	20–8	City	Brill	American
	5	Semiconv.*	28–0	City	Brill	American
Jamestown, Chautauqua & Lake Erie R. R.	1	Gas. Mot.	55–0	Int.	McK	McKeen
Jersey Central Trac. Co.	4	Semiconv.	33–4	Int.	Brill	Brill
Joplin & Pitts. Ry.	1	Express	45–0	Int.	Bald.	Jewett
Kans. City, Clay County & St. Joseph R. R.	8	Closed	57–0	Int.	Bald.	Cincinnati
	8	Comb.	57–0	Int.	Bald.	Cincinnati
	5	Express	57–0	Int.	Bald.	Cincinnati
	1	Work	40–0	Int.	Bald.	Cincinnati
	5	Frt. Trail	40–0	Int.	AC&F.	Cincinnati
Keokuk Elec. Co.	1	Closed	21–0	City	St. L.	St. Louis
	4	Closed	32–0	City	St. L.	St. Louis
	1	Closed*	31–4	City	Std.	Cincinnati
La Crosse City Ry.	2	Closed	21–0	City	St. L.	St. Louis
Lancaster Trac. & Pwr. Co.	1	Comb.	28–0	Int.	Brill	Cincinnati
LaSalle County Elec. Co.	3	Closed	48–0	Int.	M'G.C.	McGuire–C.
	1	Express	45–0	Int.	M'G.C.	McGuire–C.
Laurel Elec. Lt. & Pwr. Co.	4	Closed	24–0	City	Brill	American
Lehigh Valley Transit Co.	20	Closed*	30–1	City	.....	Brill
	6	Closed	55–10½	Int.	Bald.	Jewett
	4	Closed*	30–1	City	Bald.	Brill
	1	Line	30–0	Both	Bald	Russell
	2	Wreck	40–0	Both	Bald.	Russell
Lethbridge Munic. Tramway.	5	Closed*	29–0	City	Tay.	Preston
	5	Closed*	32–6	City	Brill	Preston
Lewisburg, Mil. & Wat. Pass. Ry.	1	Stor.Bat.	34–0	Int.	Brill	Brill
Lincoln Trac. Co.	3	Near-Side*	34–1⅜	Both	Brill	Kuhlman
	1	Ballast	28–0	Both	St. L.	Co. Shops
	1	Sweeper	27–6	City	.....	American
Logan R. T. Co.	4	Closed	....	Both	.....	St. Louis
London & Lake Shore Ry. & Transpt. Co.	4	Closed	....	Int.	.....	Niles
	1	Bag.	....	Int.	.....	Niles
Long Island R. R.	30	Comb.	54–0	Int.	AC&F.	A. C. & F.
	4	Bag.	....	Int.	AC&F.	A. C. & F.
	8	Parlor	....	Int.	AC&F.	A. C. & F.
Longview & Junction St. Ry.	1	Closed	16–0	City	St. L.	St. Louis
Los Angeles Ry.	50	Calif.	44–7	City	Brill	American
Los Angeles & San Diego Beach Ry.	3	Stor.Bat.	....	City	Fed.	Federal
Louisville Ry.	5	Comb.	40–5	Int.	Bald.	Cincinnati
	5	Comb.	33–2	Int.	Bald.	Cincinnati
	1	Sweeper	28–3	City	M'G.C.	McGuire–C
Macon Ry. & Lt. Co.	6	Closed*	28–0	City	St. L.	St. Louis
	3	Flat	30–0	City	Brill	Co. Shops
Mahon. & Shenan. Ry. & Lt. Co.	1	Derrick.	....	Int.	M'G.C.	McGuire–C.
Manchester St. Ry.	6	Closed	26–6	City	Std.	Laconia
Manhattan Bridge Three-Cent Line	1	Sweeper	....	City	Brill	Brill
Manhattan City & Inter Ry.	3	Closed	46–0	Int.	St. L.	St. Louis
Manila Elec. R. R. & Lt. Co.	3	Semiconv.	28–4	City	Brill	Brill
	1	Semiconv.	28–4	City	Man.	Brill
Mason City & Clear Lake R.R.	1	Express	50–0	Int.	M'G.C.	McGuire C.
Memphis St. Ry.	15	Closed C-E	38–3¾	City	Brill	Brill
Meridian Lt. & Ry. Co.	1	Closed	20–8	City	Brill	American
	5	Semiconv.	31–0	City	Brill	Southern
Merrill Ry. & Ltg. Co.	1	Trackless	....	City	Field	Field
Mesaba Elec. Ry.	10	Closed	50–0	Int.	Bald.	Niles
	4	Trail Pass.	40–0	Int.	Bald.	Niles
	2	Express	....	Int.	Bald.	Niles
	1	Sn.-Plow	38–0	Int.	Was'n	Wason
Metropolitan St. Ry.	26	Closed*	34–0	City	Std.	Cincinnati
	1	Dump	36–4	City	St. L.	Co. Shops
	1	Dump	39–8	City	St. L.	Oren-Arthur-Koppel
	1	Material	24–0	City	Dup	Co. Shops
Michigan United Trac. Co.	10	Closed	28–0	City	St. L.	St. Louis
	20	Closed*	28–0	City	Brill	Brill
	5	Cl. N-S	21–1	City	Brill	Brill
	1	Comb.	61–9	Int.	Brill	Brill
Milford, Attleboro & Woonsocket St. Ry.	1	Sn.-Plow	38–0	City	Was'n	Wason
Milford & Uxbridge St. Ry. Co.	2	Closed	22–0	City	Tay.	Jones
Mill Val. & Mt. Tam. Scenic Ry.	2	Trail	36–0	Int.	Brill	Holman
Millville Trac. Co.	1	Semiconv.	31–8	Int.	Brill	Brill
Milwaukee Elec. Ry. & Lt. Co.	30	Closed*	47–0	City	Bald.	St. Louis
	1	Special	50–0	Both	.....	Co. Shops
	8	Sweeper	43–0	City	.....	McGuire–C.
	1	El.Loco.	19–10	Switch	Bald.	Westing.
	6	Closed*	32–4	City	.....	Co. Shops
Milwaukee Northern Ry.	2	Closed	31–6	City	St. L.	Niles
Minn., St. P., Roch. & Dub. Elec. Tr. Co.	2	Closed	56–0	Int.	Brill	Wason
	7	Trail	48–6	Int.	Brill	Wason
Missoula St. Ry.	1	Semiconv.	30–8	Int.	Brill	American
	1	Ballast	32–0	Int.	Brill	Co. Shops
Mobile Lt. & R. R. Co.	8	Closed*	21–0	City	Brill	American
	4	Closed*	28–0	City	Brill	American
Monongahela Val. Tr. Co.	4	Semiconv.	28–0	Int.	Brill	Kuhlman
Montgomery Transit Co.	2	Comb.	43–0	Both	Brill	St. Louis
	1	Comb.	40–0	Both	Brill	Brill
	1	Express	40–0	Both	Brill	Russell

Purchaser	No.	Class	Length	Serv.	Truck	Builder
Montreal & Southern Counties Ry. Co.	6	Closed	49–4	Int.	Curtis	Ottawa
	2	Comb.	48–4	Int.	Curtis	Ottawa
Montreal Tramway	35	Closed*	32–0	City	Brill	Ottawa
	40	Closed*	32–0	City	.....	Canadian
	1	Sn.-Plow	20–0	City	Otta.	Ottawa
	2	Sweeper	39–6	Both	Can.	Ottawa
	1	Crane	36–10	Both	.....	Co. Shops
Morris County Trac. Co.	1	Sweeper	....	Both	Brill	Brill
Muskogee Elec. Trac. Co.	4	Closed*	21–3	City	Brill	American
	10	Semiconv.	*34–0	Both	Brill	American
Nashville-Gallatin Int. Ry.	4	Comb.	39–0	Int.	Brill	American
	1	Express	45–0	Int.	Brill	American
Nashville Int. Ry.	1	Closed	50–6	Int.	Brill	American
Nashville Ry. & Lt. Co.	12	Closed	21–10	City	Brill	Co. Shops
N. J. & Pa. Trac. Co.	2	Sn.-Plow	21–0	Int.	Was'n	Wason
New Midland Pwr. & Trac. Co.	4	Closed	55–0	Int.	Tay.	Jewett
	1	Express	45–0	Int.	St. L.	Jewett
Newport News & Old Point Ry. & Elec. Co.	4	Semiconv.	45–0	Int.	Brill	Brill
N.Y.C. & H.R.R.R.	19	Closed	53–0	Sub.	Pres'd	Pr. Steel
	6	Comb.	53–0	Sub.	Pres'd	Pr. Steel
	1	Stor. Bat.	....	.....	Fed.	Federal
N.Y., N.H. & H.R.R.	24	El. Loco.	50–0	F.& P.	Bald.	Westingh.
New York Railways	175	Stepless	44–0	City	St. L.	St. Louis
	1	Doub.d'k	43–1	City	Brill	Brill
	1	Stepless*	40–8	City	Brill	Brill
	1	Stepless Stor. Bat.	28–9	City	Brill	Brill
New York State Rys., Utica Lines	20	Closed*	30–11	City	Brill	Brill
	1	Sweeper	24–0	City	Brill	Brill
New York, West. & Boston Ry.	2	Sn.-Plow	....	Int.	Rus.	Russell
Niag., St. Cath. & Tor. Ry.	1	El. Loco.	....	F.& Sw.	Bald.	Westingh.
	1	El. Loco.	34–0	Int.	Tay.	Co. Shops
Nipissing Central Ry.	2	Closed	35–6	Int.	Beamis	Preston
North Car. Pub. Ser. Co.	4	Closed	21–0	City	Brill	Southern
Northern Ohio Trac. & Lt. Co.	15	Closed	42–2	Int.	Brill	Kuhlman
	25	Semiconv.	30–11	Sub.	Brill	Kuhlman
	20	Conv.	35–6	City	Brill	Kuhlman
	2	Express	60–0	Int.	M'G.C.	McGuire–C.
	1	Wr.& Pl.	40–0	City	M'G.C.	McGuire–C.
	1	Derrick	....	Int.	M'G.C.	McGuire–C.
	2	Express	60–0	Int.	M'G.C.	McGuire–C.
	1	Substa.	....	Int.	M'G.C.	McGuire–C.
Northern Texas Trac. Co.	4	Closed	52–0	Int.	Bald.	St. Louis
	2	Express	50–0	Int.	Brill	Co. Shops
Northwestern Elev. R.R.	1	Fire-Ftg.	25–0	Elev.	.....	Co. Shops
Norwich & Westerly Tr. Co.	4	Closed	30–8	Int.	Brill	Brill
	1	Express	40–0	Int.	.....	Wason
Oak, Antioch & East. Ry.	10	Comb.	56–0	Int.	Bald.	Holman
	4	Comb.	56–0	Int.	.....	Wason
	1	Parlor	58–0	Int.	.....	Wason
	1	Parlor	56–0	Int.	Bald.	Holman
	5	Express	36–0	Int.	Hol.	Holman
	10	Work	36–0	Int.	Hol.	Holman
	1	Derrick	41–0	Int.	Hol.	Holman
	6	Ballast	36–0	Int.	Hol.	Holman
	1	El. Loco.	35–0	Freight	Bald.	Westingh.
Ogden R. T. Co.	6	Trail	34–0	Int.	Brill	American
	1	Express	40–0	Int.	St. L.	Co. Shops
	1	Sn.-Plow	....	Int.	....	Co. Shops
Ohio Elec. Ry. Co.	6	Comb.	61–6	Int.	Std.	Cincinnati
	6	Trail Pass.	60–0	Int.	Std.	Cincinnati
	2	Open	29–9½	City	Brill	Cincinnati
	3	Express	50–0	Int.	Std.	Cincinnati
	2	Work	40–0	Int.	Tay.	Cincinnati
	14	Fr. Tr.	38–6	Int.	Std.	Cincinnati
	10	Flat	40–0	Int.	Std.	Cincinnati
Ohio River Elec. Ry. & Pwr. Co.	1	Elec.Loco.	30–0	Int.	Bald.	American
Omaha & Council Bluffs St. Ry.	25	Closed	42–0	City	Brill	Co. Shops
	1	Sweeper	28–3	City	M'G.C.	McGuire–C.
Omaha, Lincoln & Beat. Ry.	1	Elec.Loco.	24–0	Switch	Bald.	Westingh.
Oneida Ry.	2	Semiconv.	40–0	Int.	Brill	Kuhlman
Orange County Tr. Co.	4	Closed*	44–0	Int.	M'G.C.	McGuire-C.
	11	Closed*	34–8	City	M'G.C.	McGuire–C.
	3	Gondola	21–0	Const.	M'G.C.	McGuire–C.
Oregon Elec. Ry.	6	Comb.	58–4½	Int.	Bald.	American
	3	Coaches	57–11⅜	Int.	Bald.	American
	25	Coach.tr.	58–4½	Int.	Bald.	American
	2	Tr. Sleep.	57–0	Int.	Bald.	Bar. & Sm.
	1	Wreck	....	Int.	Bald.	Co. Shops
	1	Substa.	.....	.....	M'G.C.	McGuire–C.
Oshawa Ry.	2	Conv.	40–0	Both	Tay.	.....
	1	Express	36–0	City	Brill	.....
	1	Sweeper	35–0	Both	Ott.	Ottawa
	1	El.Loco	25–0	Shunt.	Rath.	Rathbun
Ottawa Elec. Ry.	10	Closed*	45–3	Both	Brill	Ottawa
Pacific Coast Ry.	1	Comb.	55–0	Int.	Bald.	Cincinnati
Pacific Elec. Ry.	10	Closed	42–9	City	Brill	Jewett
	53	Closed	55–6	City	Brill	Jewett
	36	Stepl's C-E	....	City	Brill	Brill
	10	El. Loco.	36–0	Fr't.	Bald.	Westingh.
	3	El. Loco.	36–0	Int.	Bald.	Westingh.
Pacific Northwest Tr. Co.	4	Fr't Box	41–0	Int.	Seat.	Co. Shops
	20	Fr't flat	41–0	Int.	Seat.	Co. Shops
	1	Caboose	41–0	Int.	Seat.	Co. Shops
Paducah Trac. & Lt. Co.	6	Closed	21–0	City	St. L.	St. Louis
Park, Marietta & Int. Ry.	2	Fr't Box	36–0	Int.	Ralst.	Co. Shops
	2	Gondola	36–0	Int.	Ralst.	Co. Shops
Peninsular Ry.	1	El. Loco.	36–0	Int.	Bald.	Westingh.
People's Gas & Elec. Co.	10	Closed	26–6	City	St. L.	St. Louis
	3	Closed	....	City	War.	St. Louis
People's Ry., Wil., Del.	10	Closed*	22–0	City	Brill	Cincinnati
Pet. & Santa Rosa Ry.	5	Fr't Box	36–0	Int.	Std.	Co. Shops
Phila. & Garret. St. Ry.	1	Sweeper	28–3	City	M'G.C.	McGuire–C.
Philadelphia R. T. Co.	50	Closed	39–7	Elev.	Brill	Brill
	950	Closed	34–3½	City	Brill	Brill
	1	Funeral	36–6	Both	Brill	Brill
	1	Sweeper	....	City	Brill	Brill
	2	Sand	30–0	City	Brill	Brill
Phila. & West. Trac. Co.	5	Closed	44–6	Sub.	Bald.	Jewett
Piedmont Trac. Co.	1	El. Loco.	35–0	Fr't.	Bald.	Westingh.
Pine Bluff Co.	12	Semiconv.	33–0	City	Balt.	Southern
Pittsburgh Rys.	6	Cl. C-E	45–0	City	Std.	Standard
	44	Trail	45–0	City	Std.	Standard
Port Jervis Trac. Co.	1	Open	20–0	City	Brill	Wason
Portland, Gray & Lew. R.R.	2	Closed	38–0	Int.	Brill	Wason
	4	Closed	46–0	Int.	Bald.	Laconia
	5	Flat	34–0	Int.	Lacon.	Laconia
Portland Ry. Lt. & Pwr. Co.	20	Flat	41–0	Int.	Seat.	Seattle
Portland R.R.	3	Closed	30–0	City	Brill	Wason
Portsmouth St. R. R. & Lt. Co.	4	Semiconv.	28–0	City	Brill	Kuhlman
Pottstown & Phoenixville Ry.	3	Semiconv.	*30–8	City	Brill	Brill
Pottstown & Reading St. Ry.	3	Semiconv.	*45–0	Both	Brill	Brill
Pub. Serv. Co. of No. Ill.	10	Closed	30–0	City	M'G.C.	McGuire–C.
Public Service Ry.	50	Closed*	32–0	City	Std.	Cincinnati
	26	Closed*	32–0	City	Std.	Co. Shops
	12	Semiconv.	34–0	Int.	Std.	Co. Shops
	12	Semiconv.	*34–0	Int.	Std.	Co. Shops
	1	Line	30–0	Int.	Tay.	Russell
Public Utilities Co.	5	Closed*	28–0	City	Std.	Cincinnati
	1	Line	28–0	Int.	Brill	.....
Puget Sound Trac., Lt. & Pwr. Co.	1	Closed	32–0	City	.....	St. Louis
Quebec Ry., Lt. & Pwr. Co.	1	Sweeper	....	Both	.....	Brill
	1	Sweeper	28–3	City	M'G.C.	McGuire–C.
Reading Transit Co.	10	Semiconv.	30–8	Int.	Brill	Brill
	10	Semiconv.	30–8	City	Brill	Brill
Regina Munic. Ry.	8	Closed*	21–0	City	Curtis	Preston
	16	Closed*	28–0	City	Brill	Preston
	6	Closed*	21–0	City	Brill	Preston
Rhode Island Co.	35	Semiconv.	*28–6	City	Std.	Osg.Brad.
	2	Substa.	....	Int.	M'G.C.	McGuire–C.
Richmond & Rappahannock River Ry.	2	Closed	31–0	City	Std.	Jewett
Roanoke Ry. & Elec. Co.	6	Closed	28–0	City	Brill	St. Louis
Rochester & Manitou R. R.	3	Open	46–3½	Sub.	Brill	Kuhlman
Rockford City Trac. Co.	2	Closed*	29–0	City	Std.	American
Rome Ry. & Lt. Co.	2	Closed	20–8	City	Brill	Brill
St. Joseph Ry., Lt., Ht. & Pwr. Co.	6	Closed	30–0	City	Brill	American
St. Joseph Valley Ry.	1	Closed	48–0	Int.	M.G'C.	McGuire–C.
St. Louis, Brownsville & Mexico Ry.	2	Open tr.	....	City	Brill	American
St. Thomas St. Ry.	2	Closed*	25–0	City	Brill	Kuhlman
Saginaw-Bay City Ry.	1	Open	....	City	Brill	Brill
	1	Closed*	28–0	City	.....	Kuhlman
Salt Lake & Ogden Elec. Ry.	3	Closed	62–0	Int.	Bald.	Niles
	1	El. Loco.	34–7	Fr't.	A.L.	Gen. Elec.
San Diego Elec. Ry.	1	Cent.-Ent.	42–0	City	Brill	Brill
	1	Work	46–0	Int.	Brill	American
Sand., Windsor & Amherst Ry.	2	Closed*	21–0	City	Brill	Preston
Sand Springs Ry.	2	Closed	50–0	Int.	Brill	American
San Francisco, Napa & Calistoga Ry.	2	.....	54–0	Int	Bald.	Niles
	4	Fr't Box	30–0	Int.	.....	.....
San Jose R. R.	4	Closed*	42–8	City	.....	Jewett
Santa Barbara Cons. Elec. R.R.	5	S-C C-E*	39–4	City	Brill	Brill
Saskatoon Munic. St. Ry.	12	Closed	32–0	City	St. L.	St. Louis
Savannah Elec. Co.	9	Closed	38–6	City	St. L.	St. Louis
Seattle, Renton & Southern Ry.	6	Closed	50–2	Both	Bald.	Cincinnati
	6	Closed	45–0	City	M'.GC.	McGuire–C.
	2	Closed	56–0	Int.	M'G.C.	McGuire–C.
Schenectady Ry.	10	Closed*	30–11	City	Tay.	St. Louis
Selma St. & Sub. Ry.	2	Semiconv.	26–0	City	.....	Co. Shops
Shore Line Elec. Ry.	3	Closed	44–5	Int.	Bald.	Jewett
	1	Express	44–0	Int.	S&W.	Sm. & Wal.
	6	Work	30–0	Int.	Brill	Brill
	1	Sn.-Plow	29–6	Int.	Grothe	J. Grothe
Shreveport Trac. Co.	5	Closed*	28–10	City	Brill	American
Sioux City Serv. Co.	7	Semiconv.	31–0	City	Brill	Co. Shops
Sioux Falls Trac. Sys.	1	Semiconv.	21–0	City	M'G.C.	McGuire–C.
Slate Belt Elec. St. Ry.	2	Conv.*	30–1	Int.	Bald.	Brill
	1	Sweeper	28–3	City	M'G.C.	McGuire–C.
South Cov. & Cin. St. Ry.	20	Semiconv.	....	City	Brill	St. Louis
Southern Cambria Ry.	2	Comb.	43–0	Int.	Bald.	Niles
Southern Ill. Ry. & Pwr. Co.	2	Pass.Sm.	48–0	Int.	Brill	American
	2	Pass. Bag.	48–0	Int.	Brill	American
	2	Trail	48–0	Int.	Brill	American
	1	Bag.-Ex.	48–0	Int.	Brill	American
Southern Pacific Co.	20	Closed	41–0	Int.	Bald.	Pullman
	2	Bag.& Ex.	58–0	Int.	Bald.	Pullman
	13	Coaches	47–0	Int.	Bald.	Pullman
	4	Gas.Mot.	70–0	Int.	McK.	Pullman
	17	Pass.&Bag.	47–0	Int.	Bald.	Pullman
	5	Bag. & Ex.	47–0	Int.	Bald.	Pullman
	11	Tr.Coach.	47–0	Int.	Bald	Pullman
	10	Coaches	58–0	Int.	Bald.	Pullman
	4	Pass.&Bag.	58–0	Int.	Bald.	Pullman
	1	El. Loco.	36–0	Switch	Bald.	Westing.
Southern Trac. Co.	4	Closed	41–0	City	.....	St. Louis
	4	Trail Pass.	41–0	City	.....	St. Louis
Southern Wisconsin Ry.	10	Closed*	20–8	City	Brill	American
Southwest Mo. R. R.	5	Closed	43–0	Int.	Tay.	Co. Shops
Southwestern Trac. Co.	3	Ballast	18–0	Gen.	.....	Co. Shops
Southwestern Trac. & Pwr. Co.	1	Open	47–6	Int.	Brill	American
	2	Closed	48–0	Int.	Brill	American
	2	Pass.&Bag.	37–5	Int.	Brill	American
Spokane & Inland Empire R.R.	1	El. Loco.	29–2	Switch	Bald.	Westing.
Springfield Cons. Ry.	1	Closed*	37–0	City	Brill	American
	7	Closed*	30–0	City	Brill	American
Springfield St. Ry.	6	Closed	28–0	City	Std.	Osg.-Brad.
	5	Express	41–2	Gen.	Std.	Osg.-Brad.
Springfield & Jacksonville Elec. Ry.	5	Closed	....	Int.	.....	.....
Stark Elec. Ry.	1	Sweeper.	53–0	Int.	M'G.C.	McGuire–C.
Ster., Dixon & East. Elec. Ry.	1	Ex.& Sw.	36–0	Int.	M'G.C.	McGuire–C.
Stockton Terminal & Eastern Ry.	1	Gas.Mot.	41–0	Int.	Hol.	Holman
Suffolk Trac. Co.	1	Stor. Bat.	....	Int.	Fed.	Federal
Syracuse & Sub. R. R.	2	Semiconv	34–4	Int.	Brill	Brill
Syracuse R. T. Ry.	9	Closed*	44–6	City	St. L.	St. Louis
	1	Cl. C-E	45–4	City	Brill	Kuhlman
	2	Sweeper	....	Both	.....	Brill
Tacoma Ry. & Pwr. Co.	10	Closed*	34–5	City	Std.	Cincinnati
Tar. Breck & Butler St. Ry. Co.	2	Closed	30–0	City	M'G.C.	McGuire–C.
Terre Haute, Ind. & East. Trac. Co.	1	Work	45–0	Int.	Peck.	Cincinnati
	1	El. Loco.	41–8½	Both	Std.	McGuire–C.
	1	Work	....	Int.	M'G.C.	McGuire–C.
Texas City Transp. Co.	3	Closed	30–0	City	M'G.C.	McGuire–C.
Tidewater Power Co.	43	Semiconv.	20–0	City	Brill	Co. Shops
Toledo Rys & Lt. Co.	20	Closed	42–0	City	St. L.	St. Louis
	7	Closed	42–0	City	St. L.	Co. Shops
Toledo & Western R. R.	1	Express	50–0	Int.	Bald.	Kuhlman
Toronto Civic Lines	4	Closed	44–0⅜	City	M'G.C.	McGuire–C.
	1	Sweeper	28–3	City	M'G.C.	McGuire–C.

Purchaser	No.	Class	Length	Serv.	Truck	Builder
Toronto Civic Lines	4	Closed*	30-0	City	M'G.C.	Preston
	1	Sweeper	23-0	City	.....	Preston
Towson & Cockneysville Elec. Ry.	1	Stor.Bat.*	27-8	Int.	Fed.	Federal
Trenton & Mercer Co. Tr. Co.	10	Closed	28-0	City	St. L.	St. Louis
Tri-City Ry.	20	Closed*	30-8	City	Std.	St. Louis
	8	Closed*	21-10	City	.....	American
	1	Sweeper	28-3	City	M'G.C.	McGuire-C.
Trinidad Elec. Trans. Ry. & Gas Co.	2	Closed	30-0	City	Brill	Woeber
Twin City R. T. Co.	100	Closed	47-0	City	Co.	Co. Shops
	3	Work	38-0	City	Co.	Co. Shops
Twin Falls Ry.	2	Stor.Bat.	....	City	Fed.	Federal
Tyler Trac. Co.	4	Comb.	45-0	Int.	Std.	Cincinnati
	1	Express	45-0	Int.	Std.	Cincinnati
	1	Flat	40-0	Int.	Std.	Cincinnati
	1	Fr't Trail	40-0	Int.	Std.	Cincinnati
Union St. Ry.	1	Closed	26-0	City	Brill	Brill
	1	Sn.-Plow	15-0	City	Rus.	Russell
Union Trac. Co.	3	Closed	48-0	Int.	St. L.	St. Louis
	1	Bag.	46-0	Int.	St. L.	St. Louis
Union Tr. Co. of Ind.	10	Comb.	60-1	Int.	Std.	Cicninnati
	6	Closed*	34-2	Sub.	Brill	Cincinnati
United R. R. of San Fran.	65	Calif.*	47-0	City	Brill	American
United Rys. Co. of St. Louis	2	Cl. C-E	45-0	City	.....	Co. Shops
	25	Semiconv.*	34-0	City	.....	Co. Shops
United Rys. & Elec. of Balt.	60	Semiconv.*	30-8	City	Brill	Brill
United Trac. Co.	20	Closed*	32-0	City	.....	Laconia
Valdosta St. Ry.	3	Closed*	18-0	City	Brill	American
Virginia Ry. & Pur. Co.	3	Stor.Bat.	26-1½	City	.....	Cincinnati
Warren, Brookfield & Spencer St. Ry.	3	Closed	20-8	City	Brill	Wason
Wash., Balt. & Annapolis Elec. R.R.	4	Express	51-0	Int.	Bald.	Niles
Wash. & Old Dom. R. R.	6	Closed	50-0	Int.	Std.	Southern
	4	Comb.	50-0	Int.	Std.	Southern
	6	Trail	42-0	Int.	Std.	Southern
	2	Freight	42-0	Int.	Std.	Southern
Washington Ry. & Elec. Co.	50	Open	40-0	City	.....	Brill
	30	Cent-Ent.*	41-0	City	Bald.	Brill
	5	Cent-Ent.*	46-0	Sub.	Brill	Brill
	20	Semiconv.*	41-0	City	Bald.	St. Louis
	10	Semiconv.*	41-0	City	Bald.	Southern
	1	Cent-Ent.*	41-0	City	Brill	Brill
	1	Sweeper	....	City	Brill	Brill
Washington, Spa Spring & Gretta R. R.	2	Stor.Bat.	....	City	Fed.	Federal
Waterloo, Cedar Falls & North. Ry.	2	Comb.	58-0	Int.	M'G.C.	McGuire-C.
	2	Express	50-0	Int.	M'G.C.	McGuire-C.
	1	Sn.-Plow	32-0	Int.	M'G.C.	McGuire-C.
	1	El. Loco.	40-0	Int.	Co.	Co. Shops
	6	Closed	32-0	City	M'G.C.	McGuire-C.
Waycross St. & Sub. Ry.	4	Closed	18-0	City	Brill	American
Wellsburg, Bethany & Washington R. R.	1	Pass.&Bag.	25-4	Int.	Brill	Kuhlman
West Penn Rys.	10	Closed	56-0	Int.	Co.	Co. Shops
Western N. Y. & Penna. Trac. Co.	1	Semiconv.	20-8	City	Brill	Brill
Wheeling Trac. Co.	5	Closed	30-10	Sub.	Brill	Jewett
Wichita Falls Trac. Co.	2	Closed*	21-3	City	Brill	American
Wilkes-Barre Ry.	1	Work	43-0	City	Brill	Brill
	2	Trail flat	32-0	City	Brill	Brill
Wilmington, New Castle & Del. City R. R.	2	Stor.Bat.	....	Int.	Fed.	Federal
Winnipeg Elec. Ry.	40	Closed	45-0	City	Brill	Co. Shops
	2	Sweeper	28-3	City	M'G.C	McGuire-C.
	1	Sprinkler	29-6	City	M'G.C.	McGuire-C.
Wisconsin Pub. Serv. Co.	1	Sprinkler	32-0	City	M'G.C.	Kennicott
Worcester Consol. St. Ry.	6	Closed	30-0	Sub.	Std.	Osg.-Brad.
Yakima Valley Trans. Co.	2	Comb.	45-0	Int.	Brill	Jewett
	1	Express	45-0	Gen.	Brill	Jewett
York Railways	4	Semiconv.	25-0	City	Brill	Brill

RECEIVERSHIPS AND FORECLOSURE SALES IN 1912

Records of electric railway companies for which receivers were appointed in 1912 show that the number of companies which became involved in financial difficulties was larger than in the preceding year but that the miles of track owned by the companies and the capitalization outstanding were much smaller. A number had not reached the stage of operation of completed systems and one, the Chicago & Oak Park Elevated Railway, is not directly an operating company. The record of receiverships for 1912 compares with the preceding three years as follows:

	No. of Companies	Miles of Track	Outstanding Bonds	Outstanding Stock
1909	22	558	$22,325,000	$29,962,200
1910	11	696.61	75,490,735	12,629,400
1911	19	518.9	38,973,293	29,533,450
1912	26	373.58	11,133,800	20,410,700

As will be noticed from the accompanying list of companies most of the properties concerned operated a very small amount of mileage.

The record of foreclosure sales of companies during 1912 involves a smaller number of companies than were affected by similar proceedings in 1911, but, as in the case of the receivership proceedings, the miles of track and outstanding capitalization were much smaller in the last year than in the previous twelve months. As in previous years when records of this character have been compiled, it was found that some companies for which receivers were appointed early in the year were able to carry out a plan of reorganization providing for a formal sale at foreclosure during the calendar year. The record of foreclosure sales compares with the preceding three years as follows:

Companies for Which Receivers Were Appointed in 1912

	Miles of Track	Bonds Outstanding	Capital Stock Outstanding
Cassville & Western Railway	5	.....	$100,000
Chicago, Fox Lake & Lake Geneva Railroad	..	.....	.....
Chicago & Oak Park Elevated Railway	..	.....	8,714,900
Columbus, Urbana & Western Electric Railway	10	$438,500	380,500
Dedham & Franklin Street Railway, Westwood, Mass.	9.5	100,000	75,000
Ft. Wayne & Springfield Railway	23.7	465,000	673,000
Geneva & Auburn Railway	17.7	400,000	450,000
Ithaca Street Railway	10.5	475,000	325,000
Kanauga Traction Co., Gallipolis, O.	4.6	100,000	100,000
Kansas City, Outer Belt & Electric Railroad	..	.....	.....
Lakeview Traction Co., Memphis, Tenn.	10.83	.....	1,500,000
Marion, Bluffton & Eastern Traction Company	32	720,000	850,000
Medfield & Medway Street Railway, Westwood, Mass.	11.25	100,000	100,000
Nevada Water, Light & Traction Co.	5	200,000	350,000
New Jersey & Pennsylvania Traction Co.	40	1,430,000	1,000,000
New York, Auburn & Lansing Railroad.	39	975,000	1,000,000
North Jersey Rapid Transit Co.	15	2,000,000	2,000,000
Pawcatuck Valley Street Railway, Westerly, R. I.	6.3	50,000	75,000
Philadelphia & Eastern Electric Railway	34.1	911,000	611,800
Rochester, Corning & Elmira Traction Co.	..	1,000,000	.....
Sandusky, Norwalk & Mansfield Electric Railway	33	600,000	600,000
Sapulpa & Interurban Railway	11	.....	80,500
Schuylkill & Dauphin Traction Co.	10	219,300	25,000
Seattle, Renton & Southern Railway	25	825,000	1,250,000
Seattle, Snohomish & Everett Railway	..	.....	.....
Warren, Brookfield & Spencer Street Railway	20.1	125,000	150,000
	373.58	$11,133,800	$20,410,700

	No. of Companies	Miles of Track	Outstanding Bonds	Outstanding Stock
1909	21	488	$21,174,000	$22,265,700
1910	22	724.36	26,374,065	19,106,613
1911	25	660.72	115,092,750	91,354,800
1912	18	457.75	26,286,250	19,947,300

The accompanying list of companies whose properties were sold at foreclosure contains the name of the Chicago & Milwaukee Electric Railroad. In this case the Illinois and Wisconsin divisions of the company were sold at foreclosure but the reorganization has not yet been perfected.

Electric Railways Sold at Foreclosure

	Miles of Track	Bonds Outstanding	Capital Stock Outstanding
Baltimore & Washington Traction Co.	4	$100,000	$100,000
Central Park, North & East River Railroad	31.38	1,200,000	1,800,000
Centre & Clearfield Street Railway	13.6	492,500	312,300
Chicago & Milwaukee Electric Railroad.	172.87	15,201,000	5,300,000
Chicago & Southern Traction Co.	47	2,500,000	2,500,000
Eastern New York Railroad	15	150,000	275,000
Geneva & Auburn Railway	17.7	400,000	450,000
Hannibal & Northern Missouri Railway.	..	.....	.....
Indianapolis, Crawfordsville & Western Traction Co.	45	1,500,000	1,500,000
Indianapolis & Louisville Traction Co.	41	1,650,000	2,600,000
Lakeview Traction Co., Memphis, Tenn.	10.83	.....	1,500,000
Pawcatuck Valley Street Railway	6.3	50,000	75,000
Pelham Park Railroad	1.4	27,750	50,000
Portsmouth & Exeter Street Railway	14.4	145,000	185,000
St. Albans (Vt.) Street Railway	13	196,000	200,000
Sedalia (Mo.) Light & Traction Co.	9	749,000	1,000,000
South Shore Traction Co.	10.5	425,000	600,000
Twenty-eighth & Twenty-ninth Streets Crosstown Railway, New York	4.77	1,500,000	1,500,000
	457.75	$26,286,250	$19,947,300

In addition to the properties mentioned in the foregoing lists other companies have undergone various kinds of reorganizations or readjustments, but without the formal receiverships or foreclosure sales which were necessary for their inclusion in these tables, for instance, in Toledo. Properties of the Chicago Subway Company and Illinois Tunnel Company were sold at foreclosure during the year 1912, but were not included because they are not of the class of electric railways which the tables are designed to include. In other cases, such as the Beaumont Traction Company, the receiver was discharged by the court long after the formal foreclosure proceedings had been completed. The Manistee Light & Traction Company was not included in the tables for the reason that the sale was the second one of the same property.

New Electric Railway Track Built in 1912

Statistics of New Track Completed During the Year—Smallest Total Since 1909

The accompanying table shows in detail the length of new electric railway track built and placed in operation during 1912. The table has been compiled from answers received from the railway companies whose names appear, so that the lengths given in each instance are official. The only mileage represented in the table is track which was completed and placed in operation during the year, but lengths of electrified steam road are included. The total is not complete as far as the total amount of track built in each state is concerned, since some of the companies did not reply in time for this compilation. The total new track built or electrified in 1912 was 950.29 miles, as compared with 1191.58 miles reported in 1911, 1397.26 miles in 1910, and 887.16 miles in 1909. Special care has been taken in compiling the table to exclude all mileage previously reported and all track laid but not put in operation.

New York heads the list of states with 93.47 miles reported. The largest part of this mileage is represented by the New York Central & Hudson River Railroad, which electrified 58.3 miles of track. This includes 38 miles, measured as single track, of the four-track stretch between Tarrytown and Croton, 14.3 miles in the Harmon and Croton yards, 0.9 mile in Harlem division sidings, 1 mile in North White Plains yard and 4.1 miles in the Grand Central Station. The New York, Westchester & Boston Railway completed and placed in operation its 18-mile line connecting New York, Mount Vernon, North Pelham, New Rochelle, Eastchester, Scarsdale and White Plains.

Oregon with 83.50 miles is second and includes the longest and most important extension built in the United States during the past year. This is credited to the Oregon Electric Railway, which built 78 miles of track connecting Salem, Albany, Junction City, Harrisburg and Eugene, Ore. During 1913 this company plans to build a 30-mile extension between Tualitin and McMinnville, Ore., and a 6-mile cut-off between Orenco and Helvetia.

California is third with 82.7 miles of new track constructed. A new interurban line 30 miles long was completed by the Tidewater & Southern Railroad between Stockton, Atlanta, Escalon and Modesto. The Los Angeles Railway added 18.5 miles of track to its lines about Los Angeles, and the San Francisco-Oakland Terminal Railways built 12.2 miles of city track.

The new mileage in Pennsylvania amounted to 63.25, of which the Southern Cambria Railway completed 11 miles between Ebensburg and Johnstown. The Lehigh Valley Transit Company and the Hummelstown & Campbellstown Street Railway each completed about 10 miles of new line.

In Texas, which has a total of 56.33 miles, the longest interurban line was built by the Fort Worth Southern Traction Company, between Fort Worth, Everman, Burleson, Joshua and Cleburne. Another interurban line, 12 miles long, was placed in operation by the Gainesville, Whitesboro & Sherman Railway.

The Chicago Railways Company built 19 miles of new city track. The electric railways of Canada built a total of 78.37 miles of track last year, in comparison with 117.1 miles in 1911.

	Miles
ALABAMA	
Birmingham, Ensley & Bessemer Ry.	28.00
Mobile Light & Railroad Co.	0.38
	28.38
ARIZONA	
Warren-Bisbee Ry.	0.14
	0.14
ARKANSAS	
Fort Smith Light & Traction Co.	5.00
Little Rock Railway & Electric Co.	0.50
Southwestern Gas & Electric Co.	0.10
	5.60
CALIFORNIA	
Bakersfield & Kern Electric Ry.	0.50
Cedar Lake R. R.	0.70
Los Angeles Ry.	18.50
San Diego Electric Ry.	8.00
San Francisco, Napa & Calistoga Ry.—Between St. Helena and Calistoga	7.50
San Francisco-Oakland Terminal Rys.—City lines	12.20
Stockton Terminal & Eastern R. R.—Between Fine and Bellota	3.00
Tidewater & Southern R. R.—Between Stockton and and Modesto	30.00
United Railroads of San Francisco	2.30
	82.70
COLORADO	
Arkansas Valley Railway, Light & Power Co.	2.50
Denver City Tramway	1.06
Denver & Northwestern Ry.	0.06
	3.56
CONNECTICUT	
Connecticut Company	2.80
Shore Line Electric Ry. Through Deep River	4.00
	6.80
DISTRICT OF COLUMBIA	
Washington & Old Dominion R. R.—Connecting line between Great Falls and Bluemont Divisions	6.00
	6.00
FLORIDA	
Tampa Electric Co.—Tampa	1.50
	1.50
GEORGIA	
Macon Railway & Light Co.	2.63
Rome Railway & Light Co.	0.25
	2.88
IDAHO	
Idaho Traction Co.—Between Meridian, Nampa and Caldwell	18.00
	18.00

	Miles
ILLINOIS	
Centralia & Central City Tr. Co.	2.50
Chicago City Ry.	3.50
Chicago Railways Co.	19.00
Freeport Railway & Light Co.	0.50
Hillsboro Street Ry.	2.50
Illinois Central Electric Ry.—Between Bryant and Lewistown	9.50
Illinois Traction System—Second track	0.60
Kankakee Electric Ry.	1.00
Metropolintan West Side Elevated Ry.	1.00
People's Traction Co.	0.50
Quincy Ry.	4.00
Rockford City Traction Co.—Rockford	1.14
Springfield Consolidated Ry.—Second track	0.50
Springfield & Jacksonville Elec. Ry.	1.50
	47.74
INDIANA	
Evansville Railways Co.	10.00
Chicago, South Bend & Northern Indiana Ry.—South Bend	1.50
Indianapolis Traction & Terminal Co.	1.52
	13.02
IOWA	
Davenport & Muscatine Ry.—Between Davenport, Blue Grass, Pleasant Prairie, Sweetland Center and Muscatine	25.28
Iowa City Electric Railway	2.00
Oskaloosa Traction & Light Co.	1.00
Ottumwa Railway & Light Co.	0.25
People's Gas & Electric Co.—Burlington	2.00
Tri-City Railway	1.35
Union Electric Co.	0.67
Waterloo, Cedar Falls & Northern Ry.—Between Gilbertville and La Porte City	20.00
	52.55
KANSAS	
Manhattan City & Interurban Ry.	2.50
	2.50
KENTUCKY	
Owensboro City R. R.	0.50
	0.50
LOUISIANA	
Algiers Railway & Light Co.—Algiers	2.00
New Orleans Railway Light Co.	0.89
Southwestern Traction & Power Co.—Between New Iberia, Olivier and Jeanerette	12.42
	15.31
MAINE	
Aroostook Valley R. R.—Margison to Sweden	2.00
Portland, Gray & Lewiston R. R.—Between Lewiston, Auburn, New Gloucester, Gray, Cumberland and West Falmouth	20.00
	22.00

MARYLAND	Miles
Frederick R. R.	1.00
Towson & Cockeysville Electric Ry.—Between Towson, Lutherville and Timonium	3.16
	4.16

MASSACHUSETTS	
Berkshire Street Ry.—Between Lee and Becket	9.58
Boston Elevated Ry.	2.46
Boston & Worcester Street Railway Co.—Natick and South Framingham	0.13
Oak Bluffs Street Ry.—Oak Bluffs	0.50
Worcester Consolidated Street Ry.	0.70
	13.37

MICHIGAN	
Detroit, Jackson & Chicago Ry.	1.96
Detroit, Monroe & Toledo Short Line Ry.	1.64
Detroit United Ry.—Detroit and Pontiac and Flint Divisions	10.28
Ironwood & Bessemer Ry. & Lt. Co.—Between Ironwood, Jesseville, Ironton, Puritan, Colby and Bessemer	7.00
Rapid Railway System.—Double track in Mt. Clemens and Pt. Huron	3.08
	23.96

MINNESOTA	
Fargo & Moorhead Street Railway Co.—Between Moorhead and Dilworth	3.65
Granite City Ry.	0.50
Mesaba Electric Ry.—Between Virginia, Hibbing, Eveleth, Chisholm, Buhl, Mountain Iron and Gilbert	36.00
Twin City Rapid Transit Co.	10.00
	50.15

MISSISSIPPI	
Jackson Light & Traction Co.	1.00
	1.00

MISSOURI	
Metropolitan Street Railway Co.	2.96
St. Joseph Railway, Light, Heat & Power Co.	0.55
	3.51

MONTANA	
Missoula Street Railway Co.—Second track	1.00
	1.00

NEBRASKA	
Lincoln Traction Co.—Between Lincoln and Bethany and between Lincoln and State Hospital for Insane	2.50
Omaha & Council Bluffs Street Railway	1.00
Omaha, Lincoln & Beatrice Railway Co.	1.00
	4.50

NEW JERSEY	
Atlantic Coast Electric Railway Co.—Bradley Beach	0.54
Morris County Traction Co.—Summit, Chatham and Madison	10.50
Ocean City Electric Railroad Co.	2.00
Public Service Railway Co.	1.53
	24.57

NEW YORK	
Buffalo & Lake Erie Traction Co.	0.42
International Ry.	1.71
Ithaca Street Railway	0.38
New York Central & Hudson River Railroad	58.30
New York City Interborough Ry. Co.	5.00
New York Railways Co.	0.31
New York State Railways.—Rochester Lines	1.38
New York, Westchester & Boston Railway Co.—Between New York, Mt. Vernon, North Pelham, New Rochelle, Eastchester, Scarsdale and White Plains	18.00
Schenectady Railway Co.	1.27
Syracuse, Watertown & St. Lawrence River R. R.—Between Cicero and Brewerton	6.20
Westchester Electric Railroad Co.—New Rochelle	0.50
	93.47

NORTH CAROLINA	
Durham Traction Co.	1.00
North Carolina Public Service Co.	6.00
Tidewater Power Co.—(Second Track)	1.00
	8.00

NORTH DAKOTA	
Grand Forks Street Railway Co.	0.50
	0.50

OHIO	
Cleveland Railway	1.00
Columbus Railway & Light Co.	0.40
Dayton, Covington & Piqua Traction Co.	0.50
Hocking-Sunday Creek Traction Co.—From Myers, through Floodwood and Circle Hill to Chauncey	5.75
Northern Ohio Traction & Light Co.	3.00
New Midland Power & Traction Co.—Between Byesville, Derwent and Pleasant City	4.75
Toledo Railways & Light Co.	1.32
	16.72

OKLAHOMA	
Muskegon Electric Traction Co.	4.50
Sand Springs Railway Co.	2.50
	7.00

OREGON	
Oregon Electric Railway Co.—Between Salem and Albany, Junction City, Harrisburg and Eugene	78.00
Portland Railway, Light & Power Co.	5.50
	83.50

PENNSYLVANIA	Miles
Chester & Philadelphia Railway Co.	4.00
Duquesne & Dravosburg Street Railway Co.	2.00
Fairchance & Smithfield Traction Co.	0.75
Hummelstown & Campbellstown Street Railway Co.—Between Hummelstown, Hershey, Palmyra, Campbellstown and City of Lebanon	10.50
Lehigh Valley Transit Co.—Between Lansdale and Norristown	10.00
Montgomery Transit Co.—Between Lederach and Harleysville	5.00
Philadelphia Rapid Transit Co.	4.00
Philadelphia & West Chester Traction Co.	2.00
Philadelphia & Western Railway Co.—Between Philadelphia and Norristown	6.00
Pottstown & Reading Street Railway Co.—Pottstown	2.00
Scranton & Binghamton Railroad Co.—Between Factoryville and Nicholason	6.00
Southern Cambria Railway Co.—Between Ebensburg and Johnstown	11.00
	63.25

PHILIPPINE ISLANDS	
Manila Electric Railroad & Light Co.	5.00
	5.00

SOUTH CAROLINA	
Columbia Railway Gas & Electric Co.	1.25
	1.25

SOUTH DAKOTA	
Chicago, Burlington & Quincy Railway Co.	0.25
Sioux Falls Traction System	1.50
	1.75

TENNESSEE	
Knoxville Railway & Light Co.—Between Knoxville and Vestal	2.60
Memphis Street Railway Co.	4.70
Nashville-Gallatin Interurban Railway	27.00
Nashville Railway & Light Co.	4.50
	38.80

TEXAS	
Amarillo Street Railway Co.	0.50
Austin Street Railway Co.	2.00
Dallas Electric Corporation	2.40
Gainesville, Whitesboro & Sherman Railway Co.—Between Gainesville, Whitesboro and Sherman	12.00
Houston Electric Co.	5.03
Fort Worth Southern Traction Co.—Between Fort Worth, Everman, Burleson, Joshua and Cleburne	28.90
Northern Texas Traction Co.—Fort Worth	5.00
San Antonio Traction Co.	0.50
	56.33

UTAH	
Logan Rapid Transit Co.—Logan, North Logan, Hyde Park, Smithfield, Providence	12.00
Utah Light & Railway Co.—Highland Park and Holliday	10.00
	22.00

VIRGINIA	
Charlottesville & Albemarle Railway Co.	0.38

WASHINGTON	
Grays Harbor Railway & Light Co.	0.27
Puget Sound Traction, Light & Power Co.	2.42
Spokane & Inland Empire Railroad Co.	2.50
Whatcom County Railway & Light Co.	0.50
Yakima Valley Transportation Co.—Selah	1.00
	6.69

WEST VIRGINIA	
Charleston Interurban Railroad Co.—Between South Charleston, Spring Hill and St. Albans	9.00
Elkins Electric Railway Co.	1.50
Monongahela Valley Traction Co.—Clarksburg to Northview	1.00
Parkersburg, Marietta & Interurban Railway Co.—North End	2.35
	13.85

WISCONSIN	
La Crosse City Railway Co.	0.50
Milwaukee Electric Railway & Light Co.—In Milwaukee, Wauwatosa, Lake and Racine	6.03
Milwaukee Northern Railway Co.—Between Milwaukee and Brown Deer	11.00
Southern Wisconsin Railway Co.	0.50
	18.03

CANADA	
Berlin & Northern Railway Co.—Through Bridgeport	0.25
Calgary Municipal Railway	18.50
Edmonton Radial Railway	2.50
Guelph Radial Railway Co.	0.60
Halifax Electric Tramway Co., Ltd.	0.75
Lethbridge Municipal Tramway	11.00
Levis County Railway.—Between St. Romaud and Gorman's Bridge	1.50
London Street Railway Co.	1.00
Moncton Tramways Electric & Gas Co., Ltd.	2.25
Montreal & Southern Counties Railway Co.—Between St. Lamberts and Greenfield Park	3.00
Montreal Tramways Co.—Montreal	2.07
Nipissing Central Railway.—Between Cobalt, Haileybury and New Liskeard	5.70
Oshawa Railway Co.—Oshawa	2.00
Regina Municipal Railway	3.50
St. Thomas Street Railway	0.50
Sandwich, Windsor & Amherstburg Railway.—In Windsor and Sandwich West	1.25
Saskatoon Municipal Street Railway	22.00
	78.37

GRAND TOTAL	
United States and Canada	950.29

Steam Road Electrifications

The Author Discusses Mountain-Grade Service and Shows That with the Electric Locomotive the Ruling Grade Need No Longer Be a Limiting Factor to Transportation Capacities

BY A. H. ARMSTRONG, RAILWAY DEPARTMENT GENERAL ELECTRIC COMPANY

The electrification of our steam railways has been the goal toward which the efforts of electric railway engineers have been directed for many years. Certain installations such as terminal and tunnel electrifications are thoroughly justified and will take place for reasons other than adequate return upon the capital invested. With a better understanding of the electric locomotive and its operating possibilities, its fitness as a superior type of motive power for main-line electrification has become apparent. This fact, together with certain fundamental conditions which have developed during the past few years, has made it possible to consider immediate electrification of certain portions of our main steam roads where the local conditions are especially favorable to electrification and where the limitations of the steam engine are most apparent.

As a result of several years of operation of electric locomotives, sufficient figures are at hand to indicate within reasonable limits their probable cost of operation and maintenance. After making due allowance for the different conditions obtaining, there seems every reason to believe that the electric locomotive can successfully replace the heaviest type of steam engine on the mountain-grade divisions of our main steam roads, provided the daily tonnage is sufficiently heavy to justify the first cost of electrification. These proposed electrifications show a saving over present steam operation sufficiently large to attract the capital investment required, and therefore come outside the scope of the so-called "enforced electrifications" demanded by local sentiment or for reasons of expediency.

There are certain fundamental causes underlying the fact that mountain-grade electrifications can in many instances be considered immediately, and these may be classed under the following three general headings:

1. Electric power situation.
2. Preparedness of the manufacturing companies.
3. Superiority of the electric over the steam locomotive.

ELECTRIC POWER SITUATION

The past few years have witnessed the formation of large power interests in both the West and the East, and these installations have reached such a magnitude and the high-tension distribution systems now cover such a large territory and are fed from so many sources of supply as to guarantee to prospective railroad purchasers a reliable and cheap source of power. The very mountain-grade divisions that are so troublesome to the operators of steam engines are frequently the centers of large hydraulic installations, so that the abundant supply of power in the mountains finds a ready local market in the railroads. The reliability of such electric power supply is indicated by the operation of the Great Falls installation of the Butte Electric & Power Company, which showed a total of seventeen minutes' delay during its first year of operation and a still better record the second year.

Except under very favorable conditions, it does not appear economical to install and operate a power station devoted solely to supplying electric locomotive load alone, owing to the high fixed charges required to furnish power with a ragged load curve and also maintain sufficient reserve apparatus to guarantee continuity of service. Such loads, however, can be absorbed by large power developments at a cost for power which may in many locations make electrification attractive, because such power systems can take full advantage of the diversity factor of railway, lighting and miscellaneous power load. Not the least of the contributing causes justifying immediate electrification in certain localities is therefore the fact that power can be purchased by the railroad companies at reasonable rates, thus eliminating the necessity of any additional outlay for power house and transmission lines, a condition most attractive when financing constitutes the greatest obstacle toward electrifying certain engine divisions.

ELECTRIC LOCOMOTIVE AND STEAM LOCOMOTIVE DESIGN

It is to be expected that the electric locomotive will be improved from time to time with the advance of the art, and the present preparedness of the manufacturing companies to build electric locomotives of any capacity demanded is based upon the experience gained in the manufacture of many such machines. Compared to the steam engine, the electric locomotive is comparatively new, and the belief is held by some that the purchase of to-day will be rendered obsolete by the improvements of to-morrow. It is difficult, however, to anticipate material improvement in the operating results of such machines, for example, as the locomotives operating over the New York Central electric zone. These machines, purchased at a reasonable price, operating at over 92 per cent efficiency from third-rail to rim of drivers, maintained in original operating condition at a total cost of approximately 3 cents per mile run and requiring inspection only after 1200 miles operation, leave small opportunity to effect any but minor future improvements.

The steam engine, on the other hand, is open to fundamental improvements in future designs that may readily make present machines economically obsolete. The change from simple to compound, coal to oil as fuel, the adoption of the superheater, feed-water heater, etc., may make for a fuel economy considerably greater than that open to future improvements in electric locomotives. The use of mechanical stokers may also be justified by reason of the increased engine output so obtained, provided such increased capacity is not purchased at a too great sacrifice in fuel economy.

In other words, the modern steam engine itself is much more liable to future fundamental changes in design than the electric locomotive, owing to the fact that the latter is already advanced to a high state of development not possible with the more complex steam engines comprising both motive power and steam generating plant. Any fear, therefore, that the electric locomotive constructed to-day will be discarded to-morrow by reason of having become obsolete is based upon a lack of understanding of the inherent qualities of such a type of motive power, as such replacement, if made, will be for reasons other than that of locomotive efficiency.

The main reason for electrification, however, rests in the superiority of the electric over the steam locomotive as a type of railway motive power and its better adaptability to the rigorous requirements of heavy mountain-grade railroading. The electric locomotive possesses certain inherent characteristics not equally shared by the steam locomotive, which offer the opportunity of introducing improved methods of operation and effecting economies in the handling of mountain-grade traffic which will have far-reaching effect.

POWER OF STEAM ENGINE LIMITED

The steam engine is a complete power house on wheels and depends upon the mechanical activity and skill of the fireman as regards its horse-power or service capacity out-

put. Its available tractive effort is a function of the weight upon the drivers, diameter of cylinder and steam pressure, all of which may be thoroughly in keeping with the local conditions obtaining in the class of service to which the engine is assigned. The speed at which this tractive effort is delivered, however, depends upon the rate at which a fireman can throw coal and also upon his skill and the efficiency of the boiler. As the result of the continually increasing demand for heavier trains operating at higher speeds in order to take care of the volume of daily tonnage on a single track and meet the schedule competition of possible parallel lines, it has been necessary to develop steam engines having a continually greater weight upon the drivers. With weight per driving axle of nearly 60,000 lb. it is probable that the limit has been reached with present weight and composition of track rails and bridge construction. A further limit has been reached in the four driving axles comprising the 16-ft. rigid wheelbase of a simple engine; hence the development of the Mallet type of engine comprising two articulated trucks of either three or four driving axles each. All this development of the running gear of the engine has been accompanied by an increase in the diameter of cylinder to keep pace with the additional tractive effort demanded, until up to 90,000 lb. may be delivered from a single Mallet engine during the starting or accelerating period of the run.

The steam engine, however, is still fired by hand where coal is used as fuel, and the limit of continued effort of one fireman is still at the rate of not exceeding 5000 lb. of coal thrown per hour. The use of two firemen alternating in short shifts of say twenty minutes may result in throwing a somewhat greater quantity of coal beneath the boiler than indicated above, but at best the steam engine has reached limits in its horse-power output by reason of the amount of coal which can be fed to the grates. The introduction of the mechanical stoker may effect a considerable increase in the amount of coal fired, but such improvements have yet to show that the increased locomotive output so obtained is not purchased at a decreased coal efficiency that largely impairs the gain effected. Oil is used as fuel in favorable localities with resulting marked increase in the service capacity and hence speed of the locomotive on mountain grades. With the continually increasing demand for oil products, it is probable that the economic operating zone for this kind of fuel will become very restricted; in fact, a return to coal has already been made on certain single engine divisions owing to recent advances in the price of fuel oil.

While the weight upon the drivers and tractive effort of steam engines has therefore kept pace more or less with the requirements of mountain-grade railroading, the increased tractive effort so provided has been purchased at the expense of speed. The simple engine of four driving axles and a total of 200,000 lb. on drivers may haul its rated tonnage on the maximum grade at 12 m.p.h., while the Mallet engine with its greater weight on drivers and increased tractive effort available will haul a correspondingly greater rated tonnage at speeds, however, not greatly exceeding 7 to 8 m.p.h. If greater speeds are required upon ruling grades, the demand can be met with the Mallet engine only by hauling less than its rated load or by providing more engines per train.

It is just in this connection that the electric locomotive offers all the advantages of the high tractive effort demanded without being penalized by the correspondingly reduced speed of its steam competitor. Just what this may mean in the operation of a mountain-grade division is best appreciated by a brief analysis of the inherent characteristics of modern steam engines and the type of electric locomotive just completed for operation upon the Butte, Anaconda & Pacific Railway. These figures are shown in Table I.

Both the Mallet and the electric locomotives have been built in units larger than listed in this table, but for general conditions the size quoted may be taken as typical for both.

LOCOMOTIVE PERFORMANCE

While fuel economy is not the most important consideration, there is generally a certain saving to be effected in this item by the substitution of the electric for the steam locomotive. The cost of coal and its quality, as well as the cost of electric power, will vary so greatly in different localities that no comparison is of any more than general interest. The coal consumption of a steam engine is, however, of the greatest interest from the standpoint of indicating its service capacity. In order not to confuse the issue being discussed, the data shown in Table II have been tabulated, based upon the coal burned by the steam engine itself, while working at full output, although of greater interest are the total amount and cost of coal purchased, including the wastage and cost of handling between purchase point and engine tender.

Table I, Showing General Characteristics of Simple Mallet Compound and Recent Electric Locomotive.

	Simple.	Mallet Compound.	Electric
Number of driving axles	4	6	8
Weight on drivers	200,000 lb.	300,000 lb.	300,000 lb.
Total weight locomotive and tender	400,000 lb.	530,000 lb.	300,000 lb.
Weight per driving axle	50,000 lb.	50,000 lb.	37,500 lb.
Length of engine and tender	70 ft.	85 ft.	75 ft.
Length rigid wheel base.	16 ft.	10 ft.	9 ft.
Diameter drivers	57 in.	57 in.	46 in.
Cylinder, diameter	23 x 28	21 x 32, 33 x 32	....
Rated tractive power	44,000 lb.	66,000 lb.	66,000 lb.
Coefficient of adhesion	22 per cent.	22 per cent.	22 per cent.

The tonnage rating of a locomotive is based upon its performance on ruling grade, and in many instances the ruling grade may extend over a considerable distance, thus calling for the continued development of maximum output and demanding the best efforts of the fireman. While delivering the large tractive effort required on ruling grade, the steam engine must necessarily operate at a considerable proportion of its full stroke, a fact that should not be lost sight of in determining its coal and water economy, and hence horse-power output, as derived from the amount of coal that can be fired per hour.

Table II, Showing Typical Steam Engine Performance.

	Simple.		Mallet Compound.	
Steam consumption per i.h.p. on ruling grade	30 lb.		23 lb.	
Mechanical efficiency	85 per cent.		85 per cent.	
Steam per hp at rim of drivers	35.5 lb.		27 lb.	
Evaporation per pound of coal*	5—8		5—8	
Coal per hp-hour at rim of drivers	7.06	4.42	5.4	3.38
Hp available at rim of drivers at coal rate of 5000 lb. per hour	709	1130	926	1480
Tractive effort on basis of rated tonnage	36,000 lb.		54,000 lb.	
Coefficient of adhesion	18 per cent.		18 per cent.	
Speed at rated tractive effort	7.35 m.p.h.	11.7 m.p.h.	6.39 m.p.h.	10.20 m.p.h.

*Evaporation will depend upon the heat units per pound of coal ranging from 10,000 b.t.u. for Western lignite to nearly 15,000 b.t.u. with Eastern bituminous. This points out that the limitations in locomotive output and speed, as determined by the amount of coal which a fireman can throw per hour, are more keenly felt on the Western mountain grades where inferior coal must be used.

SLOW SPEED OF STEAM LOCOMOTIVE ON RULING GRADES

A careful study of Table II is most instructive, as it points out one of the great weaknesses of the coal-burning, hand-fired steam engine, and that is its low speed when operating on ruling grade. The values of steam consumption and evaporation taken are fully representative of good performance, but it must be also admitted that considerable latitude should be allowed in such values as pounds of coal burned per horse-power hour output at driver rims on account of the boiler condition and the efficiency of the crew. Hence the average performance of all the engines

assigned to one grade division may quite possibly fall below the figures quoted above.

The table shows why the heavier Mallet must necessarily haul its larger rated tonnage at a lower speed than the simple engine. There are admitted large economies resulting from the movement of heavy unbroken trains over a mountain-grade division; hence the usefulness of the Mallet. But the question of operating speed must not be lost sight of, and with a congested single track a possible marked increase in speed may eliminate the necessity of constructing a second track with the large capital outlay which this would entail in the mountain districts.

Turning again to what relief from these conditions is offered by the electric locomotive, there is presented a machine entirely separate from its power supply and comprising electric motors, running gear and superstructure, all suitably proportioned to best advantage. The motor armatures may be mounted direct on the axles, as in the New York Central design, or may transmit their power through twin gearing, as is the case with the Great Northern, Detroit tunnel and Baltimore & Ohio tunnel locomotives, or may even connect with side rods or combination of gear and side rods. The several types of gearing present a radical difference in appearance but a comparatively small fundamental difference in actual efficiency from electrical to mechanical power.

The main point to be considered at this time is that, however different in type of construction, the electric locomotive, as such, is a highly efficient machine, can be maintained at a lower cost and is capable of giving a sustained output greatly exceeding that of a steam engine. With good-quality bituminous coal, the steam engine may operate its rated tonnage calling for a tractive effort corresponding to 18 per cent coefficient of adhesion of its drivers, at a sustained speed of not over 12 and 10 m.p.h. respectively, for hand-fired simple and Mallet engines. With Western lignite the speed may fall as low as 8 and 6 m.p.h. for the two types of engines working under the same maximum conditions.

The electric locomotive, however, having access to unlimited power, is restricted in its tractive effort only by the weight upon its drivers and has no reasonable speed limits other than those imposed by the curvature of the track. Moreover, several locomotive units may be coupled together and operated as a single locomotive under the control of one operator. The ability of the electric locomotive to furnish both large tractive effort and high speed is best brought out by the comparison shown in Table III

TABLE III, SHOWING COMPARATIVE HAULING CAPACITY STEAM AND ELECTRIC LOCOMOTIVES.

	Simple.	Mallet Compound.	Electric.
Total weight, including tender	400,000 lb.	530,000 lb.	300,000 lb.
Weight on drivers	200,000 lb.	300,000 lb.	300,000
Cofficient of adhesion at rated tonnage	18 per cent.	18 per cent.	18 per cent.
Tractive effort at rated tonnage	36,000 lb.	54,000 lb.	54,000 lb.
Tractive effort 2 per cent grade	40 lb.	40 lb.	40 lb.
Train and curve resistance	7 lb.	7 lb.	7 lb.
Total resistance	47 lb.	47 lb.	47 lb.
Rated tonnage, total	776 tons	1,150 tons	1,150 tons
Rated tonnage, trailing	576 tons	885 tons	1,000 tons
Per cent of electric trailing, tons	57.6	88.5	100
Speed at rated tonnage*	7.35 m.p.h.	6.38 m.p.h.	14 m.p.h.

*Speed based upon using Western lignite at approximately 10,000 b.t.u.

applying to the locomotive constants given. A typical ruling 2 per cent grade division is taken as representing general mountain-grade conditions.

A study of steam engine practice discloses the fact that engines receive a tonnage rating on ruling grade that will require a tractive effort of approximately 18 per cent coefficient of adhesion of their drivers.

SERVICE CAPACITY

The hauling capacity of the electric locomotive having the same weight upon its drivers is shown as being but 13 per cent greater than that of the Mallet, but the speed at which this tonnage is hauled is over double that possible with the steam engines. The "service capacity," or the product of trailing tonnage and speed upon ruling grade, is therefore a truer measure of the comparative performance of the several locomotives and is given in Table IV.

TABLE IV. SHOWING COMPARATIVE SERVICE CAPACITY OF STEAM AND ELECTRIC LOCOMOTIVES.

	Simple.	Mallet.	Electric.
Trailing tons, 2 per cent grade	576	886	1,000
Speed	7.35 m.p.h.	6.38 m.p.h.	14 m.p.h.
Speed multiplied by trailing tons	4,235	5,660	14,000
Per cent of electric "service capacity"	30.2	40.5	100

This table shows that the electric locomotive "service capacity," or its ability to move tonnage per hour, is three times that of the simple and two and one-half times that of the Mallet engine, while its total weight is less than either.

As compared with hand-fired coal-burning steam engines of either the simple or Mallet types, the electric locomotive may be looked upon to furnish the much-needed increased capacity of motive power for mountain-grade divisions. Such grade divisions are not only a heavy expense in operation but introduce a very slow schedule in a trunk-line service, besides greatly congesting the traffic on a single track, when steam engines are depended upon. Many divisions comprise ruling gradients of such a nature as to require the breaking up of through trains or at least a partial rearrangement of the train tonnage delivered by the adjoining low-grade division. The delay thus introduced, together with the lost time incident to steam engine haulage on a heavy grade, amounts to a considerable total.

ELAPSED TIME

A mountain division of 220 miles, comprising ruling gradients of 2 per cent, showed the results published in Table V of elapsed time under existing steam engine conditions compared with the time that could have been made with suitable electric locomotive equipment.

TABLE V, SHOWING ELAPSED TIME WITH STEAM ENGINE ON GIVEN RUN AND THAT POSSIBLE WITH ELECTRIC LOCOMOTIVE ON SAME RUN.

	Steam, Hours.	Electric, Hours.
Actual running time	15.15	13.02
Taking water	.90	.....
Cutting in and out helpers	1.00	.50
Testing air brakes	.20	.20
Changing engines and rearranging tonnage	1.40	.....
Total elapsed time	18.65	13.72

The run of 220 miles shown in Table V comprised two steam engine divisions, entailing the necessary delay in changing engines, while the schedule of the electric locomotive is based upon its making the through run of 220 miles, changing crews, however, at the division point.

The electric locomotive run is further based upon making a maximum speed of not over 35 m.p.h. on level track, the speed attained in the steam engine run, but, however, making a much higher speed on the ruling grades than the 10 m.p.h. reached with the steam engine. The delay due to taking on water is best appreciated by having knowledge that the water supply in the tender is sufficient to last only from one to one and one-half hours of continuous running at maximum output corresponding to a possible distance covered of from 10 to 15 miles. With a complement of three steam engines per train, taking water involves a delay of from twenty to thirty minutes, all of which time is saved with electric locomotive operation. Aside from the economies resulting from replacing the steam with the electric locomotive, the providing of increased hauling capacity at increased speed comprises operating advantages

that will be fully appreciated in these days of track congestion and competition.

COAL CONSUMPTION

In previous tables values of from 3.38 lb. to 7.06 lb. of coal per horse-power hour at the driver rims have been quoted. Such figures, however, apply only to the coal used while the steam engine is working at full output.

In addition, there is much coal burned from which no return in mileage is made. Commencing with firing up and ending a run with fire banked, coal is continuously being burned during the time that the train is in motion as well as when standing still.

Some idea of the coal wastage inherent to steam engine operation is gained by study of Table VI, which has been compiled from observed operating conditions.

Table VI, Showing Coal Records of Simple Engine.

Firing up preparatory to run	1000 lb.
Standing on sidings	500 to 1000 lb. per hour
Coasting down grades	950 lb. per hour
Fire banked in roundhouse	150 lb. per hour

The steam engine is actually working but a small part of the twenty-four hours, and to the coal consumed during working periods must be added that burned in making up fire, coasting down grade, standing on sidings, banking fire, etc. A series of readings extending over a period of thirty days and covering two engine divisions of a Western mountain road where lignite coal of less than 11,000 b.t.u. was used showed that nearly 12 lb. of coal was purchased for each useful horse-power hour expended at the driver rims.

In some instances nearly 10 per cent of the tonnage moved over the division consists in the coal required to move the trains.

The price of such coal may vary from $1.50 to $3 per ton upon the tender, and in this item of fuel the electric locomotive holds promise of material saving. While this article is largely devoted to a consideration of the Western mountain-grade problem, there is an even greater saving in fuel to be attained in operating electric yard locomotives. The average demand for power is less than 100 kw in yard shifting service, as given by Mr. Murray, while the coal consumption per horse-power hour of steam yard engines is even greater than the figures given above for road engines on grade divisions.

OTHER OPERATING ADVANTAGES

Electrification promises much in the way of increased hauling capacity, higher speed on ruling grades and relief from track congestion. Other operating advantages result with the use of the electric locomotive. In certain railway systems it is the practice to pool the engines, while in others best results appear to be obtained when an engine is assigned to its own crew. The greater reliability, ruggedness and uniform operation of electric locomotives make it entirely feasible to pool them and secure the benefits of a lesser outlay without risking any marked increase in the cost of locomotive maintenance. Moreover, it is entirely possible to operate an electric locomotive continuously during the twenty-four hours with no reference to coaling or watering stations or roundhouse and no delays incurred thereby or in cleaning fires and washing out boilers. The freedom of action which the electric locomotive enjoys should prove a valuable asset in the operation of a complete engine division. Many other advantages are offered such as electric braking on down grades, thus relieving the brakeshoes and wheels and eliminating possible delay and derailments due to overheating these parts. Freedom from cinders may be a consideration in passenger train operation, but is also of value as reducing the fire risk.

Few comparisons of steam and electric operation are made upon the same basis of schedule and train tonnage moved, showing in itself that electrification is primarily considered from the standpoint of improvement in the service that can be accomplished by steam. It is difficult, therefore, to express any economic value of motive power substitution, as such benefits as, for instance, decreased running time are difficult to put into figures. Such direct savings as are evident, however, indicate a very attractive return upon the capital investment required after paying all the increased fixed charges incurred. In fact, perhaps one of the most effective causes contributing toward the present electrification movement lies in the acceptance of existing proofs that the electric locomotive can be economically as well as reliably operated.

BUTTE, ANACONDA & PACIFIC LOCOMOTIVES

The foregoing data apply to the electric locomotive as such, with no particular reference to any one type of construction. Characteristics of the Butte, Anaconda & Pacific locomotive have been quoted as being typical of the performance required for mountain-grade service. This installation will be in operation in the very near future and test data made available. The Butte, Anaconda & Pacific locomotive is of interest in this article in that it is the most powerful machine thus far constructed for its weight, comprising an eight-motor equipment capable of giving a sustained output of 2200 hp in continuous operation with 75 deg. C. rise, and the complete locomotive weighing 150 tons, all on drivers. When it is realized that this large sustained output is delivered at a speed of approximately 15 m.p.h., the fitness of this locomotive for heavy grade haulage will be admitted.

The Butte, Anaconda & Pacific motors are connected to the driving axles through twin gearing, following the construction of the Cascade, B. & O. and Detroit tunnel locomotives, as affording the greatest possibilities of large horse-power output at low operating speed. The locomotive motors differ from any now in operation in this country only in the voltage, which is 2400 volts d. c. between trolley and rail. The rugged qualities of the direct-current motor are fully known, and the greater radius of action secured by the use of 2400 volts is made apparent by the statement that the 26 miles between Butte and Anaconda will be fed from two substations located at either end, with trains of 3400 tons trailing against a gradient of 0.3 per cent operating at a speed of 14 m.p.h. The Butte, Anaconda & Pacific Railway comprises approximately 114 miles of track, of which 90 miles are being electrified at present.

ELECTRIFICATION OF TERMINALS AND OF MOUNTAIN GRADES

The causes underlying the movement toward terminal electrification in our large cities are so apparent and well founded that this important class of work has received but passing mention in this article. The installation of electric locomotives to operate through tunnels is also a matter beyond question, and this fact is not lost sight of in future plans for mountain-grade divisions, as in some favored localities a very few miles of tunnel can replace many miles of surface grade, with its attendant higher elevation, high cost of maintenance and operation. The fact, however, that is just being appreciated is the value of the electric locomotive characteristics when applied to the haulage of the heaviest trains at the highest speeds feasible on mountain-grade divisions.

The introduction of the electric locomotive robs the dreaded "ruling grade" of half its terrors, as the heaviest trains can be moved up such grades at double the present operating speeds with steam engines and can be safely controlled down grade with electric brakes without having recourse to air brakes except as an emergency resort.

Moreover, the operating advantages which the electric locomotive introduces can be secured with adequate return upon the capital investment called for. In these conditions and in the availability of cheap power, with the present state of development of electric locomotives and auxiliary apparatus, we find the main causes underlying the present earnest movement toward the electrification of mountain-grade divisions.

The Development of the Electric Railway Motor

The Electric Railway Motor Has Now Reached the "Age of Economy"—Dangers in Too Great Reduction in Car Weights Are Cited—Possibilities in Field Control Are Discussed

BY N. W. STORER, GENERAL ENGINEER RAILWAY DEPARTMENT WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

The evolution of the modern railway motor began in the early eighties and is practically all confined to a period of thirty years, which may be divided into about five stages as follows:

First—The period embracing the experiments of the early inventors such as Field, Hopkinson, Henry, Daft, Edison, Van Depoele, Farmer, Bentley, Knight and Sprague.

Second—The period covering the exploitation of the double reduction motor between the years 1886 and 1891.

Third—The period from 1891 to 1907, covering the development of the single reduction motor of the straight series type.

Fourth—The period from 1907 to 1911, covering the development of the commutating-pole motor.

Fifth—The period beginning 1911, which is not yet completed, covering the age of economy in operation.

Of the first and second stages it is unnecessary to say anything at this time as they are a matter of history which is already well written in numerous articles in the STREET RAILWAY JOURNAL and elsewhere.

The third stage has not been so completely described. It begins with the introduction of the first really successful single reduction motor—the Westinghouse No. 3—and covers the entire range of motors built by the Westinghouse Electric & Manufacturing Company down to the No. 101-B-2, the motors built by the General Electric Company from the S.R.G. to the G.E.-80, and the various motors built by the Short Company, the Walker Company, the Lorain Company, the Stanley Company and the Allis-Chalmers Company. Some of these companies, such as the Short, Walker and Lorain companies, were strong competitors in the early days and made some very good motors. For one reason or another the companies abandoned the manufacture of electric railway motors. However, the good points of the motors were largely retained and transmitted to the later designs. The motors at the end of the third stage may be said to have embodied in them practically all of the improvements which were developed prior to that time. The Westinghouse No. 101-B-2 motor, for instance, had the following features, many of which are now common to all railway motors:

1. Inclosed type with cast-steel frames.
2. Four laminated radial pole pieces bolted into the frame.
3. Mummified strap-wound field coils insulated with asbestos paper between adjacent turns, the entire coil impregnated in a vacuum.
4. Large armature shafts carried in bearing housings extending inside of the armature at the pinion end and inside the commutator at the front end.
5. Bearings well lubricated by the use of oil-soaked waste.
6. Separate oil well for gaging depth of oil and for receiving fresh oil.
7. Efficient oil throwers as a protection against the oil reaching the interior of the motor.
8. Spring packing of field coils to counteract the effect of shrinking insulation, and thus prevent loosening.
9. Improved methods of holding motor leads to prevent vibration and breaking.
10. Two-point suspension of gear cases.
11. Commutator cover with simple and reliable cam-locking device.
12. Slotted drum-wound armature.
13. Ventilated armature.
14. Form-wound armature coils assembled in sets of three coils each.
15. Armature core and commutator assembled on spider.
16. Armature bands laid in grooves in the armature core.
17. Coils protected by asbestos hoods on the commutator end.
18. High-grade insulation.
19. Commutators with mica extending beyond the copper, both on the inside of the commutator and at the end next to the windings to prevent short-circuits.
20. Improved brush holders with insulation consisting of high-grade insulating tubes protected by brass shells where clamped and by porcelain sleeves to give creepage surface.
21. Brush holders with adjustable tension and frictionless springs.
22. High-grade carbon brushes.
23. Many other small details which contribute to the success of the motor but can scarcely be enumerated.

Each one of the features mentioned has its own history which, if completely written, might cover a good many pages. It is, however, not necessary to give this in detail, and only a few comments will be made.

It is, of course, understood that these special features above given did not all originate with the No. 101-B-2 motor. They were carefully selected after a study of the previous types in service and were based upon the comments and suggestions of a great many operating men. The earlier railway motors were almost entirely the product of the manufacturers' designers. It was natural that this should be so since there was so little actual experience in operating motors and so few people in the business who actually knew anything about them. Even after there were thousands of equipments in service, it was rather difficult to get concrete suggestions from operating men for improving the design of motors. At the time the No. 101-B-2 motor was designed, however, a systematic effort was made to make the operating men thoroughly understand that the motor designers were in earnest in asking for their opinion and advice, and the result was that a great many valuable suggestions were obtained and some of the most valuable features in the modern motors were due to suggestions from operating men. The close touch between the operating men and the designers, which has been brought about through association largely in the American Electric Railway Engineering Association, has been of incalculable value in the design of railway motors.

INCLOSED TYPE OF MOTOR AND LAMINATED POLES

The inclosed type of motor resulted from the large amount of trouble experienced from mud and water splashing into the early types and causing them to break down their insulation. The No. 3 Westinghouse motor had the lower half of the frame inclosed, but the top half was more or less open over the commutator. The General Electric W.P. motor went still further and had the motor completely inclosed. The use of the four radial poles followed the attempt to get the most compact as well as the lightest design for street car motors. The Westinghouse No. 3 was the first commercial motor with this feature. It had the four radial poles and four equal field coils.

Laminated pole pieces were introduced to decrease the loss from eddy currents in the pole faces, which, with the high inductions introduced with the slotted armature and small air gaps, greatly increased the total loss in the motor.

The earliest motor having laminated poles was the Westinghouse No. 38-B. The poles were cast into the steel frame. The writer well remembers testing the first No. 38 with solid steel poles and finding such an astonishing loss in the pole face that laminated poles were at once decided upon. The pole pieces were bolted in on later motors, but whether first by the Lorain Company or the General Electric Company, the writer is unable to say. This was done in order to make the motor more compact and to utilize all of the space to the best advantage. It has ever since been standard practice. The induction in the air gap and the pole face is considerably less than the economical induction for working in sheet steel, so that it was quite possible to reduce the section back of the pole face and use the projecting tips to hold the field coils in position. Later the Westinghouse generator practice of saturating the pole tips by cutting off alternate pole tips from the punchings was introduced. This is still used to some extent.

MUMMIFIED STRAP-WOUND FIELD COILS

The use of mummified strap-wound field coils with asbestos insulation has become practically universal, and the use of round wire is permitted only on the smallest sizes of motors where the section is so small that no gain is secured by the use of the flat copper ribbon. This type of field coil has been a wonderful improvement over the earlier types. Insulated as it is with heat-proof insulation in the interior of the coil, it is able to withstand a much higher temperature, and the external insulation which is so completely filled with varnish, etc., makes it practically waterproof as well. The G.E.-57 motor and some others had field coils of copper ribbon insulated with asbestos between turns. They were, however, wound in metal bobbin shells or spools and could not be wound tight enough to prevent chafing of insulation and grounding. The mummified construction adopted for the No. 101-B-2 motor eliminated this trouble and made a solid coil which when used with the spring packing is held perfectly tight. The use of springs back of the field coils to insure their being held firmly at all times has been a great addition to the motors. It prevents the breaking of leads and chafing of insulation which would result in grounded field coils.

LUBRICATION

Probably no improvement has been more marked and has done more to keep the motor cars out of the repair shop than the introduction of the type of bearing housing and the method of lubrication used with the No. 101-B motor. With the old grease lubrication, it was no uncommon thing for armature bearing shells to be replaced after 3000 miles of service. The life of the bearing on the No. 101-B-2 motor may be almost anything up to 300,000 or 400,000 miles. This extraordinary result is due to the excellent design of the bearing, which has the waste packed against the shaft on the low-pressure side, with pressure of a column of waste over it, and the oil fed from below, coming from the well, which may be gaged at any time to see that the oil is kept at the economical level. This type of bearing is now universally adopted. It is scarcely necessary even to add oil to the bearings more than once a month, so that not only is the cost of lubrication reduced to a negligible quantity but the cost of maintaining the bearings and the loss due to the armature getting down on the pole pieces, which was a fruitful source of expense with the old bearings, have been practically eliminated.

OTHER ARMATURE IMPROVEMENTS

The modern armature is a very different piece of apparatus from that of twenty or twenty-five years ago. Then the armatures were either hand-wound, as in the W.P. and S.R.G., or the coils were wound on a form and driven down on the ends of the armature with a mallet in the process of winding them, as in the Westinghouse No. 3. The evolution from that type to the one used at present has been gradual. The early motors, like the No. 3, had only one armature coil per slot; the Westinghouse No. 12-A had two coils per slot; the No. 38-B had three coils per slot. The No. 12-A introduced the barrel-shaped armature winding with the ends left open to provide circulation of air through the coils. The G.E.-57 had form-wound coils with sloping ends bound firmly on a coil. The modern type has the coils projecting straight out banded to the coil support and completely covered with canvas or asbestos cloth caps.

The asbestos hoods on the front end of the armature windings were introduced to prevent the damage incident to flashing which may occur from any reason and is liable to set fire to a canvas covering.

The modern brush holders are a great improvement over the earlier form, not only in accuracy of adjustment but in simplicity of the insulation, substantial design and the use of adjustable frictionless springs. Sluggish brush holders and inaccurate adjustments used to be fruitful sources of bad commutation and flashing, but they have been almost entirely eliminated.

Another scheme that was introduced with the No. 12-A and the No. 38-B motors was the use of longitudinal holes through the armature core that served the double purpose of paths for circulation of air and of saturating the iron beneath the armature slots, which thereby improved commutation. The saturation has been largely abandoned on later motors, but the air ducts are continued.

Introduced with the No. 101-B for small motors was the armature spider, which carries not only the armature core but the commutator and thus permits the easiest possible renewal of bent or broken armature shafts. It also stiffens up the shaft in the spider and gives a much larger diameter for carrying the armature punchings and thus holds them tighter. There is less liability of relative motion between armature core and commutatior, as both are keyed to comparatively large diameters on the same spider.

COMMUTATING-POLE MOTORS

Coming at a time when the straight series motor had thus reached its high state of perfection, it is little wonder that the commutating-pole motor introduced in 1907-08 was an immediate and unqualified success. It had the benefit of all of the experience gained in the design and operation of the earlier motors, and added to that the use of the commutating pole, which eliminated the last serious objection to the direct-current street car motor, namely, the troubles incident to the commutation of the current. It is probable that no class of apparatus ever designed had a greater measure of success than the commutating-pole railway motors introduced at this time. However, the commutating pole was not the only new feature. The close association of the designers with the operating force and the intensive study of the subject led to still further minor improvements in the motors, and some very valuable features were introduced. Among them was the two-turn strap-wound coil with the Westinghouse No. 310 motor, which was a triumph in the art of armature winding. The method of forming the coils used in this motor obviates all of the difficulties which had previously been experienced with that type of coil. It permits of increased efficiency, larger capacity, better insulation and more substantial construction than with the ordinary wire winding.

The high-grade carbon brushes which came into extensive use about the same time, added to the undercutting of the mica on the commutator surface and the sparkless commutation due to the commutating pole, have practically eliminated wear on the commutator and greatly increased the life of the brushes. The amount of carbon and copper dust originating in the motor, which would tend to reduce the efficiency of the insulating surfaces, is, therefore, very small. This feature is of the utmost importance in the motor to be used on high-voltage circuits and greatly increases its reliability. Without it the high-voltage motor would have been a difficult if not a commercially impossible problem. With it the motor operates better on 1500-volt circuits than the old motor did on 600 volts.

THE AGE OF ECONOMY

The first interruption to the course of the commutating-pole motors came with the fifth stage in the history of the railway motor, namely, the age of economy.

One of the most notable signs of the times in the last two or three years has been the demand for economy and efficiency in every field of human endeavor. This has been due in great part to the training of the thousands of engineers who have been working in every possible way to increase the outputs of factories, mills and mines, to reduce operating expenses for a given output, to reduce the losses in generating plants, to increase the efficiency of transmission lines by the use of higher voltages, and so on through the entire field, trying in every way to reduce costs and increase dividends. This craze for efficiency—for such it has become in some quarters—reached the electric railways two or three years ago when someone called emphatic attention to the fact that it costs good money to carry around dead weight on street cars. This cost is variously estimated at from 2 cents to 10 cents per pound—a favorite figure being 5 cents per pound per annum. The exact amount, of course, depends on the cost of power at the car, the mileage and the class of service in which each car is engaged. Undoubtedly there are some classes of city service where the cost of hauling 1 lb. for a year is as much as 5 cents and possibly more.

REDUCTION IN CAR WEIGHT

Of course, this was not a particularly new idea, as it had been preached in some places for a good many years; but, be that as it may, it was brought out strongly at a very opportune moment—at a time when all parts of a car equipment had reached their maximum weights as a result of the demand for safety and reliability. It cannot be denied that there was reason for the complaint about excess weights, for the reduction in weight consequent upon the demand of operators for light-weight cars was prompt, and the reduction was so large as to leave no room for doubt that the previous weights had been excessive. However, as is usually the case, the reduction in weight has been carried to such an extreme in some cases that it has increased rather than decreased the cost of operation. It is always a question where to stop in such changes, and it is always a mistake to have only one idea in mind, especially if this idea consists simply of the possible fact that it costs 5 cents per pound per annum to haul the weight around on the cars.

Other things being equal, a reduction in the weight of a street car will effect a proportional reduction in the power required to move it. However, one should always be certain that the reduction in weight is not accomplished at the price of decreased operating efficiency or of increased cost of maintenance. Either of these can easily far more than offset any saving effected by decreased weights.

The prime idea should be a broader one. The reduction in cost of operation is the most comprehensive idea, but the demand for a reduction in the energy required to move the cars is a far safer and saner idea to inculcate in the minds of the operating men than the sole idea of the reduction of weight to save money. It should be understood that the lightest equipment is not necessarily the one which will have the lowest energy consumption per car mile.*

OTHER METHODS OF IMPROVING OPERATING EFFICIENCY

Ample proofs have been offered to show that the energy consumption can be greatly decreased by other methods than by decreasing the weight of equipment. This is especially the case where a decrease in the weight of the railway motor means an increase in the speed and consequently gives a lower efficiency in operation. A light-weight, high-speed motor may have a very good efficiency when operating at full voltage, better possibly than that of a heavier motor which runs at 20 per cent lower armature speed. In service, however, it is very frequently the case, and is nearly always the case in city service, that the motor with the lower speed will give a higher operating efficiency. This is due to the fact that the motor with higher speed will necessarily have a much greater resistance loss in accelerating, which is far more than enough to offset the power saved by reducing the weight.

In general, it is dangerous to make radical reductions in the weight of railway motors. It must be remembered that the motors built ten years ago were lighter in weight than the standard motors of to-day, but they were not nearly so reliable. For instance, a reduction in the size of armature shafts, which have been brought to their present generous proportions by years of hard experience, even though accompanied by the use of heat-treated material, is dangerous. Heat-treated materials have not yet reached the stage where they can be considered as standard, and until the methods of heat-treating of steel are much better understood by the general run of manufacturers and it is possible to obtain more uniform results by such treatment, we believe it will be better to make shafts strong enough to stand the service required of them without a resort to heat treatment. An extremely careful redesign of railway motors is, of course, producing some reduction in weight, but a radical reduction is sure to be followed by increased cost of maintenance, which will render the equipments less reliable and will more than offset any saving that can be made on account of the reduced weight.

The use of a coasting-time clock and of similar devices has drawn attention to the tremendous waste of power due to inefficient handling of equipment. It is said that the coasting-time clock, by putting a premium on rapid acceleration and on the maximum amount of coasting, has resulted in a saving of power consumption in some places of 20 per cent to 25 per cent or even higher. For the benefit of those who are seeking to reduce weights it is well to call attention to the fact that efficient handling of the cars may in some cases result in so much less heating in the motors as to permit the use of a smaller size of motor, which will thus effect a reduction in weight without a decrease in the mechanical strength of the motor.

Another scheme for reducing the weight of the equipment is by the use of ventilated motors. For some years back the use of forced ventilation has been common on locomotive motors and some motors for car service as well; notably, the motors on the Long Island Railroad have been operated for several years with forced ventilation secured by the use of small motor-driven blowers. The circulation of the external air through the internal parts of the motor is very effective in carrying off heat and will very largely increase the continuous capacity of the motor. This same result may be brought about by the use of perforated covers on the motor or of a fan on the armature shaft arranged so as to draw air through all parts of the motor. Either method is very effective and is quite satisfactory where the dust and dirt do not offer a serious obstacle. In cases where the danger from dust and moisture is serious, the air should simply be circulated about inside of the motor with no connection to the outside air, as has been the practice for many years. Any method that will cause the air to circulate inside the motor is helpful, because it brings the heat to the surface much more quickly than if the air were to remain stagnant in the motor.

FIELD CONTROL

Undoubtedly the most positive power saver which has been introduced with the interpole motors in the last two years has been the use of field control for the motors. This, as is well known, is simply a revival of the old-time control system, which was used in some of the earliest railway motors. The Sprague double-reduction motor made

* Under the subject of "Economies in Railway Operation," F. E. Wynne has very ably discussed this matter in a paper presented before the Baltimore Section of the A. I. E. E. last spring and published in the *Electric Journal*, October, 1912. He shows clearly the effect of higher armature speed, corresponding to small gear reduction, on power consumption in city service. He also takes up the methods for securing the greatest efficiency in operation.

the most extensive use of this, since the control was entirely by commutating the field and employed no external resistance at all. It was used to a greater or less degree in the early double-reduction motors and in one or two or the single-reduction motors. However, the commutation with slotted armatures was not good enough, and the selection of equipments and operation of motors were not well enough understood at that time to make the system a success. It was dropped nearly twenty years ago and was not revived to any great extent until it was applied on the locomotives of the New York, New Haven & Hartford Railroad, which were supplied in 1906 and 1907. These were single-phase motors of the series compensated type and permitted a wide range of variation in the field strength without impairing the commutation. The system in this instance worked with marked success. Its later application to the commutating-pole motors on the giant Pennsylvania locomotives used for the New York terminal was also an entire success, so that the engineers of the company which had furnished both of these types of locomotives were satisfied that this system of control could be used safely with any size of motor. The trial equipment placed in service on the Metropolitan Street Railway in New York City nearly two years ago met with just as great success as that of the locomotives, and the decrease in the energy consumption of this car equipment over the standard type of equipment in use was quite remarkable. A motor of very slow speed was used, and the resistance was normally cut out of circuit before the car reached a speed of 8 m.p.h. Higher speeds were obtained by weakening the fields of the motors. The maximum speed obtained was hardly as high as that of the standard equipment so that a part of the saving of power is due to the lower speed, but the larger part of it is undoubtedly due to the use of field control.

The table given in Mr. Wynne's paper before referred to shows that the energy consumption of the standard equipments of double 60-hp motors was 152.26 watt hours per ton mile, while that of the equipment of double 40-hp field control motors was 124.41, or a total reduction of over 16 per cent in energy consumption per ton mile. This, added to the fact that the equipment weighs considerably less, effected a total saving of over 20 per cent in the energy consumption. There is no doubt that similar savings can be effected in other places.

When we consider what a large part of the work done by the railway motor in city service, consisting chiefly in storing energy in the moving car, is done at speeds under 10 m.p.h., and we realize that most of this work with ordinary control is done with resistance in series, we can begin to understand how very important it is to cut the resistance out at the lowest possible speed. The standard type low-speed motor operates efficiently in the slow service, but the maximum speed is too low to maintain most schedules. Field control both cuts out resistances at the minimum speed and gives the maximum speed desired. It is almost ideal.

Practically the entire advantage of the use of field control in city service is in securing a lower energy consumption. On interurban railways, however, there are additional reasons for using it. The energy consumption is, of course, reduced a certain amount for each acceleration, the peaks on the line are decreased, and the maximum demand from substations is correspondingly reduced, but possibly the most important advantage for interurban work lies in the fact that the field control equipment is suitable for both limited and local service. There are a great many instances where cars equipped with standard motors have been geared for the high speed required for limited service and are operated in both limited and local service. The high-speed gearing renders the cars unfit for local service, since either the acceleration will be very poor and the schedule extremely low or the motors will be badly overworked. As it is the almost universal custom of railways to maintain the fastest possible schedules at any cost, the natural result of this is that motors have been generally overloaded where used for both classes of service. The use of field control enables the motor to be equipped with a comparatively large gear reduction which fits it for the local service, while the operation with the short field enables the car to attain the high maximum speed which is necessary for the limited service. It has been demonstrated that the motor with field control has great advantages on locomotives, on street cars and on interurban cars. The question may be asked: Is there a twilight zone where it is not good? The opinion of the writer is that its advantages should bring it into use in every known class of railway service. Its advantages are positive. Its disadvantages are almost negative. It requires one extra motor lead and a slightly more expensive and complicated control equipment.

We believe that in most classes of service the use of properly designed field control equipment will effect a saving of not less than 10 per cent in the total power consumption required for operating the cars. When it is considered what a vast amount of power this would save in the course of a year if all the railway motors were operated in this way, one feels justified in believing that it will be only a very short time before every one will demand field control equipments. Already many inquiries have come from roads operating large equipments to know if field control can be applied to their existing motors. In most cases, in city service, it is impossible to do this and effect any considerable economy. This is especially the case where the motors are already provided with the maximum gear reduction.

Adaptation of Field Control to Existing Motors

In such a case the possibility for saving is very limited since the standard motors are usually worked at a fairly high induction at normal accelerating loads and the induction can be increased very little by the addition of extra turns on the field coil. There will, therefore, be very little decrease in the accelerating current and a correspondingly small decrease in speed. Consequently, the saving in rheostatic losses would be very small and not enough to pay for a change in the equipments. The use of fewer turns on the field for obtaining higher speed would be of no advantage whatever where the equipment is already geared for speed as high as is required. To get the advantage from field control in slow city service, *motors must be wound for slower armature speed than is ordinarily used for standard motors.* This will in most cases require new armature windings. Where interpole motors are now used with large pinions the advantages of field control can be secured in most cases by an increase of the gear reduction, a change in the field winding and by making the necessary changes in the control equipment. These changes in most cases cost so much as to be prohibitive unless made at a time when gears are to be changed and motors overhauled. It should be kept in mind, however, when new equipments are bought and when all the advantages may be secured at a minimum cost.

Field control with non-commutating-pole motors cannot be recommended, as it will result in most cases in trouble with commutation.

Any well-designed commutating-pole railway motor may be adapted for field control by a proper arrangement of its field windings. To get the full benefits, however, the gears must be properly selected. For interurban work the benefits of field control may be secured by the use of standard high-speed armatures with a larger gear reduction than usual. In most cases, also, sufficient space is available to permit the extra field winding to be used. Special armatures for use with field control are necessary only for cases where the slowest speeds and the maximum gear ratio are required.

It will usually be found that where a motor of a given size is used in city service with the maximum gear reduc-

tion and the usual series parallel control a slower-speed armature may be used with the same motor frame and will make the same schedule with a lower energy consumption when field control is employed. The motor will have a lower horse-power rating, but the current used will be correspondingly less, and, consequently, the motor will have no more loss in it than with the motor of higher speed with a larger rating. In other words, the use of field control permits the use of a motor of a smaller rating for a given service. Where the maximum gear ratio is used in both cases, the same size of frame must be used. However, where the gear reduction can be increased for the field control motor it will frequently be found that a smaller size of motor can be used at a lower first cost and with less weight to be carried around. A double saving will thus be effected.

The question frequently arises as to what range of speed may be covered by field control. For car equipments it is usually from 15 per cent to 25 per cent, which may be secured by cutting out 20 per cent to 40 per cent of the field turns. This amount may usually be secured by one step on the controller. On the Pennsylvania locomotives the field turns are reduced 50 per cent in three steps on the controller. It will generally be found most economical to have the speed of the motor with the short field 20 per cent to 25 per cent higher than with the long field. This will reduce rheostatic losses at least one-half and will give the simplest arrangement of control. The limit to the amount of variation in speed which is possible by a variation of the field of the commutating-pole motor depends to a large extent on the number of commutator bars. If the average voltage between bars is low, the field may be weakened very greatly without materially affecting the commutation, but where the number of bars is small, so that the average voltage is relatively high, a small change in the field strength may result in an increased distortion of the field, and this will cause a corresponding increase in the maximum voltage between bars and will result in flashing over.

Why do we not use a shunt on the motor field instead of having two separate windings? Simply because a shunt on the field makes the magnetism sluggish and renders the motor liable to flash over in case of sudden applications of current resulting from a jumping trolley or contact shoe. It is always preferable to cut out a certain portion of the field and have neither short-circuited turns nor a non-inductive shunt around the field or any part of it, and though it costs more to do it in that way, it should always be done in railway work.

A number of the possible economies in the operation of railway equipments are dependent to a large extent on the control. Fortunately, the development of controllers has kept pace with that of motors, so we can at once secure the benefits that have been pointed out—at least in new equipments.

It has been stated that the use of the coasting-time clocks put a premium on rapid acceleration. To get the best results, therefore, the rate of acceleration should be fixed beyond the control of the motorman. Various schemes have been devised for checking the speed of operating the hand controller, but undoubtedly the best arrangement is a purely automatic control with the steps dependent on the current in the motor. Multiple-unit control has now reached the point where an automatic field control equipment is in operation that will permit the control to be stopped on any notch and requires only five or six train-line wires and an extremely small number of interlocks. Space will not permit a description of this control, and it is mentioned only to show that the advantages secured by the offer of a bonus for the maximum amount of coasting can be secured without risk of injury to equipment and discomfort to passengers due to bad acceleration. The control is so simple that anyone can take care of it. It has also the advantage of being very light.

PRESENT OUTLOOK

The outlook is extremely hopeful. There never was a time in the history of electric railroading when developments came more rapidly than at present. It has been rather disconcerting to the railway manager to find improvements coming so fast that he cannot keep absolutely up to date unless he buys new equipments every year. Fortunately, however, one does not have to be up to the minute in railroading. The more modern of the old equipments are giving as good service as the new ones can do. The only thing is that they are not quite so economical in energy consumption. The advantages of the most modern equipment should be secured in new equipments, so that in time they will be universally obtained, but the old equipments should be worn out in service.

THE TREND OF PUBLIC UTILITY REGULATION

In an article in the *New York Commercial* for Dec. 14 H. M. Byllesby has reviewed the conditions which are now confronting the public as well as the public service corporations. Mr. Byllesby's statements are in part as follows.

"A community which by accident, design or misfortune is poorly served by any of the so-called public service corporations is a community which necessarily is behindhand in its material development. A community suffering from faulty equipment or management of the public service corporations likewise endures a consequent loss of material advancement with attendant inconvenience and dissatisfaction. No one questions the occurrence from time to time of mistakes, errors, hardships and frauds in the past on the parts of both parties to these enterprises, viz., the projectors and owners of the enterprises and the citizens, communities, governments and municipalities served. The net result, however, has been a service on the part of all such corporations in the United States of America which has not its equal in the world.

"Up to a comparatively recent period the public service official was justified in extending the operations under his charge on the general doctrine of averages—that if a given extension proved unprofitable for the time being or permanently, it would be compensated for by the greater profit to be reached from some other contemporaneous, subsequent or existing branch of or extension to the service. Under this condition of affairs enterprise was fostered and development went forward actuated by the hope of a reward beyond the ordinary fixed small return of the absolutely settled and non-hazardous enterprise.

"To-day throughout the country the unmistakable tendency by Interstate Commerce Commissions, Public Utility Commissions, and by the law-making and legal administering bodies, to hamper and curtail and paternalize the conduct of all of these corporations to a point which is rapidly destroying the enterprise of the individual officers and employees of such corporations is putting a period to the further investment of capital for the extension and enlargement of such enterprises. The result of this policy, if carried along the lines of its present extreme tendencies, will be simply a stop to the further energetic development of these enterprises, and will destroy the individual initiative of these corporations. This policy, if persisted in along the program of the political agitators of the present time, leads inevitably and logically to federal and municipal ownership.

"A new situation and new conditions are now confronting the public and these corporations. It is a time for the underlying common sense of our people to take these questions out of the hands of the muck-raker and the professional politician and to put them before the great tribunal of common sense and love of justice of the American people. These questions are of such deep and far-reaching importance that they should be placed in the hands of entirely non-political tribunals."

Developments During 1912 in Power Plant Design

An Account of the Progress of the Year in the Field of Power Generation, Including Brief Descriptions of Typical Plants, Together with the Author's Comments and His Conclusions Regarding the Tendencies of Modern Practice

BY HENRY H. NORRIS, PROFESSOR OF ELECTRICAL ENGINEERING, CORNELL UNIVERSITY

The past year has been unusually productive of interesting developments in power plant practice. A number of new plants have been put into commission and some evidence of standardization, particularly in large steam plants, is furnished by these. The number of electric railways purchasing energy from central stations has considerably increased, indicating a growing appreciation of this principle of power station economics. This is the period when the early d. c. plants have become practically obsolete and also have reached the stage where they are rapidly wearing out. At the same time the number of large, efficient central stations is growing, and, through the use of very high voltages, their tributary areas are widening. Every railway company located within these areas must carefully consider the advantages to be gained by purchasing rather than generating the energy which it needs.

The principal railway power plants placed in service during 1912 have been described in detail in various issues of the Electric Railway Journal and other technical papers. It is not necessary, therefore, to mention more than the salient features of a few to prepare the way for some general conclusions regarding the tendencies indicated by latest practice. Among these railway plants may properly be included the central stations designed originally for lighting and power but now called upon to supply railway current in increasing amount.

SOUTH BOSTON STATION

The South Boston station of the Boston Elevated Railway is a fine example of a plant designed for efficient operation with fluctuating loads. In appearance it resembles somewhat the famous Fisk Street plant in Chicago, both inside and out. This plant is part of the general scheme of improvement which has been under way for some years. Ultimately it is to be of 125,000-kw capacity, but at present an output of only 30,000 kw is being produced with two units. The B. and W. boilers, now sixteen in number, are rated at 600 hp on the usual basis of 10 sq. ft. of heating surface per boiler hp. While these are not large compared with the units used by the Detroit Edison Company, they are of a popular size which may be considered standard at present. The completed turbine room will be nearly 500 ft. long and about 80 ft. wide, and the boiler room will be of the same length and only slightly wider. This is a remarkable fact in view of the tendency which has been evident for some time to consider the turbine room, as far as space is concerned, a mere annex to the boiler room. The liberal space allowed in the turbine room in this and other recent plants is partly to accommodate the enormous condensers, partly to provide room for as many auxiliaries on the main floor as possible and to house the increasingly elaborate and bulky electrical switching and transforming apparatus, and partly to give ample space in which the turbines and generators may be taken apart for inspection and repair. The latter consideration is no small item, as the modern machines work under such difficult operating conditions of high speed, high temperature, dusty ventilating air and the like that close watching is absolutely necessary. Obviously if the parts of a dissembled machine can be laid out in an orderly manner without crowding, better work can be done on them than under less favorable conditions.

In the Boston plant provision is made for taking care of variable load by means of forced draft controlled by Mason pressure regulators. These regulators, operated by variation in steam pressure, automatically adjust the speed of stoker engines as well as fan engines to suit the load requirements. The forced draft is necessarily accompanied by liberal combustion chamber space in the boilers, the tubes of which are set high, giving the fuel opportunity to burn before the gases are chilled by the tubes. The stokers, of the Taylor seven-retort type, are designed to carry several times the rated boiler load, and the fans are of similar overload capacity, so that the boilers can be forced to generate steam at a rate far greater than their nominal capacity. In fact, the present installation of 9600 boiler hp is counted upon to supply steam for 45,000 kw of turbines. As a few boilers will usually be out of commission for cleaning or repairs, the remaining ones must evidently be ready for strenuous duty.

Such forcing for peak loads is now recommended practice for railway plants and in no way injures the boilers. At the same time the necessary investment is kept down. At Boston the result is evident in the small relative size of the boiler room, which, unlike those in several recent plants, is arranged with the firing aisle parallel to the turbine room. This plan has the advantage of convenience in handling and in inspection. The steam header, of 14-in. pipe, is placed in the boiler room 2 ft. above the floor near the turbine room partition and on about the same level as the turbine valves. A high-arch connection is made to each turbine and excellent flexibility is thus assured. Steam-flow meters are connected in the boiler leads. The utility of such meters in assisting the firemen to keep each boiler steaming properly is recognized, and if the experience of such companies as have been using steam meters establishes the ruggedness of the device, a wide field of usefulness is open before them.

Among other interesting features of this plant the use of numerous concrete piles under the footings is conspicuous. The site consists of "made" land on the shore of Boston harbor, hence every possible precaution was taken to prevent settling. A total of 1500 concrete piles, as well as many of wood, was used for this purpose. The electrical generators are wound for the moderate voltage of 6600, and this is doubled by means of auto-transformers or compensators which serve also as reactance coils to limit short-circuit currents. The generators are ventilated in a somewhat novel manner, the air being drawn in through large ducts terminating above the boiler room roof and downward through the generator by the usual internal fans. The air thus drawn from a considerable elevation is cool and free from dust.

T. H., I. & E. POWER STATION

The new plant of the Terre Haute, Indianapolis & Eastern Traction Company is another good example of up-to-date practice, and it, too, has two units installed out of an ultimate capacity four times as great. This plant, however, presents several contrasts to the one just reviewed. The boilers, of which sixty will ultimately be required, will be divided into three sections, with the firing aisles perpendicular to the turbine room, somewhat on the order of the familiar unit system. A total of twelve boilers of 520 hp each is now installed to provide steam for two 6000-kw

horizontal steam turbines. This is a much greater provision than is made in the Boston plant. The result is a greater proportionate space occupied by the boiler room. The ultimate boiler capacity of 31,200 hp will supply 48,000 kw of rated turbine capacity. While this boiler allowance appears high, it includes provision for the very large overload rating of the turbines, which are expected to be able to deliver a maximum output of 80,000 kw. The boiler tubes are set 10½ ft. above the boiler room floor, illustrating again the tendency toward liberal combustion space. The boilers are equipped with Roney stokers and differential draft gages. The absence of the usual coal and ash conveyors is noticeable in the Indianapolis plant, the work being accomplished by an industrial railway system. A narrow-gage track is located over the coal bunkers and under the ash hoppers, and the cars which run upon this track are hoisted by means of two electric elevators.

Each of the horizontal turbo-alternator units of 6000-kw capacity discharges its steam into a Wheeler surface condenser hung from the bottom of the turbine frame. The basement floor is thus kept clear for the accommodation of auxiliaries. These are said to be the first large surface condensers to be furnished with Le Blanc type pumps. The steam piping is of open-hearth steel, and the fittings are of cast steel, which is approved practice in plants using superheated steam. The header is located in the basement about 10 ft. below the boiler room floor, and the steam pipes to the turbines are brought up from below without conspicuous arches in the turbine room. The result is a very neat appearance of the latter.

The three-phase alternators generate 13,200 volts, which is used on the local transmission system without transformers. This practice gives simplicity of construction, but is somewhat out of line with the tendency, noted in the Boston and other stations, toward lower generator voltage with step-up compensators. The evil effects of short-circuits on these large generators are so great that reactance is generally considered necessary to limit the short-circuit current, and as this reactance can be obtained in the compensators almost as cheaply as in special reactance coils and the generator construction simplified by the use of the lower voltage, the tendency toward the use of this arrangement is logical.

The Indianapolis station is conspicuous for the neat appearance of the turbine room. The enameled brick walls with simple ornamentation assist the management in instilling a sense of pride on the part of the operatives to keep the machinery in good order. The glass-inclosed operating gallery is free from the noise of the turbine room, insuring strict attention to switching and to the indications of the instruments. The simplicity of the turbine room is enhanced by the partitioning off of the space occupied by all the switch gear, which is located on several galleries, one over the other, closely adjacent to the turbine room but invisible from it.

GEORGETOWN POWER STATION

An interesting plant which shows at a glance the progress made in steam turbine development is that of the Capital Traction Company of Washington, D. C., at Georgetown. There are here two 1500-kw, one 3000-kw and one 5000-kw horizontal turbine. Although the smaller machines have been in use but a few years, such has been the progress in design that the 5000-kw turbine is not noticeably larger than the 3000-kw machine or even the still smaller ones. The same condition has been shown in other plants using vertical turbines where units of 20,000-kw capacity now occupy little more floor space, except for the condensers, than did the 5000-kw machines of ten years ago. The Georgetown plant is the result of the rapid outgrowing of former stations, and much of its equipment has been moved from them. This has, however, been so skilfully incorporated with the new apparatus that there is no evidence of patchwork. The result may be partly due to the fact that the engineering work was done by the company's own staff, which naturally would be well acquainted with the virtues and the faults of each part of the older equipment. The turbine room presents a rather unusual appearance on account of the auxiliary apparatus galleries, which are uninclosed, as is also the operating gallery. The most obvious advantage thus gained is ease of inspection. The general tendency seems to be toward isolation of the switch gear from the turbine room.

The three-phase, twenty-five-cycle generators at this station produce current at 6600 volts, which seems to be the standard toward which practice is tending. Current at this voltage is delivered to the transmission system and to the lowering transformers used in connection with rotary converters for local 600-volt d.c. distribution.

On account of the gradual development of this plant, a considerable variety of condensing equipment is found in it. The smallest turbines have Alberger jet condensers maintaining a 28-in. vacuum. A Wheeler surface condenser on the 3000-kw unit holds a 29-in. vacuum, which is about the same as in the Le Blanc condenser on the 5000-kw unit. The air and circulating pumps for the condensers are of the centrifugal type, but the boiler-feed pumps are reciprocating.

In the design of the building the architect has been very successful in producing a structure which, while it looks like a power station, would be an ornament anywhere but in a residential neighborhood. Much more attention is being given to the architecture of power plants than formerly, and it is fitting that in a vicinity containing so many handsome structures the railway power plant should be in keeping with its surroundings. On account of the danger of dampness in the basement of this building, unusual attention was given to waterproofing. On top of the piles, which are liberally distributed under the entire building, is a concrete cap on which is a five-ply layer of Hydrex felt. On this is a floor of 30-in. concrete slabs under the boiler room and one of 18-in. slabs under the turbine room. The outside of the basement wall is also covered with a thick layer of waterproof concrete.

NORTHWEST POWER STATION

The new Northwest station of the Commonwealth Edison Company of Chicago is possibly the past year's most notable addition to the electric railway equipment of the Middle West. While but two generating units are now installed, the plans are complete for a total of twelve 20,000-kw units in twin stations. This project, which will call for an ultimate expenditure of $20,000,000, illustrates the principle, mentioned earlier, of planning for the future. Under this policy, stations will not be outgrowing their capacity and becoming obsolete, but they will be growing naturally to meet the demand. While this policy may have been followed in a few cases in the past, it was by no means as general as it is now.

The unit system is carried out in this plant, each turbine having its battery of ten boilers of 560 hp each. The entire battery is not necessary to maintain full load on the turbine and the firing aisles are perpendicular to the line of the turbine room. The turbine room is comparatively small because all electrical auxiliaries are placed in separate buildings, the total ground area required for that purpose being greater than that of the turbine room. Taking all of the generating equipment together, it occupies nearly as much space as the boilers.

In the Northwest station the separation of transforming, switching and measuring equipment from the turbine room has been carried to the extreme, there being separate buildings for the compensators and for the busbars and switches. This is to insure absolute reliability, for even if the power house should be destroyed its load could be cared for by other stations by means of the very complete switching arrangements. The switching devices in this plant are

very elaborate, and the contrast between the railway power station of twenty years ago and this one is striking. Then the switchboard was on the engine floor and occupied a few panels, on the back of which great busbars were mounted. The space occupied by the board was negligible. Now, at least in the present case, the switching requires a separate building more than half as large as the turbine room, which itself is liberal in size.

KEOKUK HYDROELECTRIC STATION

The hydroelectric power project at Keokuk, Ia., will soon have a close relation to electric traction in its territory. Rapid progress on this great plant has been made during the past year, and within a few months the first generating units will be in operation. Fifteen units, consisting of 10,000-hp Francis vertical turbines and 7500-kw General Electric generators, are being installed for the present. A considerable part of the output has been contracted for by the railway and lighting companies of St. Louis, 140 miles from the plant. The rest will be sold in Quincy, Burlington, Hannibal, Fort Madison, Keokuk and other cities within easy reach. The ultimate cost of the project has been estimated at over $20,000,000, about the same as the cost of the completed Northwest station of the Commonwealth Edison Company. The ultimate capacities of the two plants are the same, 240,000 kw. Energy is to be sold in St. Louis at $18 per hp year at 60 per cent load factor, which price is based on the cost of power with coal at $1.42 per ton. To obtain this load factor it will be necessary for the railways to adopt means to fill in the load-curve depressions. The electric power will be produced at 6600 volts, three-phase, twenty-five cycles, and the transmission voltage will be 100,000. On account of the low speed, 56 r.p.m., the weight of the revolving part of the unit is very great, nearly 250 tons, probably the heaviest load ever placed on a step or vertical thrust bearing.

The question of steam reserve for use in case of low water or high back water will presumably be taken care of by the utilization of existing steam plants in the tributary territory. In many cases the steam reserve greatly increases the cost of energy, sometimes wholly or nearly offsetting the inherent cheapness of the water power. In the present case the cost of reserve service is evidently very low, as is indicated by the low price of the energy delivered in St. Louis.

MARSEILLES HYDROELECTRIC STATION

A much smaller plant, utilizing water power at a lower head than that at the Mississippi River dam, which has a maximum value of 35 ft., was completed last year by the Northern Illinois Light & Traction Company at Marseilles, Ill. The head here is but 11 ft. The new equipment consists of six vertical 74-in. Samson turbines with direct-connected umbrella-type Westinghouse alternators of 320-kva capacity. These alternators are wound for 2300-volt, three-phase current, four being twenty-five cycle machines and the other two sixty-cycle. As the umbrella type of generator is rather unusual in this country, excepting in very large plants, this installation is exceptionally interesting. The machines rotate at 75 r.p.m., and the rotating field magnet is 10 ft. in diameter, the outside diameter of the complete generator being about 14 ft. The Keokuk generators of the same general type are about 32 ft. outside diameter. This type of generator was selected for the Illinois River plant in preference to the horizontal type, geared to the turbines, on account of the higher efficiency and the lower cost of maintenance.

In addition to the equipment of this plant described above, some old 62-in. Samson turbines were utilized in the new plant by gearing them together in two groups of three each by horizontal shafts direct-connected to 2300-volt generators, one of which has a capacity of 450 kva at sixty cycles and the other a capacity of 500 kva at twenty-five cycles. The excitation for all of the alternators is furnished by two 90-kw generators direct-connected to 40-in. wheels and by one 100-kw machine driven by a motor.

The output of the plant is both twenty-five-cycle and sixty-cycle current. The latter is furnished to a number of small lighting and power companies, and the relative demand for each of the two varieties of current varies during twenty-four hours. To meet this condition the generators producing the two frequencies are connected through a 750-kva frequency-changing motor-generator set, so that a large part of the capacity of the plant is available in either form of current.

This plant is one of several which are operated in parallel supplying railway and lighting current for the McKinley properties in northern Illinois. The power system includes two steam equipments which will furnish reserve power for emergency use to take the peaks of the loads and to assist in governing. As the Illinois River is the outlet of the Chicago Drainage Canal, a steady flow of water is practically assured. The new plant has been designed on the basis of the minimum flow of the river, and its size is conservative.

TECHNICAL SOCIETY REPORTS ON POWER PLANT PRACTICE

The two associations most intimately concerned with the electric railway power plant are the American Electric Railway Engineering Association and the National Electric Light Association. Both of these bodies have committees charged with the duty of studying and bringing before the respective memberships the live questions relating to their specialty, power plant practice. The railway association report is presented at the October convention in each year and that of the other society in June. These reports, being based on extended study and correspondence, presumably contain the latest obtainable information. Their recommendations should have great weight in a review of a year's progress. The following paragraphs summarize the findings reported in 1912.

Large central stations interconnected with network of conductors are to be preferred to isolated ones. These conductors will in large cities be mostly underground, and they form a most important part of the system; hence special attention must be given to their maintenance. The problem of locating faults and isolating defective cables is demanding careful attention at present. The methods now in general use are not satisfactory. A plan involving circuit breakers operated by differentially wound relays with the two windings carrying current from the two ends of the protected cable is satisfactory. For short cables—such, for example, as those connecting the Fisk Street and Quarry Street stations in Chicago—the expense is not serious, but with long cables the cost is prohibitive. H. G. Stott has suggested a simple plan for testing which promises well. He applies to the supposed defective cable the secondary emf of a three-phase transformer of considerable magnetic leak. This emf with the secondary on open circuit, as it is when applied to a good cable, has the regular working value. If, however, the cable is short-circuited, a secondary current is set up and its presence is indicated by ammeters in the primary circuit. The magnetic leakage prevents the draft of much more than normal current in the cable.

The increase in the size of generating units and the improvement in their voltage regulation have made the effects of short-circuits more serious than formerly. The result is the introduction of reactance coils to limit short-circuit currents. The preference seems to be for reactance in outside coils rather than in the generator winding. These coils undoubtedly take up space and interfere with good regulation, but they seem to be necessary. Reactance coils are constructed of stranded conductor wound usually on skeleton concrete cores. Their presence in power houses is an interesting novelty. Generator design is being influenced by the demand for higher steam economy, which results in high rotative speed and small diameter. The small size makes ventilation difficult.

ECONOMIES IN THE BOILER ROOM

In the boiler room chain-grate stokers are recommended for low-grade coal high in ash and volatile matter, but they are not adapted to coals with a tendency to coke and run without some means for breaking up the coke as it forms at the front of the grate. With the aid of most types of mechanical stokers which now are in general use it is possible to operate fires practically without smoke after the brickwork becomes heated. This is an important conclusion in view of the considerable agitation for smoke prevention. Steam-flow meters are being found increasingly useful but are not yet perfect.

In steam plants the matter of intelligent purchase of coal is important. Both associations gave attention to this matter last year. The A. E. R. E. A. committee took up the whole matter of chemical testing in connection with power work, especially coal analysis. A number of companies sent in data regarding their practice in this matter. It is apparent that modern methods of coal buying are growing in favor. Both ash and heat determinations are made. Attention is called to the fact that the heat value of coal from a given mine will not vary much, but that the proportion of ash, clay and other non-combustible matter will vary a great deal. The recommendation, therefore, which agrees with that of the N. E. L. A. committee, is that ash determinations be made frequently, even by small companies. Chemical laboratories are useful in analyzing water and oil as well as coal, and the committee believes that all three should be analyzed in order that these most important materials may be intelligently purchased and used.

TENDENCIES IN PRIME-MOVER DESIGN

Steam turbine equipment is still in a state of progress, and new problems are constantly coming up for solution. The general use of superheated steam has brought out the superiority of steel pipe and fittings for service in turbine plants, as cast-iron fittings fail when exposed to superheated steam. Strenuous efforts are being made to improve condenser design in order to reduce maintenance and insure reliability. Liberal condensing surfaces are used, and the water of condensation is removed from the tubes as quickly as possible, thus keeping up their heat conductivity, the effort being to create air currents sweeping toward the pumps. Some trouble has been experienced in keeping dirt out of the tubes, even with careful screening.

In hydraulic plants horizontal-shaft wheels continue to be preferred to the vertical type except for very low heads. As is evident in the case of the Keokuk plant, the weight of the rotating member of a vertical wheel imposes difficult design features, particularly in machines of large size. Horizontal bearings present no serious difficulties. The roller bearing is proving of service in vertical turbines and is obviating one of the main objections to them. There is still room for improvement in governing devices. Where steam engines and waterwheels can be operated in parallel the governing is better, being controlled by the steam engine.

ELECTRIC RAILWAY POWER CONTRACTS

The contract between the Commonwealth Edison Company of Chicago and the two surface and one elevated railroad system of that city has now been in operation for several years and is giving excellent satisfaction both to producer and consumers. The contract is very simple, the rate consisting of two parts, a service charge and an energy charge. The service charge is based upon the investment which is assumed to be necessary to have the power plants at all times in readiness to supply a demand of an estimated amount, and amounts to $1.25 per month per kw of maximum demand. In addition there is an energy charge of 0.4 cent per kw-hr. In a contract of this kind a most important element is the manner in which the maximum demand is determined. Obviously a swing of load lasting only an instant is not a fair criterion of the equipment necessary, because any power plant can carry an instantaneous overload without detriment to the equipment. The maximum load therefore must be rated in such a way that it really necessitates a definite amount of equipment. In this contract the maximum demand is determined in a peculiar but effective manner. The supply company selects from the records on three consecutive days in each month the kilowatt-hours of energy consumed in one hour in the morning and evening peaks and adds these hourly demands together. One-sixth of this total is called the maximum demand for the month. The advantages of this contract are its simplicity and the incentives which it offers for the keeping down of the peaks. Unfortunately a railroad company has very little control over the form of its load diagram, but careful operation of the cars and trains, combined with the use of storage batteries, can reduce the peaks somewhat. That the operation of the contract has been satisfactory in Chicago is evidenced by the plans for the development of the power plants on the one hand and the apparent lack of plans on the part of the consumers to build power plants of their own. From this it is not necessarily to be inferred that the railway companies consider that they could not generate energy as cheaply as the Commonwealth Edison Company, but even if they could do so, which is questionable, they could not obtain the degree of security of service at anything like this cost. During the past year the Commonwealth Edison Company has made a new move in the matter of power provision for electric railways by installing a railway substation which it will operate, selling energy in d.c. form.

The first new railway contract announced during the past year was one between the Cleveland Electric Illuminating Company and the Cleveland Railway. The terms are more complex than those of the Chicago contract, which has been in operation for several years. There are similar provisions regarding line losses, installation and maintenance of transmission lines and of substations. The same general theory also underlies the financial features, but the details are much more elaborate. In the first place, the service charge is graduated, varying from $1.475 per kw of monthly maximum demand for the first 500 kw to $1 for excess above 1000 kw. The average value will presumably be somewhat less than the Chicago figure. The unit charge is also graduated from 0.95 cent per kw-hr. for the first 50,000 kw-hr. per month down to 0.38 cent per kw-hr. for excess above 2,300,000 kw-hr. per month. The average will be practically the same as in the Chicago contract. These figures are based upon 90 per cent power factor, the railway obtaining the benefit of increased power factor by corresponding reduction in rates. A table given in the contract shows that with a consumption of 9,000,000 kw-hr. per month, 50 per cent load factor and 90 per cent power factor, the cost is 0.681 cent per kw-hr. The rates are based upon a minimum demand of 15,500 kw, which may be increased by due notice.

The monthly maximum demand in the Cleveland contract is calculated from the sum of the kilowatt-hour consumption during the peak-load hours on three successive days. These hours are integral hours, that is 5 to 6 p.m. or 6 to 7 p.m., and the sum of the kilowatt-hours during these three peak-load periods is to be greater than that of any three similar periods during the month. One-third of the total consumption during the three hours is the maximum demand for the month.

Two new contracts were announced late in the year and details of the financial features are not yet available. These contracts are between the New York Edison Company and the Third Avenue Railway Company in New York City, and between the Philadelphia Electric Company and the Philadelphia Rapid Transit Company. The former contract presents an interesting contrast to the Chicago contract. In the Chicago case the old steam plants were not taken over by the Edison company but were either shut down or are still being operated by the railway companies.

These steam stations will probably not be remodeled but will be allowed to become obsolescent and will gradually be eliminated. The case of the Third Avenue Railway contract in New York, however, is quite different. This company less than ten years ago put in a very modern plant consisting of eight vertical, cross-compound engines of 5000 hp each, with 6600-volt, three-phase, twenty-five-cycle alternators. With the exception of the use of reciprocating engines this plant is quite up-to-date at present, and it is operating very economically. The New York Edison Company has taken over this plant and will operate it in conjunction with the Waterside stations, which have generators of the same voltage and frequency.

The latest contract of all is that in Philadelphia, and it presents some interesting features in that it is divided into several parts. Energy is to be furnished by the Philadelphia Electric Company in a.c. form as well as in d.c. form. The electric-light company takes over, at a nominal rental, a substantial part of the generating equipment of the railway company and may operate this as an emergency reserve. The electric-light company has also the privilege of utilizing its own equipment if it so desires. The load factors guaranteed are 35 per cent in one part of the system and 30 per cent in another. The minimum demand is at present 15,000 kw, which will be increased by 5000 kw during the fall of 1913.

The process of central station energy in railway work will be watched with great interest during the next few years. All of the contracts described have been drawn in such a way that a period of about ten years is allowed for the solution of the various problems involved. During this period, unless some new type of prime mover becomes prominent, central station practice will probably have settled down to a standard construction. During this period much attention will be devoted to a study of cost of generating electrical energy. At the present time operating costs appear to be susceptible of accurate calculations, but overhead costs are still problematic. This will not be the case when central station construction is standardized and after sufficient time has elapsed for the experimental determination of the maintenance and depreciation costs of the new generating units.

PROBLEMS AFFECTING MECHANICAL EQUIPMENT

As has been pointed out in the technical press from time to time, it is questionable from the standpoint of economy whether there is much gain in increasing a plant above a certain size unless this plan permits a marked improvement in the load factor. Some gain comes from the diversity of load obtained by combining lighting, industrial power and railway power in one station, and the purchaser gets at least part of the benefit, but the determination of the cost of generating energy is so difficult that only in a general way can it be estimated. On general principles, however, it should be true that a company specializing in the manufacture of electrical energy can generate it more cheaply than one to which the power plant is a side issue. Manifestly the advantages of large units favor the central station, and the limit in steam turbine size has apparently not yet been reached.

The Commonwealth Edison Company has under construction in England a 25,000-kw unit of the horizontal type, a radical departure for this company. The problem of supporting on a step-bearing the enormous weight of the revolving part of the turbo-alternator in much larger sizes than those at present in use is a serious one. There is also not much further advantage to be gained by the use of the vertical type because the condenser is already larger than the turbine in the 20,000-kw size and will be proportionately larger with increased turbine capacity. It is probable, therefore, that the still larger units which are sure to come will be of the horizontal type.

The demand for higher rotative speeds in the steam turbine brings in other problems for the designer. Aside from the question of mechanical strength, there are serious difficulties in getting the exhaust steam away from the turbine, as the high vacuums used result in the expansion of the steam to enormous volumes. There is an accompanying difficulty in ventilating the cores and windings of the generators. Several serious hindrances, therefore, stand in the way of farther development of the very high-speed turbines.

Thrust and step bearings have given trouble both in steam and water turbines, but progress has been made. The step-bearings of vertical turbines are in general lubricated with oil under high pressure, special attention being given to its quality and condition. In a few cases water is used. In water turbines roller bearings have been used with success. The latest development in high-pressure bearings is the Kingsbury thrust bearing, which has been adopted for the great turbines at the new Keokuk plant of the Mississippi River Power Company and in other important installations. In all high-pressure bearings the problem is to get the lubricant between the rubbing surfaces. In the new bearing the usual stationary collar is replaced by a spherically seated collar, on the working surface of which are several separated spherically seated bearing blocks faced with soft metal. These blocks adjust themselves to the revolving collar and the lubricant is drawn between them and the revolving collar as it is not when the stationary collar is rigid and continuous. At present the greatest load on bearings of this type is in the McCall's Ferry plant at Holtwood, Pa., where it amounts to 410,000 lb. In the Keokuk plant it will be 560,000 lb. The load on the step-bearings of the usual type in the 20,000-kw steam turbine units in Chicago is about 200,000 lb.

TURBO-ALTERNATOR PROBLEMS

In the electrical end of the turbo-alternator unit the heating problem is serious. It is not only a question of getting heat away from the radiating surface of coils and cores but also one of getting the heat to those surfaces, as heat is generated in the interior of cores and coils and these have a limited heat conductivity. This heat can come to the surface only at a certain rate, depending upon the temperature head and the resistance offered to the heat flow. This fact is illustrated by the time-temperature curve at the surface of any part of an electrical machine after a run. A thermometer applied to the surface shows a rise of temperature for some time after the machine has been stopped, indicating a flow of heat to the surface from internal superheated parts. Forced circulation of cold air increases the temperature head and thus assists in the removal of heat, but even with this help internal temperature must still farther increase. Insulation must be developed to stand these higher temperatures, and the conventional 50 deg. rise cannot hold much longer. With this greater rise of temperature will come greater mechanical difficulties due to expansion and contraction. Even now the designer has to scheme carefully to avoid the loosening of windings due to this cause. These problems will be solved as they arise as others equally difficult have been solved in the past, but they are mentioned to indicate the far-reaching effect of the demand for higher speed with smaller and cheaper turbines.

The ventilating air for the turbines is ordinarily very dusty as well as warm. Washing devices have been developed to remove the dust and cool the air, which is passed through sheets of water and around sharp bends. The water washes out the dust or wets the particles so that they are easily thrown out by baffle plates. This matter was covered in detail in the 1911 N. E. L. A. report on prime movers, the committee on the subject having made a careful study of the washing and cooling of air for buildings. A start which was made in applying this principle to a turbo-alternator was described. In view of the ventilation difficulties mentioned above some such treatment of air seems quite necessary.

Progress in Electric Power Transmission Practice

The Author Discusses the Effect of Interpole Design Upon the Development of the Sixty-Cycle Converter and Power Distribution to Direct-Current Lines and Makes Suggestions About Improvements in Line Construction

BY LOUIS BELL, PH.D.

In examining the recent tendency in power transmission practice for railways, one may profitably glance at those limitations which have hitherto made themselves felt in the adaptation of transmitted power to the service of electric railways. Although the utilization of electric power transmission for railway work dates far back, the hydroelectric plant has not been up to the present a usual source of power for the operation of railroads. If the writer remembers correctly, he had the pleasure in 1894 of installing the first plant using transmitted energy for operating a railway, merely a railway generator of the type then standard, belted to a three-phase synchronous motor. It was not then judged practicable to build a synchronous converter of the necessary size for fifty cycles, much less for the sixty cycles used in most subsequent three-phase plants.

The result has been that on the whole hydroelectric plants have been cut off from doing a large business with railways on account of the loss in, and cost of, the apparatus necessary to deliver direct-current energy supplied from a transmission service. There have been from time to time a small number of twenty-five-cycle hydroelectric plants installed which have been able, as in the case of Niagara and a few others, to supply railway power through synchronous converters, but despite the fact that to-day power transmission networks ramify very widely over the eastern and western sections of the country, railways have been slow to utilize this cheap and convenient source of power for the reason stated.

One of the things which are interesting and altogether agreeable changes for the better is the development at last of satisfactory synchronous converters for sixty-cycle circuits, thanks to the interpole construction which has so greatly relieved the difficulties of commutation, the only serious difficulties that have stood in the way of the use of such machines hitherto. With such apparatus available as it is, at least in all except the large sizes, in the present state of progress it will be increasingly common for railway companies to take power from the transmission networks so widely available.

PURCHASED POWER

Most electric roads are not big enough from the standpoint of necessary output to operate power stations of their own with a high degree of economy. Both size and load factor are against them, so that it is quite safe to say that where a road can reach conveniently an existing transmission system of large capacity it can buy power cheaper than it can make it. This is emphatically true in the case of hydroelectric transmissions. It is also true in the case of many of the large central station networks fed from modern steam-driven stations.

Those who have read the columns of this journal during the past year have a realizing sense of the extent to which purchased power is advantageously and economically used even in large amounts, thanks to the economies of generation possible in our present big central stations. These very commonly work at twenty-five cycles and so do not require anything special in the way of synchronous converters. On the whole, perhaps, the most notable tendency of the past year or so in transmissions for railway purposes has been this increase in the practice of purchasing power. It means the replacement of a steam-driven station with its considerable cost of attendance by one or more simple and easily cared for substations, and the possibility of increasing the number of these substations without considerable increase in expense, thus lessening feeder costs and steadying the voltage along the lines—a matter of great importance in the extended electric roads, particularly those of light service. And aside from the use of sixty-cycle synchronous converters, now making decided advance, undoubtedly material progress is being made in the development of the beautiful mercury converters already in widespread use for other purposes. Recent reports from abroad give hope of successful conversion in units perhaps as great as several hundred kilowatts. Of their performance it is too early to speak with certainty, but it goes without saying that such apparatus, if it fulfils the promise of recent developments, will be of the utmost use in facilitating a cheap and efficient supply of power over wide areas from stations now existing. At all events, it is perfectly clear from the progress made during the last year that the unification of power supply, with all which that implies in the matter of operative and installation economies, is going steadily on, to the great benefit of the electric railway business.

DISTRIBUTION TO HIGH-TENSION DIRECT-CURRENT RAILWAYS

Just how far these tendencies can progress depends on the direction of advance in the matter of traction motors themselves. As the readers of this journal are aware, the past year has seen considerable progress made toward high-voltage, direct-current motor service, several installations of 1200 volts from trolley to track having been in operation, and even this voltage has been doubled in one of the projects now under way, and that on a large scale. It is unnecessary to comment on the great advantage of these increased voltages in the matter of distribution, but they involve some serious considerations as to apparatus. Thanks again to the interpole construction, the motors themselves can be worked out with reasonable factors of safety, but when it comes to the supply of energy at this voltage on a considerable scale there are other things to be considered. It is one thing to build a sixty-cycle converter for 600 volts; it is quite another to build it for 1200 volts or for 2400 volts. Just how this difficulty will be met remains to be seen. Possibly converters coupled in tandem or cascade converters, which practically halve the difficulty of commutation, may come into play, although some of the enterprises requiring high-voltage motors are big enough to justify the installation of low-frequency generating stations for their special service. Mercury converters, on the other hand, lend themselves readily to high-voltage work and to installation on locomotives when these are used. It will therefore be seen that things are in an extremely plastic and formative condition as respects the general features of supply for railway operation in spite of the improvements to which reference has been made.

POWER STATION DESIGN

In minor matters of supply, those pertaining to power station design and operation, the most conspicuous tendency has been toward the use of the horizontal rather than the vertical type of turbo-generator and the installation of boilers of considerably greater steaming capacity

than those heretofore common. The installation of the huge boilers of the Detroit Edison Company last year taught a much needed lesson. Their very high efficiency gives promise of great improvement over present progress. It is a moot point among steam engineers whether such increase in size or a corresponding increase in steaming capacity by forced draft is the better plan to follow for the future. Several recent railway plants have been using forced draft to secure the intensive combustion necessary for pushing the steaming capacity over the peak of the load, with good results in practical economy and to the considerable simplification of the plant. Personally, the writer believes we are going to have progress along both lines, with big boilers worked intensively to secure still greater output. At all events it is certainly in the boiler and furnaces that the greatest improvements in plant efficiency are now to be obtained, and the movement during the past year has been conspicuously in this direction.

LINE CONSTRUCTION

As to transmission line progress, most transmissions primarily intended for railway purposes are at comparatively moderate voltages, as befits the usually not very great distances of transmission. The line construction standardized during the past year or two seems to answer perfectly well for most cases, but in several instances it has been seriously called in question. It seems probable that the suspension insulator and line construction more closely approximating that of general transmission plants will push their way steadily into railway practice. There is no use of transmitted power in which interruptions occur, because they are never more exasperating than in railway service, and considering the fact that one seldom has to deal with very high voltages it would appear the part of wisdom to take advantage of modern constructions to increase very considerably the factor of safety in transmission circuits. This tendency has already been felt as the work of the last year or so plainly shows, and it should consistently increase in the work of next year and the years to follow.

Attention should here be called to the advantages of steel construction for important feeder lines, a practice which is beginning to appear here and there in isolated spots and is altogether commendable. A steel transmission line with suspension insulators, giving at least double the factor of safety now common on railway transmissions, need not be unreasonably expensive and in the long run will very likely make up in decreased maintenance the modest increase in initial expense. If American constructors would investigate thoroughly the light latticed "A" poles in large use on the Continent, they would get a new light on line construction. A few steel "A" poles have been used for railway work in this country, but so far as the writer is aware they are very much heavier than those used for corresponding work abroad and are consequently more expensive.

NECESSITY FOR DURABLE CONSTRUCTION

Certainly no serious work of electrifying a long line should be undertaken without following the best precedents of general transmission practice in the construction of the supply circuits. Incidentally the increase in the factor of safety of the insulators means greater security against lightning, on the whole the most troublesome thing with which the transmission engineer has to contend. Closely allied with these matters of line construction is the matter of voltage on the working conductors. Where large amounts of energy are required for the rolling stock, high voltage, either direct or alternating current, is a necessity in order to secure proper current collection from overhead conductors, and this in turn requires for small collection accurate alignment of the conductor and first-class mechanical support. Here again steel construction is the obvious remedy for mechanical difficulties, and on recent important lines it is coming into play, although far less than sound forethought would indicate. The design of feeder lines and supports for the working conductor on sound engineering principles is the particular thing on which the success of large electric traction is going to turn. Such design has heretofore only been touched in spots, and one of the encouraging things about very recent work has been the greater attention paid to workmanlike and permanent construction. If asked to level a general criticism at transmission for railway purposes as commonly carried out, the writer would be inclined to say that the average railway line is built only for year after next, with too little regard for the matter of maintenance and for the secure permanence of the investment represented. Few conservative railway managers would be willing to buy power from transmission circuits no better than those along their own right-of-way. Within the last year or two these conditions have improved, which is one of the encouraging things about the growth of the art. And yet, as one rides along beside a railway transmission line, in nine cases out of ten he is roused to instinctive wonder that it meets the necessary demands for continuous service. This comment is by no means intended to "knock" the designers of these lines, who have commonly had to cut their coats according to their cloth, but is merely meant to emphasize the increasing necessity for reliable and permanent types of construction.

PROGRESS TOWARD GENERAL MERGER OF CHICAGO TRACTION INTERESTS

The sub-committee appointed by the local transportation committee of the Chicago City Council, in compliance with instructions, has examined the books of the Chicago Elevated Railway Companies and submitted a report to the parent body.

In the work of preparation of this report the subcommittee was assisted by representatives from the Corporation Counsel's office, the comptroller's office and James J. Reynolds of the Harbor and Subway Commission. While no definite steps have been taken toward a satisfactory valuation of the elevated companies, the sub-committee questioned certain items contained in the original figures of $86,086,623 presented by the representatives of the elevated railway companies. Among items in question are the following:

Chicago Junction bonds	$2,327,000
Working capital	2,336,091
Brokerage (reduction urged amounting to)	1,500,000
Value of company's lines outside city limits	3,000,000
Oak Park income bonds, 51 per cent	444,159
Oak Park accrued interest obligation, 51 per cent	283,314
Oak Park 5 per cent notes, 51 per cent	530,400
	$10,420,964

In making up report of progress to the general committee, the chairman of the sub-committee said that it had verified the figures presented by the company, item for item, with slight corrections, and that, although it had found the figures approximately correct, the total contained certain items which could not be considered as the value of the property to the city.

The sub-committee did consider, however, that the time had arrived when satisfactory settlement could be made, as the new proposition submitted by the elevated companies was approximately $11,000,000 under the valuation their experts presented at the time the first negotiations were discontinued. Owing to the absence from the city of the representatives of the elevated companies, it was decided to postpone a general discussion of the verified valuation until such time as all parties interested could be present.

Plans are under way to electrify the present mule line in Merida, the capital of the State of Yucatan, Mexico.

Heavy Electric Traction on the Continent

A Review of Recent and Proposed Heavy Electric Railway Work in Germany, Switzerland, Italy and Other Continental Countries

AUSTRIA

Among recent important electrifications of Austrian railways are the St. Pölten-Mariazell Railway (narrow-gage), 66 miles long, described in the ELECTRIC RAILWAY JOURNAL for Aug. 3, 1912, and the Mittenwald Railway, 63 miles long, on which 800-hp locomotives are operated over grades of 3.6 per cent by means of 15,000 volts single-phase current at 16 2/3 cycles. The Vienna-Pressburg electrification now under way will use 10,000-volt, 16 2/3-cycle single-phase current on 42 miles of right-of-way track and 600-volt direct current over 9 miles of terminal track. This line will be furnished with 800-hp locomotives for freight service. By the end of 1913 at least 191 miles of track in Austria will be operated by means of single-phase motors.

Independently of the foregoing undertakings, the Austrian State Railways have made studies covering the possible electrification of 613.8 miles of route. The administration has now reported to the Ministry of Finance that it would be desirable to proceed as soon as possible with the electrification of 66.34 miles between Attnang, Puchheim, Stainach and Irdning. The maximum grade on this section is 2.5 per cent. The average daily load on this line is 2500 gross metric tons.

FRANCE

The largest a.c. installations in France comprise the Lyons single-phase suburban tramways, which have been in service for about four years; the first electrification of the Haute Vienne network of narrow-gage lines about Limoges, as described in the ELECTRIC RAILWAY JOURNAL for July 6, 1912, and the installation of the Midi railway. In 1908 the Midi company equipped 10 miles of track between Villefranche and Perpignan with 4000-volt, 16 2/3-cycle, single-phase equipment. After experimenting for a couple of years it was decided to electrify about 175 miles of single track. This will consist of 70 miles of main-line track between Pau and Montrejean and 105 miles of intermediate branches. A 12,000-volt instead of 4000-volt overhead line will be used. In 1911 an order was placed with the French Westinghouse Company for all of the line equipment and for thirty double-truck motor cars, each equipped with four 125-hp motors. An order for one trial locomotive each was also placed with the French Westinghouse, French Thomson-Houston, Brown-Boveri, Schneider, Allgemeine and Jeumont companies respectively. The Allgemeine locomotive was described in the ELECTRIC RAILWAY JOURNAL for Oct. 7, 1911. The experimental catenary construction of the Midi Railway was described in the issue for July 6, 1912.

The Paris-Lyons-Mediterranean Railway has not yet begun any important electric operation, but has been experimenting with a permutator locomotive, described in the ELECTRIC RAILWAY JOURNAL for Sept. 21, 1911.

The western division of the French State Railways has ordered for its Paris suburban lines 130 motor cars, twenty of which are to be equipped with two 220-hp and 110 with four 150-hp motors. The smaller cars weigh 65 tons and the larger cars 70 metric tons. The maximum speed for the suburban service for which these cars will be used will be 49.6 m.p.h. There has also been ordered equipment for two substations, each containing four 500-hp, 25-cycle, 650-volt rotaries, and for three other substations, each containing three 2000-kw rotaries. About $1,000,000 worth of three-phase, 15,000-volt cables have also been ordered. Two power stations, one with about 25,000-kw and the other with about 50,000-kw capacity, are to be built by a private contractor who will operate these stations and sell the output to the railway at a special price. The power station contract will include provision for the purchase of the power station by the State at any time in accordance with a certain schedule. At present the management is considering the purchase of eight 1000-hp to 1200-hp electric locomotives for freight service on the Versailles electric line. The average weight of the freight train, including the locomotive, would be approximately 300 metric tons, and the maximum speed would be 37 m.p.h.

GERMANY

The Prussian State Railroads now have in hand three large electrification projects. The first is the Dessau-Bitterfeld electrification, which will be completed in 1914 between Magdeburg, Leipzig and Halle. This installation was described at length in the issues of May 27, Nov. 4, Nov. 11, Nov. 25, Dec. 2, 1911, and March 2, April 20 and May 4, 1912. The second electrification project is the Lauban-Königszelt line, of which a map and electrification costs were published in the issue of July 6, 1912. The third is the Berlin Stadtbahn, the electrification of which is still in abeyance. The Lauban-Königszelt lines are in a mountainous country where the ruling grade is 2½ per cent. The trackage consists of the following divisions: Lauban-Königszelt, 80 miles of double-track main line; Niedersalzbrunn-Halbstadt, 21.7 miles single-track main line; Ruhbank-Liebau, 2.7 miles of double-track and 6.8 miles of single-track main line; Hirschberg-Grünthal, 33 miles single-track branch; Hirschberg-Landeshut, 24.8 miles single-track branch. This district is of a mining and industrial character, and the greater part of the business is freight haulage. There is, however, a heavy summer passenger business on the Niedersalzbrunn-Halbstadt division, which serves a number of mountain pleasure resorts. The latter line is therefore being furnished with five three-car trains, comprising a central motor car and two "control" trailers. The motor truck will carry two motors meshing with a common gear and driving the wheels with the aid of connecting rods. The joint output of the motors on the hour basis will be 500 hp and on a continuous rating 300 hp. The cars will be operated at a maximum speed of 37.2 m.p.h.

A total of seventy-two locomotives, of which forty-four have already been ordered, are to be used on the various lines named. The initial order has been distributed as follows: Siemens-Schuckert Company, twenty freight locomotives, type B + B + B, namely, locomotives with three pairs of driving wheels on separate trucks; Bergmann Company, fourteen passenger and express locomotives, type 1-D-1, namely, trailing axle, four driving axles and one leading axle; Brown-Boveri, ten locomotives, type C + C, namely, two trucks each carrying three pairs of driving wheels. The C + C locomotives will be of the same capacity as the B + B + B type. The contract for the motor cars went to the Allgemeine company. The twenty Siemens-Schuckert freight locomotives will have a maximum tractive effort of 36,300 lb. and a constant tractive effort of 16,500 lb. at the circumference of the wheels. These locomotives will handle trains up to 1200 metric tons, including 1000-ton trains on 1 per cent grades. They are so arranged that the central compartments can be used for baggage. The Siemens-Schuckert Company has also built for this line a combination passenger and freight locomotive of the 1-D-1 type, which is capable of handling 1200-ton freight trains at 21.3 m.p.h. The initial tractive effort of this locomotive is 39,600 lb. and the tractive effort for one hour 18,040 lb. The two motors are rated at 850 hp each. The weight per driving axle is 17 tons, the diameter of the driving wheels is about 45 in. and that of the pony wheels is 33 in. The drive is

by means of a jackshaft and connecting rods. The superstructure of this locomotive is fully inclosed at the ends to form the cabs. The transformers are open to the air, while the motors are carried in sheet-iron cases which are also in the open. It is expected that the first section of this installation, namely Königszelt-Dittersbach, will be in operation in the fall of 1913, and that the complete network will be in service in 1915. Energy will be taken from the high-tension busbars of a private company at the rate of 0.69 cents per kw-hr.

The electrification of the Berlin Stadtbahn, covering about 248 miles of double track, including outlying lines, has been approved by the Prussian State Railroads, but at this writing the funds for the work have not been granted by the Prussian Chamber of Deputies.

The Prussian State Railroads now have on order with the Siemens-Schuckert Company thirteen additional accumulator cars. The most interesting feature of the new cars is that the battery equipments are large enough to give a car an operating radius of 112 miles.

In addition to the electrification work of the Prussian State Railways, the Bavarian State Railways are electrifying at 15,000 volts, 16⅔ cycles, a 25-mile section which extends between Salzburg, Freilassung and Berchtesgaden and an 18.6-mile section between Landesgrenze, Griesen, Partenkirchen and Landesgrenze. The Baden State Railways have already commenced trial runs on the Wiesental 30-mile railway for which the Siemens-Schuckert Company has furnished ten and the Brown-Boveri Company two type 1-C-1 combined passenger and freight locomotives. Nine of the Siemens-Schuckert locomotives carry two 625-hp motors each.

ITALY

Since the original three-phase electrification of the 67-mile Valtellina line in 1902 (see Street Railway Journal for May 30, 1903), the same system has been applied among other lines to the Busalla-Pontedecimo division of the Genoa-Milan line, a distance of 13 miles measured as single-track, and the Savona-San Giuseppe division of the Savona-Turin line. The Italian Westinghouse Company, as noted in the Electric Railway Journal for April 8, 1911, furnished the locomotives for both of these lines. Another important three-phase electrification now under way is that of the Mont Cenis tunnel. The Italian State Railways are also considering the electrification of the Turin-Pinerolo line, a distance of 18.6 miles, with single-phase current.

SWEDEN

Since its experiments in 1905-1907 on the Tomteboda-Värtan and Stockholm-Järfva lines, the administration of the Swedish State Railways has adopted high-tension, single-phase distribution at fifteen cycles. Its first large installation is the Kiruna-Riksgränsen division, an ore-carrying railway which is the northernmost line in the world. The distance between the towns named is about 80 miles, but it is proposed to continue the electrification to the seaport of Lulea, making the total length about 300 miles. The present equipment consists of thirteen Siemens-Schuckert freight locomotives, each equipped with two 1220-hp motors, weighing 99 metric tons complete and having a maximum speed of 37.2 m.p.h.; two additional freight locomotives of exactly the same design, but constructed by the Allmänna Svenska Electriska Aktiebolaget, Vesteras, Sweden, and two 70-ton passenger locomotives of Siemens-Schuckert manufacture, each equipped with one 1220-hp motor and operated at a maximum speed of 62 m.p.h. A preliminary description of this electrification was published in the Electric Railway Journal for May 6, 1911.

The Swedish State Railways are also building an entirely new trunk line called the Inlansbanan (Inland Railway) from Gellivare on the Riksgränsen-Lulea line southwest to Gothenburg, a distance of about 1000 miles. The initial section of 68.2 miles between Östersund and Sund is now completed, but is being operated by steam. This line is being constructed with the deliberate intention of opening up virgin territory for settlement, and it is proposed to electrify it as fast as the abundant water powers in this territory are developed.

SWITZERLAND

The Electric Railway Journal for July 29, 1911, and Oct. 7, 1911, contained detailed particulars of the first or trial equipment for the Loetschberg tunnel single-phase line, to be a part of the Simplon line between Switzerland and Italy.

The additional equipment ordered for the operation of the complete line early in the summer of 1912 consists of thirteen 2500-hp locomotives, the largest in Europe. All of these are of Oerlikon design, but six are being equipped by the Brown-Boveri Company. These locomotives weigh 105 metric tons each and are 52 ft. 6 in. long. The locomotive is of the 1-E-1 type; that is to say, there are five intermediate driving axles and one pony axle at each end. The central driving axle and those adjacent to the pony axles are arranged to have a little side play, but the remaining two driving axles are rigidly mounted. Each locomotive carries two 1250-hp compensated series motors with separate transformer and other unit equipment to permit each machine to be operated independently if necessary. The motors are designed to give their maximum output for one and one-half hours without dangerous heating. The normal speed of the locomotives is 31 m.p.h. and the maximum speed 46.5 m.p.h. The drive is through a combination of single reduction gearing, countershaft, crank pin and connecting rods following the original Oerlikon locomotive for this line. This drive was chosen largely because of its superiority in starting. Speed regulation is obtained through steps on the transformer secondaries, and a motor-operated controller is used instead of contactors. The normal drawbar pull of 22,040 lb. was fixed by State regulations covering Swiss railway equipment.

The next large electrification will probably be the Chiasso-Lucerne division of the St. Gotthard line, a distance of 93 miles. The hydroelectric rights for this purpose have already been obtained. An early decision is expected because a large amount of the steam equipment on this road will soon require replacement. In the event of electrification any steam equipment which was still in serviceable condition would be turned over to branch lines. The Swiss Study Commission estimates that the total cost of the St. Gotthard electrification would be approximately $13,500,000, divided as follows: Hydroelectric stations and transmission, $5,800,000; rolling stock and shops, $4,400,000; overhead system, $1,900,000, and annual cost of maintenance, $1,400,000. The estimated maintenance charge is much less than with steam. It is further estimated that the operating cost with electric traction will be 0.7 centime per ton-km (about 0.224 cent per ton-mile), whereas in 1908 the cost with steam traction was 0.94 centime per ton-km (about 0.3 cent per ton-mile). The commission estimates that a total output of 500,000 hydroelectric hp would be required if all Swiss railways were electrified. The two plants for the St. Gotthard project alone would total 95,000 hp. Ample water power is available for complete electrification.

The Rhaetian Railway, which is a 10,000-volt, 16⅔-cycle, single-phase, narrow-gage line, comprising in all 38.5 miles of single track, has recently ordered two 52-ton locomotives from the Oerlikon Company, each carrying two 620-r.p.m. motors which are geared to the same shaft and develop 600 hp at the wheels for one hour when the locomotive is operated at 17.3 m.p.h. The maximum locomotive speed, however, is 31 m.p.h. Each locomotive is about 35 ft. 6 in. long over all and is of the 1-D-1 type, the four driving axles being so arranged that those next the pony axles have a little side play. Details of the original locomotive orders for this line were published in the Electric Railway Journal for March 4, 1911, in an article entitled "Single-Phase Railways Abroad."

Gas Rate Decision in New Jersey

The New Jersey Public Utilities Commission Issues Important Decision on Rates Charged by Public Service Gas Company, Reduces Valuation of Intangible Property and Says Price Fixed Will Permit Return of Approximately 8 per Cent on Value of Property as Found by the Board

The Board of Public Utility Commissioners of New Jersey handed down a decision last week involving the rates charged by the Public Service Gas Company in the Passaic district. As this decision considered the valuations to be allowed for good will, going value and franchises, the consideration to be allowed for the amount of securities issued by the original public utility companies in the district which were merged to form the Public Service Gas Company, and the rate of return to be allowed on the valuation as found by the board, the decision is of special interest, although it does not affect the railway properties. The company has not yet announced what it intends to do in the matter. A summary of the decision follows:

THE DECISION

The board determines the existing rate of $1.10 per 1000 cu. ft. of gas with a discount of 10 cents per 1000 cu. ft. for prompt payment to be unjust and unreasonable. It fixes in place of the rate of $1.10 per 1000 cu. ft., with a discount of 10 cents per 1000 cu. ft. for prompt payment, a charge of 90 cents per 1000 cu. ft., as just and reasonable, and requires the company to put such charge into effect in the "Passaic Division" on and after Feb. 1, 1913. It also recommends that the company set the same reduced rate throughout all of the other divisions of the State where now it is exacting the rate of $1 net per 1000 cu. ft. It makes this recommendation as to territory not embraced in the "Passaic Division" because under the statute it can only issue an order fixing rates "after hearing, upon notice." It is also recommended that the schedule for quantitative discounts be readjusted in accordance with the proposed rate.

REJECTS COMPANY'S PROPOSITION

At the outset of the proceeding initiated by the board the Public Service Gas Company and Public Service Electric Company submitted a proposition to the board.. This proposition contemplated in the case of the gas company the putting into operation of a uniform flat rate of $1 as of Jan. 1, 1912, and on Jan. 1, 1914, the reduction of this rate to 95 cents and on Jan. 1, 1916, the further reduction to 90 cents. It further contemplated in the case of the electric company as of Jan. 1, 1912, the adoption of the same schedule of discounts from the base rates put into effect in New York by the Edison company. The proposition was submitted as an entirety with regard to the two properties—gas and electric. The board did not act upon the proposition because it tied up two rates, one for gas and the other for electricity, having no relation, and because to accede to it meant the fixing, without investigation, of rates for a period of five years.

VALUE OF PROPERTY

The board finds the value of the tangible property of the company in the "Passaic Division," as of Oct. 1, 1911, to be:

Land	$111,160
Manufacturing plant	1,161,550
Distributing system	2,465,270
Working capital	250,000
	$3,987,980
Less sum required to adjust figures to July 1, 1911	62,000
	$3,925,980
Less depreciation	200,980
	$3,725,000

For these items a value of $5,818,940 was claimed by the company.

The board allows for organization, franchises, cost of establishing business, etc., $1,025,000. The company claimed allowance for these items amounting in all to $3,090,551.

The total value as found by the board is $4,750,000. The total value as claimed by the company was $8,909,491.

NO ALLOWANCE FOR "GOOD WILL"

As to "good will" the board says: "For good will we allow nothing whatever. The company, we understand, makes no claim for good will. It seems well settled also that where a particular service is furnished by only one company within a given area, the option of patronizing a rival public concern is absent and that under such circumstances good will, or the value of voluntary patronage where a competing service is available, does not exist."

"GOING CONCERN" VALUE ALLOWED

With respect to "going concern" value the decision says that however the various conceptions of going concern value may fail of precise coincidence, they all have a common core. This is the value a utility property has, or may have, over and above the value of its tangible belongings. In this connection the board puts two questions. First, can a public utility have any excess in value over and above the value of its tangible belongings? This, moreover, presupposes that the excess value, if any, is wholly distinct from any capitalized earning power predicated on a future setting of rates higher than required to afford a just return. To this question the board answers there is such a thing as "going concern value" and continues: "A plant with a business attached has a value greater than the value of the mere plant without the business attached," and concludes: "The going concern value will then be largely represented by the cost of developing the business as distinct from the cost of securing the physical structure."

Next, the board puts the question: "In case it transpires that such excess value, known as 'going concern value,' exists, and in case the costs involved in the acquisition of such value have been met out of rates exacted from consumers, should such excess value, known as 'going concern value,' enter into the base upon which public utilities are entitled to earn a fair return?"

This question, too, the board answers in the affirmative so far as it does not appear that the rates exacted from consumers were legally challenged and says: "We see no escape from the necessity of recognizing the intangible property designated as 'going concern value' as well as actual physical structures similarly obtained as constituting part of the present lawful possessions of a public utility, even though both these tangible and intangible values were built up in the past out of rates exacted from consumers, it being always assumed that the rates exacted were not legally assailed or assailable . . . The business thus acquired must be regarded as a legitimate part of the property of the company. We cannot equitably project back into the unregulated past a form of prices that might today be regarded as fair and adequate and assume that actual rates exacted in the past, in so far as they exceed what are now deemed fair, have not lawfully become the property of the company. If these high rates in the past have been employed by the company to acquire intangible property in the shape of extensive patronage, that expectation of patronage in theirs, and on its fair value the company is entitled to a return. It may or may not be a subject of regret that regulation was so long deferred, but deferred regulation is no excuse for refusing at present to allow a fair return upon what is the lawful property of the company."

COMPANY'S CONTENTION AS TO VALUE OF FRANCHISES DENIED

The company claimed allowance of $1,392,235 as the value of its franchises. This claim the board denied. The board finds the value of all intangible property of the company, including franchises, to be $1,025,000, and says:

"It is the public policy of the State of New Jersey at present not to allow the capitalization of franchises for an amount in excess of the actual cost involved in obtaining said franchises. That this is a wise and equitable policy we think is incontestable. One of the characteristic features of a public utility such as a gas company is that it does not possess and ordinarily cannot afford to purchase the land requisite for the location of its distributing apparatus. When by its secondary franchises such permits to locate are granted to a company without other expense than the necessary business and legal costs of securing municipal consents, it seems unthinkable, as a matter of equity and public policy, that the easements gratuitously granted should be made the basis for an additional charge to be imposed upon the grantor." The board further says: "It is quite obvious that our finding as to the total amount of intangible property ($1,025,000) is tantamount to including the franchises of the company at a moderate rating—at a value comparable with the cost of obtaining these or similar franchises. It amounts therefore to a practical denial of the company's contention as to the value of its franchises. The figures claimed for the franchises . . . by . . . the company . . . of $1,392,235 considerably exceed our appraisal of the company's entire intangible property."

SECURITIES ISSUED IN MERGER NOT PROPER BASIS FOR RATES

The company contended before the board that the par value of securities originating in the merger of six different gas and electric concerns in the district concerned in 1899 determine an amount below which the board's aggregate valuation could not fall. This contention is expressly denied by the board. Dealing with this contention the board points out that in the consolidation of the six gas and electric companies creating the Paterson & Passaic Gas & Electric Company in 1899, the capitalization of the latter company was fixed at $5,000,000 in stock and a like amount in bonds. Of this amount approximately all of the stock and $4,100,000 of the bonds were used in effecting the consolidation. The board finds that the capitalization resulting from the consolidation was in excess of the real assets.

In confirmation of this conclusion it says that it appears that, over and above $2,224,100 issued to the United Gas Improvement Company for "sundry claims and franchises," the excess of par value of stocks and bonds issued over the par value of stock and bonds received was $3,893,691, and while it points out that no evidence of the value of the "sundry claims and franchises" of the company was produced, yet that "as the company under the arrangement received in bonds $764,000 it may perhaps be surmised that not all of the $1,460,100 in stock received by that company was represented by its extant property of an equivalent value. If this stock was all bonus, and if the excess in securities received by the six merging companies was similarly bonus, it would seem that the consolidation involved a total of $5,353,791 in securities based on anticipation rather than of solid assets, and of the capitalization here involved it is agreed that approximately two-thirds is applicable to the gas properties."

In further confirmation the board points to the terms of the lease of 1903 of the property of the Paterson & Passaic Gas & Electric Company to the Public Service Corporation. This lease provided for payment as rental of interest on the bonded debt and of an amount equivalent to dividends on the stock of the Paterson & Passaic Gas & Electric Company for the first year of 1½ per cent, for the second of 2 per cent and for each subsequent year of an additional one-half of 1 per cent, until eventually 5 per cent was reached.

In this connection the board puts the question: "If, at the time of the lease, the property taken over by the Public Service Corporation in excess of the bonded indebtedness was represented by assets of value equivalent to the stock created by the consolidation, why was so low a return accepted by the constituent companies, or how was the Public Service Corporation able to induce the lessors to accept so meager a return as rental upon the stock of the newly created company?" It makes like comment upon the later lease of the Ridgewood company to the Public Service Gas Company, which, while guaranteeing 5 per cent on the bonds, guaranteed only 2 per cent on the stock.

The decision states the claim of the company to be that whatever the precise amount of water that was injected into securities resulting from the consolidation, yet that since the securities were issued under due form of law, are widely scattered "and people have paid for them in honest money," the board, while it should not allow any rate like 10 per cent thereon, should "stamp 5 per cent on the bonds and 5 per cent on the stock" and treat the money behind that (i. e., cash subsequently invested in the property) as "genuine money."

To this claim the board, adopting the language of Smyth vs. Ames, 169 U. S. 466, answers that if a utility corporation has bonded its property for an amount which exceeds its fair value, or if its capitalization is largely fictitious, it may not impose upon the public the burden of such increased rates as may be required for the purpose of realizing profits upon such excessive valuation or fictitious capitalization.

The board states its conclusion "that both at common law and now in this State by statute a public utility assumes the responsibilities of furnishing safe, proper and adequate service at reasonable rates and that it undertakes its business with explicit knowledge of the State's right and power to set reasonable rates, that any capitalization it effects is effected subject to the State's reserved power in the premises and that it cannot plead its capitalization nor any contracts it may have undertaken as barring the State's exercise of its power as to rates. When, moreover, the capitalization, albeit legal, is demonstrably in excess of the value of its assets at the time of capitalization, the public utility cannot cite its unchallenged capitalization as a bar to the State's exercise of inherent prerogative."

RATE OF RETURN

As to the rate of return, the board states that it does not wish to go on record as favoring any particular rate of return applicable to all cases. It declares, however, that the return must be sufficient to attract the large amount of capital required each year in making the additions and extensions to plant and distribution system which the growth in communities demands. The price fixed, 90 cents per 1000 cu. ft., will afford a return of approximately 8 per cent on the value of the property as found by the board.

GENERAL EFFICIENCY GOOD

The board finds that the general efficiency of the company is at least as good as, and probably better than, the average of the companies with which comparisons have been made.

CHRONOLOGY

The case was called to the attention of the board on June 9 through a complaint by Mayor Andrew F. McBride, of Paterson, relating to gas, electric, water, trolley and railroad commutation rates. After a separation of the complaint was required by the board it issued on July 25 a call for a hearing "as to whether the existing schedule of rates of Public Service Gas Company for gas is just and reasonable." Later a petition was received from the city of Passaic for inquiry as to the reasonableness of the gas rates charged in that city.

After the company had submitted its proposition engineers were engaged by the board to make inventory and appraisal of the property in the Passaic division and the taking of testimony was begun. Arguments on the case were heard on Oct. 11-12 and the transcript of the testimony taken contained 2541 pages, not including exhibits.

Counsel for the company were Thomas N. McCarter, Frank Bergen, L. D. H. Gilmour and E. A. Armstrong. The accountant employed by board was Marvyn Scudder, and Prof. Edward W. Bemis represented the cities as expert adviser.

ELECTRIC VEHICLES FOR STREET RAILWAY SERVICE DISCUSSED IN NEW ENGLAND

The regular monthly meeting of the New England Street Railway Club was held at Boston on Dec. 18, with President Lees in the chair. The evening was devoted to an illustrated address upon "The Electric Vehicle," by Day Baker, New England manager of the General Vehicle Company. Touching upon phases of the subject of general interest to electric railway operators, Mr. Baker stated that practically all the electric commercial vehicles of to-day are built upon the same general lines, with a low-hung battery, single series-wound motor, simple chain drive and steering gear. The power application is by a simple controller with large-sized copper contacts. From 60 volts to 85 volts is used on the motors.

SPECIAL USES FOR ELECTRIC VEHICLES ON STREET RAILWAYS

The Philadelphia Electric Company operates a large fleet of electric vehicles, including a pole-setting wagon manned by two attendants. The wagon is equipped with a derrick at its back, and a small winch under the driver's seat hauls the pole to the proper height and drops it into the hole with great ease. The output of the machine is highly satisfactory. In Boston the Edison Electric Illuminating Company has a large fleet of electric machines. One wagon of this type is used in pumping out manholes, and two men with this outfit do the work which formerly required eight men, and it is performed in one-half the time. In Boston conduits are filled with cable by an electrically driven winch located under the driver's seat on the vehicle. The same machine that hauls the wire through the conduits can be used in setting poles. The Rio Janeiro Tramways Company, Ltd., utilizes twelve electric trucks in its service, including six battery-operated tower wagons and machines for hauling wire and doing general heavy work about the city.

The tower wagon is of the Trenton type, and the body and tower are mounted on a 2-ton chassis, which will carry six men in addition to the driver, with a large assortment of tools. The New York Railways Company now has three electrically driven emergency wagons used for clearing the streets, for hauling cars around difficult corners and for general heavy service. During the snowy season cars frequently become stalled at a difficult corner at Madison Avenue and Forty-second Street, on account of the congestion of vehicles. One of these emergency wagons, rated as a 2-ton machine, will pull a horse-drawn vehicle off the track or pull a car around a corner with ease. The Third Avenue Railway Company is also using electric trucks successfully, three emergency outfits being in service at present. A 5-ton electric winch equipment is a recent addition, and a number of large trucks and smaller wagons are in use, notably in hauling cable, reels and other supplies. Electric machines are in use at Washington and Milwaukee in connection with overhead-line construction, and recent purchasers are the Lehigh Valley Transit Company and the Public Service Railway of New Jersey.

CONSTRUCTION AND PERFORMANCE

Mr. Baker specially emphasized the point that within its field the electric truck and delivery wagon is a highly economical transportation agency and pointed out that the cost of supplying it with electrical energy from a street railway plant is trifling, since the charging of batteries can be most effectually done during the small hours of the night when a large portion of the plant capacity would otherwise stand idle. Boosting charges can be given from the trolley system when desirable during the standing of the equipment on the roadside, and in this way the question of mileage per battery charge becomes comparativcly unimportant. High speed is undesirable in the operation of motor vehicles through congested sections, and the speeds for which such machines are now designed are ample for practically all purposes.

The speaker also emphasized the advantages of an electric motor bus service in territory where the density of traffic is too light to warrant the installation of track and overhead line construction, and he showed views of motor-driven battery trucks for use inside shops. The electric crane truck is a recent development of value in connection with the unloading of freight cars and the handling of material around railroad yards. A small size of this type of equipment is built to operate inside a car as well as outside and is of great value in handling express matter. Electric runabouts are now available for street railway officers which will travel 100 miles at five hours upon one charge of a battery, and in the near future a guarantee of 150 miles in seven hours is anticipated. The true economic field of the gasoline machine is where it can have an uninterrupted run of at least 10 miles, whereas the electric truck or commercial wagon shows its greatest economy on short runs with many stops, the absence of transmission gears and cranking being important features.

Responding to inquiries, Mr. Baker pointed out that the fire risk has been reduced almost to negligible terms in electric trucks by the use of conduit wiring and the provision of a safety switch by means of which the driver of the vehicle cannot stop in the street and apply his brakes without cutting off the current. The mileage obtainable with a battery-driven Trenton wagon depends upon the number and size of the cells used, as well as upon the speed, but in general, running the wagon at 12 m.p.h., about 40 or 45 miles can be secured per charge of the battery. It is seldom that a Trenton tower wagon has to travel a distance that will use up such a mileage. The average run of the emergency wagon of the Third Avenue Railway is 4 miles. Good results in electric vehicle service are being obtained with Motz tires and also with the Palmer-Webb tire. Most commercial machines are equipped with solid tires. A 3-cent rate per kw-hr. on central-station service compares with gasoline at 7.8 cents per gallon. Notable improvements have been made in the storage battery within the last few years, and the life records now being indicated are much better than was possible until within two or three years With the newer forms of plates there is no reasonable objection to the practice of boosting batteries. Charging at a low rate is preferable.

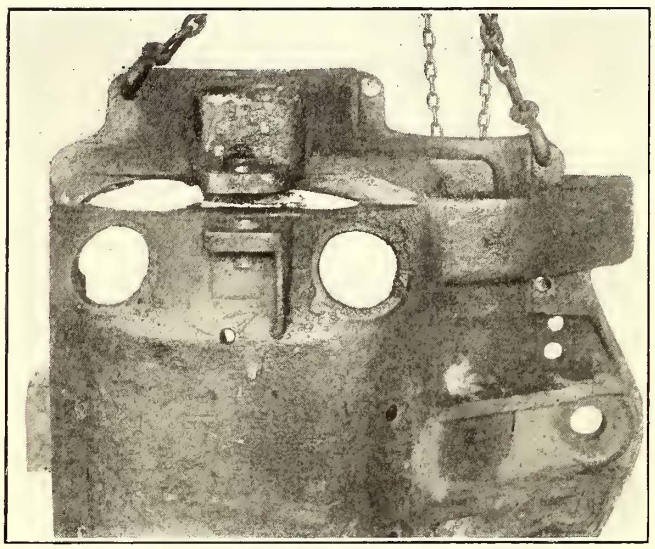
Frank J. Stone, Electric Storage Battery Company, Boston, brought out the point that in charging the Ironclad Exide cell recent tests show that as high a current input as possible without producing gassing may safely be utilized. By keeping just below the gassing point and consequently running the charge at a reduced temperature, very efficient charging is accomplished. In charging a flat-plate battery and getting to the gassing point, the gas which comes off the plate has a tendency to disrupt or disconnect the small atoms of oxide, which fall to the bottom of the jar as the gassing proceeds. The tube and cell construction of the ironclad type of battery enables the gas to be disposed of from the cells without disturbing the active material, giving about three times the life of the old flat form of plate.

The cost of freight car maintenance on the steam railways of the United States was reported at the November meeting of the American Railway Association to have been 24.75 cents per car per day during the year of 1911. This was divided between repairs, replacements and taxes, repairs costing 16.87 cents, replacements, including the charges which were made to renewals and depreciation, 6.78 cents, and taxes 1.10 cents.

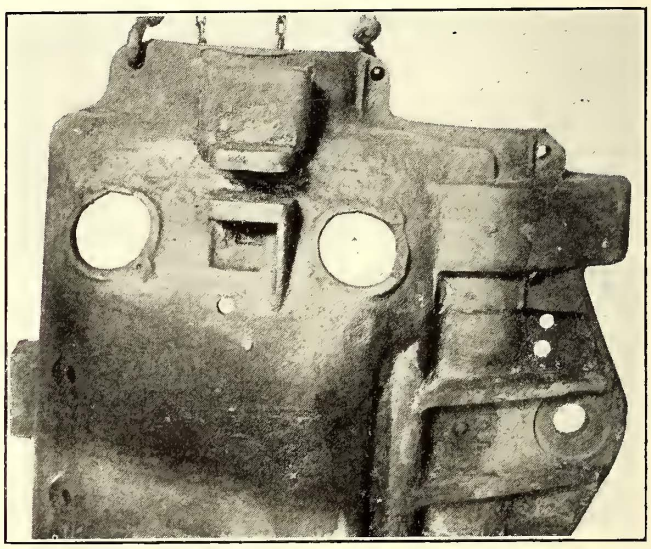
INDIANAPOLIS TRACTION & TERMINAL COMPANY'S EXPERIENCE WITH OXY-ACETYLENE WELDING

The employment of the oxy-acetylene process of welding and cutting of metals in electric railway shops is comparatively recent. Its practicability in this new field, however, has been clearly demonstrated by the results secured by the Indianapolis Traction & Terminal Company's mechanical department. L. M. Clark, master mechanic, who made the initial installation of this type of welding apparatus, has obtained exceedingly satisfactory results with it in his shops, and new work is being found for the equipment almost daily. One man is now kept at work with the welding outfit continually, and it is expected that a second equipment will be purchased in the near future so that two operators may be employed to take care of the large amount of work which may be handled by this means.

The original installation was made about two years ago and comprised an "Oxweld" 100-lb. duplex acetylene generator, a number of oxygen and acetylene cylinders for portable work, the necessary regulators, blowpipes, welding head and welding material furnished by the Ox-Weld Acetylene Company of Chicago. In looking around for a man to operate the plant a car repairman of average intelligence was selected. After receiving instructions from one of the manufacturer's experts, which extended over a period of about ten days, it was decided that the company's man could go ahead on his own responsibility.



Oxy-Acetylene Welding—Motor Frame Worn Through by Suspension Bar Between Lugs



Oxy-Acetylene Welding—Motor Frame with Hole Between Lugs Built Up with New Metal

EARLY EXPERIMENTS

At first Mr. Clark gave considerable personal attention to the plant in order to determine its adaptability to the requirements encountered in his own shop practice, and although he had familiarized himself with the various classes of work which were usually handled by this process before purchasing the plant, he soon discovered that numerous other savings were possible. The convenience of being able to repair in a short time truck frames and motor frames which under ordinary conditions would have gone to the scrap heap resulted not only in a great saving of money, but also in the saving of time required to replace parts which were not regularly carried in stock. This offered an attractive field for experiments, and during the first few months attention was directed to the reclamation of different pieces of apparatus in order to determine the saving over the cost of new duplicate parts as well as the possible saving in time during which cars were held out of service.

After about six months of experience with the original equipment the operator became proficient and there seemed to be no limit to the variety or quality of work that could be done. The money and time saved by reclaiming large pieces of equipment caused attention to be turned to smaller parts in order to determine whether the same proportionate saving could be made, and in some cases similar results were obtained with the smaller castings. Other cases showed that, even though the repair was made at a loss when the cost of a new part was considered, the time required for holding equipment out of service for repairs was reduced more than enough to offset the additional expense. A recent experiment has demonstrated that it is economical to weld or build up pieces even as small as resistance grids.

That successful operation of the oxy-acetylene plant does not require an expert is evident from the fact that not a single weld made at the Indianapolis shops has failed, even though the operator was under instruction for only ten days. As a matter of fact, it is reported that anyone having a practical knowledge of the handling of heated metals will become proficient in a short time. Trouble may, however, result from a failure to allow a proper amount for expansion and contraction, but as this information can be furnished to an operator in tabular form for different kinds of metal the element of individual judgment in this matter may be largely eliminated. Practically all the metals found in electric railway equipment may be welded, built up or cut off, the oxy-acetylene flame being especially adaptable to the latter.

The cutting of metal can be handled very quickly by the process at a very low cost, and the small working space required makes it particularly advantageous in places where a hack saw could not be used. For example, Mr. Clark recently found it necessary to trim off portions of the platform knees on certain cars in order to provide proper wheel clearance. Under ordinary conditions it would have been necessary to remove the platform knees from the car, but with the plant available the work was done with the platform knees in place, thus avoiding a considerable item of expense on this score alone.

SAVINGS EFFECTED

Before the economies possible with this plant had become evident it was decided to keep a close check record on the work which was done, in order to give an accurate idea as to the monthly and annual savings. A form of report for this purpose was drafted early in 1912. From April 1 to Oct. 1 of that year the total net saving was $3,200. This amount represents the difference between the actual cost of welding and the cost of replacing the repaired part with a new one. It was impossible to estimate the value of the

time which might have been lost by a car awaiting the shipment of a part for renewal, but there can be no doubt that this would have materially increased the net saving. In fact, in many instances the equipment was of an old type and it was practically impossible to purchase repair parts for it.

The two accompanying illustrations showing a motor frame before and after welding are representative of a lot of five lower half-frames shipped to the Indianapolis Traction & Terminal Company by the Fort Wayne & Northern Indiana Traction Company for repair. It will be noted that the body portion of the frame has become worn through by contact with the suspension bar used in connection with this type of motor. This wear was the result of elongation in the bolt holes in the suspension lugs of the frames. In addition to building up the worn portion of the motor frame, the holes in the suspension lugs were filled with new metal and new holes were drilled at the proper locations and at the

INDIANAPOLIS TRACTION & TERMINAL COMPANY—MATERIAL USED AND COST OF TYPICAL JOBS AT WEST WASHINGTON STREET SHOPS.

Name of Part	Amount of Material Oxy.	Acet.	Filler	Time, Hours	Cost of Welding	Cost of Duplicate New Part	Net Saving
Motor axle cap.....	5	3	1	1	$0.48	$5.39	$4.91
Armature housing	5	3	1	1	0.48	7.94	7.46
End bearing for mixer.	190	104	5	10	9.44	....	....
Cutting anti-climber....	30	18	..	2	1.43	....	....
1 bumper iron.....	70	42	1½	3	3.02	....	....
1 journal box, 5 x 90..	90	54	2	5	4.40	5.00	0.60
1 brake valve body....	10	6	½	1	0.67	4.12	3.45
1 scissors	5	3	½	1	0.52	....	....
6 motor axle caps.....	30	18	1	3	1.75	32.34	30.59
1 motor frame.....	340	204	5¾	20	15.92	....	....
1 magnet frame.....	20	12	½	2	1.23	....	....
1¾ x 7 journal box....	50	30	1	3	2.58	3.55	0.97
Peck. truck side frame.	170	102	2	12	8.40	47.50	39.10
Peck. truck frame.....	150	90	1½	10	7.25	47.50	40.25
6 motor axle caps.....	30	18	1	3	1.75	32.34	30.59
5 Lorain compressor shells	100	60	2	7	5.26	....	....
1 5 x 9 journal box....	40	24	1	2	1.95	5.00	3.05
1 door sheave.....	20	12	Brass	1	1.04	....	....
5 motor caps	35	21	1	3	1.91	26.95	25.04
1 Peck. truck side frame.	190	114	2¼	10	8.56	47.50	38.94
Cam for stoker engine..	45	27	5	2	2.43	....	....
1 armature shaft.....	280	178	3	11	11.73	....	....
1 truss rod anchor....	15	9	1	1	0.79	....	....
Heating 2 tires.....	15	9	..	1	0.72	....	....
Standard truck frame..	220	132	3¼	11	9.82	....	....
1 pipe vise.....	5	3	½	1	0.52	2.50	1.98
Annealing wheels	30	18	..	2	2.42	....	....
Steam trap	20	12	1	1	1.02	....	....
Coal elevator cam.....	40	24	1½	3	2.25	....	....
Side frame on truck...	215	129	2½	12	9.84	47.50	37.66
Cut hole in boiler.....	30	18	..	4	2.20	....	....
3 coal elevator cams...	140	84	3½	5	6.37	....	....
Cut .6-in. I beam.....	15	9	..	..	0.72	....	....
Peck. truck side frame.	175	105	2	4	6.56	47.50	40.94
Westinghouse top motor frame	400	240	4	20	17.16	77.76	60.60
I beams cut-off.....	50	30	..	2	2.00	....	....
Westinghouse pinion axle cap	100	60	4¼	7	5.25	6.24	0.99
Peckham truck frame.	250	150	4	15	11.39	44.25	32.86
Peckham truck frame..	50	30	½	5	2.72	47.50	44.78
Anti-climber castings cut	50	30	..	2	2.00	....	....
West'g pinion axle cap	100	60	2	10	5.74	6.24	0.50
West'g top motor frame.	400	240	7	20	17.36	84.24	66.88
West'g pinion axle cap.	150	90	3	10	7.10	10.05	2.95
Peckham truck frame.	150	90	3	15	8.23	44.25	36.02
Lorain bottom motor frame	100	60	2	3	3.91	61.56	57.65
West'g top motor frame.	400	240	4	20	17.16	77.76	60.60
West'g top motor frame.	140	84	3	12	7.24	105.17	97.93
West'g motor frame...	450	270	5¾	15	18.48	33.69	15.21
West'g top motor frame.	300	180	4	18	13.61	77.76	64.15
Anti-climber castings...	50	30	..	2	2.00	....	....
4 3¾ x 7 Sym'gton fire boxes	350	2.10	5¾	15	15.38	14.20	—1.18
West'g compressor gear case corer cap	25	15	1	3	0.68	22.50	21.82

original dimensions. The cost of repairing this particular frame was approximately $35. This cost is considerably above the average for the five, as it not only represents the cost of repairs but includes the cost of providing a special preheating device which was used in the repairs to the other motor frames. In proportioning this charge against each frame the cost of repairs was reduced to about $25 as compared with approximately $125 or $130 for the cost of a new duplicate part. It is contemplated that there will be a further reduction in the total cost of repairing each motor frame, as the preheating device may be used in other repair work.

The net savings for the seven months during which time a record was kept ranged from $230 to $860 per month. This varying valuation is largely due to the character of the parts which are repaired.

A partial list of the pieces welded, the savings made and the cost of welding is given in the tabulated statement herewith. Some of the repairs included in this list consisted in refilling the tapped holes of railway motor frames the threads of which had become stripped and welding on new ends to railway motor armature shafts which had become damaged at the taper pinion fits and would have otherwise required complete replacement. The outfit has also been used in correcting errors made in machine work and punchings in structural steel. In fact, at the present time the plant is considered indispensable in the shop and is a source of great convenience to the department.

COMMITTEES OF NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS

O. P. Gothlin, Columbus, Ohio, president of the National Association of Railway Commissioners, has announced his appointments of committees for the ensuing year. Among the committees are the following:

RAILROAD TAXES AND PLANS FOR ASCERTAINING FAIR VALUATION OF RAILROAD PROPERTY

Milo R. Maltbie, of New York, chairman; J. C. Clements, Washington, D. C.; Royal C. Dunn, of Florida; B. L. Caughman, of South Carolina; W. P. Geary, of Arizona; S. P. Watson, of Oklahoma; E. P. Spofford, of Maine.

RAILWAY CAPITALIZATION

John M. Eshleman, of California, chairman; H. F. Bartine, of Nevada; Frank J. Miller, of Oregon; George A. Lee, of Washington; J. S. Harlan, of Washington, D. C.; William R. Willcox, of New York; J. J. Meredith, of Louisiana.

SAFETY APPLIANCES

William Kilpatrick, of Illinois, chairman; George W. Bellamy, of Arkansas; Sheridan S. Kendall, of Colorado; Henry B. Schrieber, of Louisiana; Joshua W. Hering, of Maryland; H. R. Oglesby, of Missouri; Edward C. Niles, of New Hampshire.

STATISTICS AND ACCOUNTS

B. H. Meyer, of Washington, D. C., chairman; George A. Henshaw, of Oklahoma; H. J. Winnett, of Nebraska; W. C. Wishart, of New York; C. A. Radcliffe, of Ohio; Thomas Yapp, of Minnesota; C. I. Sturgiss, Association of American Railway Accounting Officers.

STATISTICS AND ACCOUNTS OF ELECTRIC RAILWAYS

George W. Bishop, of Massachusetts, chairman; A. F. Weber, of New York; F. K. Lane, of Washington, D. C.; Jesse S. Jones, of Washington, D. C.; George F. Giddings, of Maine; Joseph F. Gray, of Georgia; William F. Ham, American Electric Railway Accountants' Association.

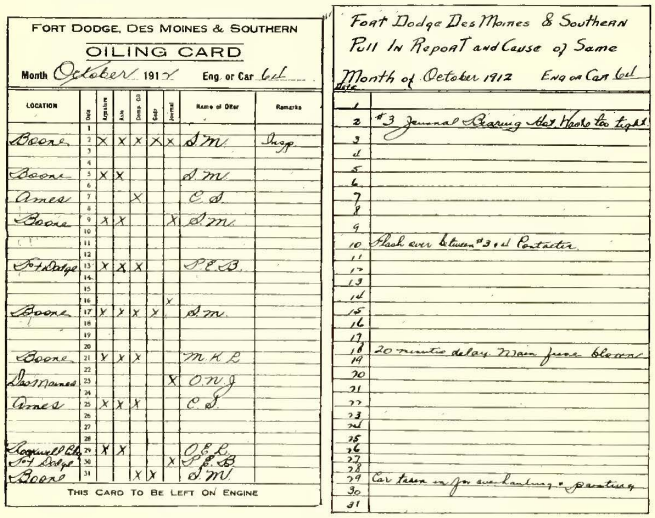
RAILS AND EQUIPMENT

James E. Sague, of New York, chairman; E. E. Clark, Washington, D. C.; W. J. Wood, of Indiana; G. W. Bishop, of Massachusetts; Frank Avent, of Tennessee; J. A. Knott, of Missouri; W. H. Mann, of North Dakota.

To undertake the work of running cars on the Shanghai bund a company was started some three months ago under the name of the Compagnie Chinoise de Tramways. Its capital is $400,000. At present the company is confining its activities to laying a track from the southern end of the French bund, where the boundary of the concession lies, to the station of the Shanghai-Hangchow Railway, but it is understood that it is intended to extend the line to the arsenal. The contract for the construction of the line and for the cars has been placed with Siemens-China Electrical Engineering Company.

FORT DODGE, DES MOINES & SOUTHERN OILING RECORD

The mechanical department of the Fort Dodge, Des Moines & Southern Railroad has devised a scheme which not only informs the inspector at any terminal of the exact date of the last oiling of any car, but serves as a permanent record. The oiling card is of the form shown in the illustration and space is provided for a thirty-one-day month. One of these cards is slipped into a metallic slide attached to the side of the car in the baggage compartment. This slide has a glass cover which holds the oiling card in place but



Front and Reverse Side of Oiling Card

permits the inspector to read it without removal. Instructions have been issued to all inspectors and oilers calling attention to the oil card and requesting that each oiling he recorded in the proper column opposite the correct date.

Armatures and axles are oiled every 1000 miles, and 2 lb. of grease is applied to each set of gears every fifteen days. The journal bearings receive 2 gills of oil every seven days. With this set of instructions it becomes the duty of each inspector to read the posted record on the oil card and act in accordance. At the end of the month the inspector removes the card and records the last oiling dates at the top of the new card. This makes the record continuous for the outside men, and the completed card is forwarded to the office of the master mechanic as a permanent record. The back of each oiling card provides space for a record of pull-ins and parts repaired or renewed.

STEAM RAILROAD STATISTICS FOR 1912

It is interesting to note that statistics for steam railroads published in the *Railway Age Gazette* for Dec. 28, 1912, show conditions quite similar to those indicated in the electric railway industry by the figures published elsewhere in this issue of the Electric Railway Journal. The *Railway Age Gazette* shows that one has to go back for fifteen years, namely, to 1897, to find a year in which as small a mileage was built as in 1912, and one has to go back six years, to 1906, to find a year in which as large a number of locomotives and as large a number of freight cars were ordered. The marked increase in activity along industrial lines during the last part of 1912 is shown by the fact that between two and three times as many freight cars were actually built in 1912 as in 1911, and a third more locomotives were actually built in 1912 than in 1911.

Notwithstanding the fact that 1911 was considered a very unsatisfactory year for railroad building, 3066 miles of new first track were built in 1911, while in 1912 only 2997 miles were built. The largest mileage was built in North Dakota, in which State 347 miles of first track were built. Texas, in which 336 miles were built, had second place in the list.

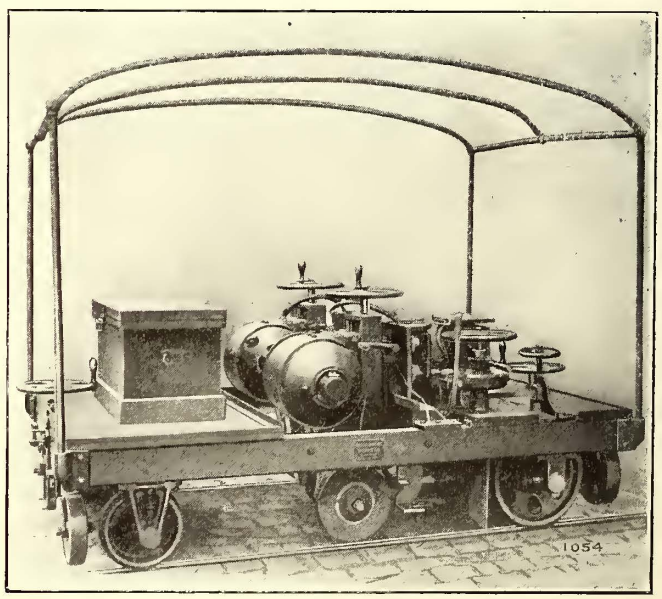
The totals for cars and locomotives ordered during the year show the heavy demands that were made on railroad facilities during the last part of 1912, both for the movement of extraordinarily heavy crops and for the general business resulting from greater industrial activity. The new equipment ordered during 1912 was as follows: freight cars, 226,195; passenger cars, 3623, and locomotives, 4424.

AN IMPROVED RAIL GRINDER

The Goldschmidt Thermit Company, New York, has made several important improvements in its well-known grinder and corrugation machine. The most important is in the character of grinding, for instead of describing the arc of a circle of long radius as it moves backward and forward over the joint, the new grinding mechanism is set to follow a flat sinusoidal curve, which becomes horizontal at each end and therefore tangent to the surface of the rail.

As in the original machine, the entire weight (about 5500 lb.) is concentrated over the grinding wheels so that the maximum cut can be made without danger of chattering. In addition, the possibility of chattering because of worn bearings has been forestalled by mounting the emery wheel on a shaft which runs in two main bearings and a new type of center bearing. This center bearing is drawn up by a flat spring from the saddle casting. As the spring is always under heavy tension, its effect is to draw the emery wheel spindle tightly against the top of the other two bearings, thus holding the emery wheel against chattering and also preventing any tendency it might have to sway unsteadily because of worn bearings.

The use of motor power and the concentration of weight directly over the emery wheels make it possible to take deep cuts and to run at most economical speed. Thus, the most efficient results are secured by running at 1833 r.p.m., which corresponds to an initial peripheral speed of 6719 ft.



Non-Chattering Rail Grinder

per minute for a new wheel and proportionately smaller peripheral speeds as the diameter of the wheel decreases with wear. The power equipment consists of two 5-hp inclosed motors, which are belt-connected to the emery wheels, and one 3½-hp inclosed motor for traction.

A third improvement in this machine is the addition of a substantial canopy, which will withstand heavy winds and shed water at the ends but not at the sides. The latter feature permits the crew to work in a heavy rainstorm with no discomfort from dripping water.

LONDON LETTER

(From Our Regular Correspondent)

The report of the Glasgow Corporation Tramways for the half-year shows that 150,000,000 passengers were carried, an increase of fully 21,000,000, due largely to the doubling of halfpenny distances. The receipts for the six months were £492,000, a reduction of nearly £10,000 on the corresponding period last year. Halfpenny fares represent more than 60 per cent of the entire traffic.

The result of the operation of the Morecambe Tramways since the adoption of petrol tramcars has been presented. The company operates only a few cars which previously had been operated by horses at a considerable loss. The directors announce that since the change from horse to petrol-propelled cars there has been a profit of more than £1,200, and they have declared a dividend of 2½ per cent. The petrol cars cost 9.06d. per mile to operate, or 4.57d. less than by horse traction. It is the only line of its kind in Great Britain.

It is expected that by the end of this year the work of constructing the experimental electric railway on the branch line of the Lancashire & Yorkshire Railway from Bury to Holcombe Brook will be completed. This is the line which Dick, Kerr & Company are constructing on the direct-current, high-pressure system. A large staff of men has been engaged on the work and the overhead wires for the high-pressure power are nearly all erected. Power will be supplied by the Lancashire Electric Power Company. The line is to be worked at a pressure of 3500 volts and the installation is the first one at that voltage in Great Britain.

The Tramways Light & Power Company has been organized with an authorized share capital of £600,000 under the ægis of George Balfour, of the firm of Balfour, Beatty & Company, the promoters of a number of successful tramway companies in England and Scotland. The directors are the Right Hon. Viscount Chilston, director of the South Eastern & Chatham Railway Company; Alfred R. Holland, chairman of the Mansfield & District Tramways, Ltd., and Mr. Balfour. The company has been formed to own and work electric supply, tramway and kindred undertakings in Great Britain and elsewhere, and particularly to produce, supply and distribute electricity for power and lighting purposes in the counties of Derby, Nottingham, Leicester and Warwick, to construct the Nottinghamshire & Derbyshire Tramways and other works, and develop other tramway and lighting properties in the immediate vicinity. The company will take over the Derbyshire & Nottinghamshire Electric Power Company, the Nottinghamshire & Derbyshire Tramways, the Leicestershire & Warwickshire Electric Power Company, and the Leamington & Warwick Electrical Company, Ltd., all of which have rights in that district. The annual net earning from these tramways, lighting and power properties are estimated at £46,500. After paying interest on £150,000 debenture stock and a dividend of 6 per cent on 300,000 preference shares, a surplus of about £21,000 should be left for the ordinary shares.

Additional details are available in regard to the London & North Western Railway's electrification scheme from London to Watford. Seventy-nine miles of track are concerned, not including that of the Bakerloo Tube, with which the North Western Railway will have a physical connection at Queen's Road Station. It has been stated that current will be delivered by a third and fourth rail in the same manner as employed on most of the London tubes, and continuous current will be delivered to the track at 600 volts. Tenders have already been invited for part of the electrical equipment, and it is expected that the work of installation will be commenced early in the year. The new power house will be built near Wembley, with an initial capacity of 25,000 kw, but so arranged that large extensions can readily be made. Special attention is being paid to the matter of coal supply, accommodation being arranged for three months' requirements. The rolling stock will be of two types—that for use on the North Western Railway itself, where the trains will run from Watford to Broad Street Station, and that which will have to be used for the trains which have through running on to the Bakerloo. The latter type will be of smaller dimensions, owing to the size of the tunnels.

While the Metropolitan Railway has kept out of the Speyer group of railways, it is making vast improvements. Perhaps one of the most interesting improvements is being effected at Baker Street, where a proper junction is being made with the company's circle track. Hitherto there has only been a single-line junction between the circle and the Metropolitan extension lines to the suburbs, and it has therefore been decided to construct a "flying junction" at this point, which will eliminate many of the possibilities of accident.

The London & South Western Railway has announced that it will commence the electrification of its Thames Valley route immediately. It is expected that the work will take about two years to complete. The first line to be electrified will be the loop line from Waterloo to Kingston and back, via Wimbledon, Richmond and Putney, and the Hampton Court lines will be electrified a little later. Ultimately 246 miles of single track will be equipped, and about 73 miles will be converted as soon as possible. The company has decided to adopt the direct-current third-rail system, using 600 volts on the third-rail, similar to the system in use on the London tube lines and the District Railway, the trains of which already run to Richmond and Wimbledon over the South Western rails. A through service of trains will therefore be made possible. A power house with a capacity of 25,000 kw will be built, and substations will be provided for the first portion of the work at Clapham Junction, Raynes Park, Barnes, Twickenham and Kingston, while the existing generating station at Waterloo will also be used for this purpose. Two classes, first and third, will be used on the electric trains, but the compartment system will be adhered to. The immediate proposals provide for six trains an hour in each direction, and afterward electric trains will leave Waterloo at an average interval of three minutes throughout the day. The new Waterloo Station, which has been under reconstruction, has been designed with a special view to these electrified lines. Sir Alexander Kennedy and his partners are the company's consulting engineers for the electrification, but the electrical work will be in charge of Herbert Jones, the company's electrical engineer, and the permanent way reconstruction will be under the direction of J. W. Jacomb Hood. Within the next few years, therefore, London will be completely surrounded by a network of electric railways working in connection with the various main railways.

A provisional agreement has been entered into between the Metropolitan District Railway and the promoters of the authorized Wimbledon & Sutton Railway, under which the District Company will acquire the Parliamentary powers granted to the Wimbledon & Sutton Railway in 1910, with a view to the dissolution of that company and the construction of that railway as part of the District Railway system. This agreement will require confirmation by Parliament to be made effective.

The North Eastern Railway, with a view to affording improved facilities for the development of the residential area on the Northumberland coast, served by its Newcastle and Tynemouth electrified lines, is arranging to construct a new stretch of railway from Monkseaton to Seaton Sluice on the Northumberland coast. The new section of railway will be of standard gage construction, and traffic will be worked on the third-rail system.

A special meeting was held recently at the Guildhall by representatives of the various local authorities in the London area to consider the question of motor omnibus traffic. A resolution was carried to the effect that requisite powers should be conferred upon the Board of Trade, Local Government Board, or other government authority, to limit and define the routes to be taken by such traffic. Doubtless the board of traffic is causing the London authorities a tremendous increase in the cost of repairing the roads. A select committee of the House of Lords has also been appointed to inquire into the circumstances which have led to the large number of fatal accidents in the metropolis due to the motor omnibus and other power-driven vehicles. In 1909 the number of persons killed was 52; in 1910, 61; in 1911, 95, and this year it would appear as if the number of fatalities caused in this way would be more than 100, while the number of pedestrians and others who have been injured by these vehicles will probably total more than 2500.

A. C. S.

News of Electric Railways

Franchise and Terminal Questions in Dallas

M. M. Phinney, president of the Dallas (Tex.) Electric Corporation, addressed a communication recently to the Chamber of Commerce of that city in regard to extensions and improvements which Stone & Webster propose to make in and about Dallas. These improvements will total about $5,000,000. Mr. Phinney said in part:

"Your letter to Mr. Moore refers to three specific matters in which Stone & Webster are directly interested, namely, the Terrell interurban, the interurban terminal and the extension of street railway lines. As to the Terrell interurban, a contract has been signed by which we have bound ourselves to build the Terrell line, beginning as soon as the right-of-way is provided in accordance with the terms of the contract.

"The interurban terminal project has been advanced to the extent of the purchase of the necessary land. The work of preparing plans for the structure is under way. A difficulty will arise, however, concerning the tracks to the terminal within the city limits. Tracks of the existing Dallas companies to the terminal would be subject to the existing franchises. This disadvantage would, of course, be removed if the franchise extensions were to be cleared up.

"The third matter is that of the extension of our street car lines. Our street railway franchises were granted when Dallas was a comparatively small city, long before Stone & Webster had any interest in the properties in Dallas. The franchise of the Dallas Electric Light & Power Company will expire in 1922, of the Dallas Consolidated Electric Street Railway in 1922 and 1923, of the Rapid Transit Railway in 1923, of the Metropolitan Street Railway in 1922. By reason of the short time which these franchises have to run they no longer furnish a satisfactory security for the investment of new money by Stone & Webster or by those who look to Stone & Webster for guidance in making their investments.

"The Terrell interurban investment is based upon the substantial rights granted under the law to interurban properties, including permanent ownership of the right-of-way. The interurban terminal investment is based on the permanent ownership of the land, without restrictions or qualifications. But the large sums of new investment required for extension of the local lines and new equipment have no other security than that of the expiring franchises referred to. That is not a sufficient security. It is, therefore, impossible for us to consider the construction and operation of extensions until the people of Dallas deal with the franchise situation.

"The kind of a new franchise Stone & Webster would accept is a matter of negotiation, for we do not know what terms the people of Dallas would wish to impose. All the terms of a franchise are interdependent and must be considered in the light of all other conditions. As to the length of the term provided for in a new franchise, however, I can say this: Our present difficulties with an expiring franchise naturally lead us to want to avoid similar conditions in the near future. We have, therefore, earnestly desired a forty-year franchise; that is, an extension of thirty years beyond the time our present franchises have to run. This has been objected to. The charter fixes twenty years as a maximum grant. While still believing that it would be more advantageous to Dallas to grant us the longer term, we are ready to accept a twenty-year extension of our present franchises, making, with the ten years our present franchises have to run, a thirty-year franchise for the properties. In a broad sense relief as to the franchise situation in Dallas would materially advance all the projects we have in view in this vicinity. In reaching an agreement with the city, the management will deal honorably, frankly and justly. It will not neglect to safeguard the interests of the Dallas properties, but it will at the same time act with an intelligent recognition of the fact that the Dallas properties are engaged in a public business, not a private one."

Mr. Whitridge Complains About the Burden of Taxation in New York

Frederick W. Whitridge, president of the Third Avenue Railway, New York, N. Y., and affiliated companies, has addressed a letter to the State Board of Tax Commissioners of New York in which he complains of the excessive assessments tentatively placed upon the special franchises of the various properties under his control. In his letter Mr. Whitridge says in part:

"I have this day filed with you formal complaints against the tentative assessments placed by you upon special franchises of the several surface railways in Manhattan and the Bronx which are under my control. I desire to supplement my formal complaint by this brief history of the experience of these companies and to make a final appeal to you for relief from what is obviously a glaring case of injustice.

"The special franchise tax law was passed in 1899 and the first assessments were placed on these companies in the year 1900. Since that time they have, with one exception, either remained substantially stable or show slight increases, although with the electrification of the elevated railways and the operation of the subways everyone knows that street railway franchises in New York City are not of great value, and their value has, speaking generally, fallen since 1901. You have now announced practically the old figures as the tentative assessments for 1913.

"From 1901 to 1909 the companies did not pay any special franchise taxes. In 1901 the companies were solvent. In 1907, together with all the other surface railways in New York City, these companies all became financially involved, and at the beginning of 1908 they were placed in the hands of myself and others as receivers, and the receiverships continued for several years. In spite of this insolvency, your predecessors in office never made any reduction in their valuations.

"When I took charge of these companies in 1908, I found that very little intelligent effort had been made on behalf of the companies or the State to settle the correct amount of the overdue taxes, although certioraris to review the assessments had been taken out each year. In conjunction with the other roads, we decided to make the assessment on the Third Avenue Railroad for 1901 a test case, and had it carried up to the Court of Appeals. The Court of Appeals cut the assessment practically in half and laid down clear rules for future assessments.

"With the result of that test case to go by, I then set about settling all the arrears of franchise taxes, and I had lawyers and accountants working on this matter for months. Finally a settlement for all years up to 1910 was made which was, generally speaking, on the basis of this test case, and I paid up all the arrears.

"Within the last year there has come a change in the personnel of the State Tax Board, and with that change I took fresh hope that something would be done. I instructed my lawyers to present fully to you the facts in regard to these companies and to try to avoid all the trouble of litigation and it was therefore a good deal of a shock to me to find that the tentative assessments which your board made for the coming year were along the old lines.

"Your assessment for this year aggregates $20,000,000, substantially the same figures you fixed thirteen years ago. It was, as I state, cut in half for the first ten years; nevertheless, you have continued to make the assessment of about $20,000,000, thus presuming to recall the decision of the Court of Appeals and compelling me to begin a separate set of actions for each of the three last years. Is this fair from any point of view? Especially, is it fair when you consider that all our theorists hold, under the Public Service Commissions law, that on a reorganization of these companies the whole $20,000,000 is lopped off from the supposed value of the properties? I submit to you that you are doing me a grave injustice and I ask you for relief."

Changes in Boston Elevated Organization

Important changes in the executive organization of the Boston (Mass.) Elevated Railway were put into effect on Jan. 1, 1913, to meet new administrative conditions. C. S. Sergeant, vice-president, will continue to perform such duties relating to the general conduct of the company's business as have been or may be required of him, but will be relieved of his duties as chief of the bureau of operation. Among other duties, he will take immediate charge of the bureau of elevated and subway construction. The bureau of operation will be divided into two bureaus—one to be known as the bureau of transportation, and the other the bureau of maintenance. Matthew C. Brush, second vice-president, has been appointed chief of the bureau of transportation, and Charles H. Hile, for the past seven years assistant to the vice-president, has been appointed chief of the bureau of maintenance. H. B. Potter has been named as Mr. Brush's assistant.

Subject to the approval of the president, the chief of the transportation bureau is placed in charge of all matters relating to car and train service, on both surface and rapid transit lines, including the care of motive power, arrangement of timetables, making of rules and hours of operation, and the recommendation for appointment or removal of all assistants and employees of the road in his bureau, including compensation. He reports as may be required by the president, executive committee or board of directors upon conditions in his bureau and upon the general interests of the company.

In the bureau of transportation, the head of the department of surface lines, George R. Tripp, will be in charge of the movement of surface cars and of all officials and employees engaged in surface car service and in the carhouses and subways used by surface cars. He is required to arrange timetables, investigate complaints, receive and care for lost articles, provide for chartered cars, etc.

The head of the department of rapid transit lines, H. A. Pasho, is assigned general charge of the movement of all elevated, subway and tunnel trains, and of all officials and employees engaged in train service, and under his jurisdiction are also placed the elevated and tunnel shops and yards and all stations, tunnels and elevated structures.

The department of power, headed by James D. Andrews, includes the operation and maintenance of all the company's power plants and substations, with the exception of maintenance delegated to the department of wires and conduits.

Clarence E. Learned, head of the department of inspection, has charge of the inspection of the conduct and efficiency of car service employees, and performs such other duties as the chief of the transportation bureau may determine.

J. E. Rugg, head of the department of employment, is responsible for the hiring of all employees for service, and is to report to the chief of the transportation bureau.

The chief of the bureau of maintenance reports to the president, and has charge of the maintenance work required by the company, such construction work as devolves upon the several departments composing the bureau and all necessary supplies except those otherwise provided for.

In the bureau of maintenance, the head of the department of mechanical and electrical engineering, Paul Winsor, is placed in charge of mechanical and electrical engineering work arising within the bureau. The department consists of the mechanical engineering drafting room force and the electrical engineering division.

The department of maintenance of way is placed in charge of H. M. Steward, chief engineer, who is required to exercise general supervision over the civil engineering of the company other than that performed by the bureau of elevated and subway construction, and over the maintenance of way of both surface and elevated lines. He is required to report to the chief of the maintenance bureau, as do other department heads in its organization. The civil engineer and the roadmaster of surface lines report directly to the chief engineer of maintenance of way. The roadmaster of rapid transit lines reports to the chief engineer as in the foregoing cases, but through the superintendent of the rapid transit lines. Division trackmasters on surface lines are held responsible to the chief engineer of maintenance of way through their respective division superintendents.

The department of rolling stock and shops, in charge of John Lindall, includes the immediate supervision of the Albany Street and Bartlett Street shops, tools and machinery, and of all repairs to cars and car equipment, besides the distribution and collection of coal and supplies by car. The immediate care of the buildings, shops and rolling stock of the department of rapid transit lines devolves upon the superintendent thereof, and that of the surface cars in the several carhouses, together with buildings and structures, upon the division superintendents. The superintendent of rolling stock and shops, however, is required to exercise a constant inspection and supervision over all work of car repairs.

The superintendent of wires, J. P. Boyden, is placed in charge of the department of wires and conduits, and is held responsible for the repair and maintenance of all overhead and underground wires and equipment, interior wiring and all wiring construction. The immediate care of signal, telephone and certain power and lighting wires used in the rapid transit line and subway service devolves upon the superintendent of rapid transit lines and upon the superintendent of division.

The department of buildings, under F. F. Low, is concerned with the inspection, repair, maintenance and construction of buildings.

The stores department, in charge of F. T. Lewis, handles the receipt and issue of material and supplies.

The general maintenance force of the department of power stations is placed under the superintendent of power, and its general foreman is held responsible to the chief of the bureau of maintenance through the superintendent.

Strike in Yonkers

The trainmen in the employ of the Yonkers (N. Y.) Railroad went on strike on Jan. 1, 1913, claiming that the terms of the verbal agreement which they had with the management had been violated. The men on strike have demanded the reinstatement of three employees whom they allege were discharged because they refused to meet requirements of the management which the men as a body felt were in violation of the understanding between the men and the management. The men also claim that the company has violated the promise which is said to have been made to them to adhere strictly to the plan of hiring men in numerical order from the eligible list. Charles Long, representing the men, said on Jan. 1:

"We will hold a meeting on Jan. 2 in which to formulate our demands. These may include a change in the wage scale, together with the elimination of many rules that are unjust. I expect that Mr. Whitridge, the president of the company, will have a force of strike-breakers here. If he does he will find he has a battle on his hands."

Mr. Whitridge is reported to have expressed himself as follows:

"This is purely a question as to whether the railroad is going to be operated by the motormen and conductors or by the officials. The union came to me with a preposterous agreement which the members asked me to sign. It was impracticable, unconstitutional and opposed to the terms of the Sherman law, and I refused to meet the conditions which it sought to impose. I am not going to fight the men. I think that if Yonkers is left without service for a few days the public officials will be glad to take the matter in hand and bring about a settlement. It is going to be an arrangement according to my own ideas, however.'"

Toronto Civic Line Opened.—The new civic line in the east end of Toronto, Ont., has been placed in operation with a ten-minute service at a 2-cent cash fare. Tickets are sold at the rate of six for 10 cents. The new line is operated by power from the Hydro-Electric Commission.

Municipal Road Opened in San Francisco.—The first section of the Geary Street Municipal Railroad, built and equipped by the city of San Francisco, Cal., has been placed in operation. The road extends from Kearney Street downtown to Golden Gate Park, a distance of 4 miles.

New Companies Incorporated in Ohio in 1912.—Twelve street, suburban and interurban railways were incorporated in Ohio during 1912, with a capitalization of $2,080,000.

Some of the new companies were organized as successors of other companies in reorganization proceedings.

Joint Use of Poles in Winnipeg.—Public Utilities Commissioner Robson has issued an order for the joint use and ownership of poles between the city and the Winnipeg (Man.) Electric Railway. The matter has been under consideration since June 15, 1912, when the first application was made. This is said to be the first case in which a municipally owned utility and a privately owned utility have adopted the policy of joint use and ownership of poles.

Rehearing Refused in United Railways Case.—The Supreme Court has overruled the motion of the United Railways for a rehearing in the J. Brooks Johnson case. The company must settle Johnson's claim and the claims of those with him in the suit, totaling about $63,000. It is understood that the company will appeal to the United States Supreme Court. The decision holds the company liable for all outstanding claims against the St. Louis Transit Company, which was absorbed by the United Railways.

Public Hearing on New York Rapid Transit Operating Contracts.—The Public Service Commission of the First District of New York announced on Dec. 30, 1912, that the terms of the agreement of the city of New York with the Interborough Rapid Transit Company and the New York Municipal Railway Corporation, as the new Brooklyn Rapid Transit Company is called, had been so far determined that the statutory public hearings on the form of contract for the proposed dual rapid transit system would be held on Jan. 14, 1913.

B. S. Josselyn Honored by Employees.—Employees of the Portland Railway, Light & Power Company, Portland, Ore., on Dec. 24, 1912, presented B. S. Josselyn, president, with a scroll containing the signatures of 1000 of their number and testifying to their appreciation of his efforts in their behalf during the closing year. The scroll was inclosed in a frame 4 ft. wide and 5 ft. long. Across the top was engrossed the legend "Christmas Greetings." The text called particular attention to Mr. Josselyn's loyalty to the cause of humanity and to the precepts of the golden rule.

Test of Automatic Train Stop on the Delaware, Lackawanna & Western Railroad.—After an examination of the mechanism of the device, as shown in a model in the office of the International Signal Company, New York, N. Y., the Delaware, Lackawanna & Western Railroad recently authorized the signal company to install one of its signals on a branch line of its road, the mechanism for the test to be put on a single engine of the railroad. The International Signal Company is busy in its shops making up parts for the apparatus and expects to have it ready for installation soon.

New Traffic Ordinance in Newark.—On Dec. 25, 1912, the Public Service Railway, Newark, N. J., posted in its carhouses bulletins informing the employees of the notice served on the company by the Police Department of Newark of its intention to enforce after Jan. 1, 1913, the traffic ordinance as it relates to the stopping of street cars. This ordinance requires that cars shall be stopped on the near side of all intersecting streets except where trolley stations are designated. At the same time lists of the stops that will be made in Broad and Market Streets after Jan. 1, 1913, were distributed.

Amendment to New York Public Service Commissions Law.—Counsel to the Public Service Commission for the First District has been directed to prepare a form of amendment to the Public Service Commissions law for presentation to the Legislature, giving jurisdiction over telephones and telegraphs within the First District to that commission. The First District embraces the territory within the boundaries of Greater New York, and while the commission for the First District exercises control over railroads, gas and electric companies in that territory, the jurisdiction over telephones and telegraphs within the city is vested in the commission for the Second District.

Public Utility Bill Introduced at Washington.—Representative A. W. Lafferty, of Oregon, has introduced a bill which calls for the creation of a public service commission with jurisdiction over the public utility companies which operate in Washington, D. C. The commission proposed by Mr. Lafferty would be composed of three members to be appointed by the President for terms of three years. The commissioners would receive compensation of $4,000 a year each. The bill provides for a valuation of the properties of the public utilities corporations of the District by the commission as a basis for fixing rates. The District Supreme Court would have power to review and revoke a decision of the commission where compliance with the orders of the latter would endanger the property of the concern financially.

Failure of Railroad Stairway with Concrete Treads and Risers.—The upper section of the stairway at the east end of the platform at the Nostrand Avenue station of the Long Island Railroad in Brooklyn collapsed on Dec. 19, causing the death of one person. The stairway was built in two sections, and was erected in 1905 at the time the station was constructed. There was a landing and support at about mid-height. The framework was of structural steel, with cast-iron columns beneath the landing. The stairs were built of reinforced concrete. The individual steps, however, were not separately reinforced. A hearing to investigate the collapse of the stairway was held by the Public Service Commission for the First District on Dec. 24. Testimony at the hearing tended to show that the collapse was due to the breaking of the connection between the steel girder forming the side of the stairway and a cast-iron post on the first landing, against which the end of the girder rested. The commission has directed its engineers to examine all similar stairs from all elevated railroads, with a view of disclosing any defects which may exist in their condition.

Public Utilities Issue.—The New York *Commercial* of Dec. 14, 1912, issued a special supplement of seventy-two pages devoted to public utilities, including light, heat and power companies. Notable features of the issue were the following articles: "Maintenance and Depreciated Replacement Values," by John F. Wallace, president of Westinghouse, Church, Kerr & Company; "The Work of the Public Service Commission in Safeguarding the Investor," by William R. Willcox, chairman of the Public Service Commission of the First District of New York; "Valuation of Public Service Properties," by L. R. Nash, of Stone & Webster; "The Great Problem of the Public Service Corporation," by H. M. Byllesby, of H. M. Byllesby & Company, and "The Interrelation of Traction, Light, Power & Heating Companies," by Francis C. Prest, of Meikleham & Dinsmore. Operating statements were published of representative companies such as the American Light & Traction Company, the Portland (Ore.) Railway, Light & Power Company, the Electric Bond & Share Company, Stone & Webster, California Railway & Power Company, Tennessee Railway, Light & Power Company, Henry L. Doherty & Company, the United Light & Railways Company, etc. Maps showing the territory covered by the properties of these companies were also published.

New Haven Railroad Acknowledges Inspection Report of the Public Service Commission.—E. H. McHenry, vice-president of the New York, New Haven & Hartford Railroad, New Haven, Conn., has replied in part as follows to the letter addressed recently by the Public Service Commission to the company in regard to the inspection of the tracks of the company made by the engineers of the commission. Mr. McHenry's reply follows in part: "I beg to advise that instructions have been issued to correct all of the defects noted by the inspectors and the commission may feel assured that the recommendations therein contained will receive complete and literal compliance. The criticisms concerning the belated renewal of ties are well founded, but it should be explained that the ties for renewals were ordered in sufficient season and the deliveries were made not more than thirty days later than the time stipulated in the contract. Through some error on the part of the contractor the ties were improperly bored for the reception of the screw spikes, and it was accordingly necessary to reject the entire lot, which correspondingly delayed the receipt of new ties in replacement. I note the conclusion of the commissioner in regard to the possible improvement in the detailed supervision of maintenance work and will give this matter prompt attention. In conclusion I beg to express the appreciation of the railroad company for the fair and impartial form in which the inspection and conclusions of the commission have been presented."

Financial and Corporate

Stock and Money Markets

Dec. 31, 1912.

Trading on the New York Stock Exchange to-day was more active than on recent days, and the price movement was upward. There was unusual breadth to the trading in bonds to-day, the total business in the bond department being $2,346,000, par value. The stringency in the money market has been relieved, and to-day call money opened at 6 per cent, which was the highest price for the day. Rates in the money market to-day were: Call, 5@6 per cent, with the last loan at 3 per cent; sixty days, 5½@5¾ per cent; ninety days, 5¼@5½ per cent; five and six months, 5@5¼ per cent.

The trading in Philadelphia to-day was broad and active. The demands for bonds were good.

In Chicago the market was broad but the volume of transactions not very large. The bond transactions to-day totaled about $60,000.

In the Boston market there was very little trading in the railroad issues. The market for bonds was quiet.

In Baltimore the only traction issue dealt in to-day was the United Railways. The market for bonds continues good, the transactions to-day totaling $46,000.

Quotations of traction and manufacturing securities as compared with last week follow:

	Dec. 24	Dec. 31.
American Brake Shoe & Foundry (common)	93¼	95
American Brake Shoe & Foundry (preferred)	132½	135½
American Cities Company (common)	47½	47½
American Cities Company (preferred)	a98½	78½
American Light & Traction Company (common)	400	400
American Light & Traction Company (preferred)	107½	108
American Railways Company	41	41
Aurora, Elgin & Chicago Railroad (common)	40	40
Aurora, Elgin & Chicago Railroad (preferred)	88½	86
Boston Elevated Railway	113½	113
Boston Suburban Electric Companies (common)	10	10
Boston Suburban Electric Companies (preferred)	75	75
Boston & Worcester Electric Companies (common)	6⅞	7
Boston & Worcester Electric Companies (preferred)	40	40
Brooklyn Rapid Transit Company	92⅛	92⅛
Capital Traction Company, Washington	122	122
Chicago City Railway	150	150
Chicago Elevated Railways (common)	30	27
Chicago Elevated Railways (preferred)	91	92
Chicago Railways, ptcptg., ctf. 1	90	86
Chicago Railways, ptcptg., ctf. 2	23	26¼
Chicago Railways, ptcptg., ctf. 3	8¼	8
Chicago Railways, ptcptg., ctf. 4	4	3½
Cincinnati Street Railway	123¾	122½
Cleveland, Southwestern & Columbus Ry. (common)	*6½	*6½
Cleveland, Southwestern & Columbus Ry. (preferred)	*34	*34
Cleveland Railway	104½	103½
Columbus Railway & Light Company	55	55
Columbus Railway (common)	82	82
Columbus Railway (preferred)	90	81
Denver & Northwestern Railway	121	*121
Detroit United Railway	70	70
General Electric Company	182¼	186
Georgia Railway & Electric Company (common)	120½	120
Georgia Railway & Electric Company (preferred)	83	83
Interborough Metropolitan Company (common)	19¼	18½
Interborough Metropolitan Company (preferred)	64¼	64
International Traction Company (common)	39	*39
International Traction Company (preferred)	92	*92
Kansas City Railway & Light Company (common)	18	18½
Kansas City Railway & Light Company (preferred)	41	40
Lake Shore Electric Railway (common)	*6	*6
Lake Shore Electric Railway (1st preferred)	*89	*89
Lake Shore Electric Railway (2d preferred)	*25½	*25½
Manhattan Railway	128	129
Massachusetts Electric Companies (common)	16¾	17
Massachusetts Electric Companies (preferred)	75½	75
Milwaukee Electric Railway & Light Co. (preferred)	*100	100
Norfolk Railway & Light Company	*26	*26
North American Company	79	79
Northern Ohio Light & Traction Company (common)	75	80
Northern Ohio Light & Traction Company (preferred)	105	100
Philadelphia Company, Pittsburgh (common)	50	50
Philadelphia Company, Pittsburgh (preferred)	43½	44
Philadelphia Rapid Transit Company	27¾	27½
Portland Railway, Light & Power Company	*66	*66
Public Service Corporation	119	117
Third Avenue Railway, New York	40¼	40½
Toledo Railway & Light Company	*3½	2¾
Twin City Rapid Transit Co., Minneapolis (common)	102½	105
Union Traction Company of Indiana (common)	*6½	*6½
Union Traction Company of Indiana (1st preferred)	*80	*80
Union Traction Company of Indiana (2d preferred)	*34	*34
United Rys. & Electric Company (Baltimore)	24⅞	24½
United Rys. Inv. Company (common)	34	35
United Rys. Inv. Company (preferred)	63	63½
Virginia Railway & Power Company (common)	51	51
Virginia Railway & Power Company (preferred)	89	90
Washington Ry. & Electric Company (common)	88	88
Washington Ry. & Electric Company (preferred)	89	90
West End Street Railway, Boston (common)	80	80
West End Street Railway, Boston (preferred)	*99	96
Westinghouse Elec. & Mfg. Company	79	79¼
Westinghouse Elec. & Mfg. Company (1st preferred)	121⅜	115

*Last sale. a Asked.

Hearing on Application of United Railroads to Refund Issues of Subsidiaries

The Railroad Commission of California held a hearing at San Francisco, Cal., on Dec. 21, 1912, on the application of the United Railroads, San Francisco, Cal., for permission to issue five-year serial notes to the amount of $2,350,000 with which to retire bonds of the Market Street Cable Railway and the Park & Cliff House Railway which matured on Jan. 1, 1913. Patrick Calhoun, president of the United Railroads, explained the application of the company and reviewed its history in part as follows:

"There are two applications pending before this commission, and I desire to give a correct idea of what they are. The first is an application for permission to issue serial notes, secured by the bonds of the Market Street Cable Railway, with which to retire $3,000,000 in bonds of the same corporation, coming due Jan. 1, 1913. The second proposition is to issue other notes of the same description, the funds from which are to be used in retiring $350,000 of bonds of the Park & Cliff House Railroad, maturing at the same time. The sinking fund created at the time these bonds were issued will furnish $1,000,000 toward retiring them. We ask the commission for permission to secure $2,350,000 more, with which to pay our debts.

"If the commission so desires, we will consent to a reduction of our application to $2,150,000, the exact amount of our present indebtedness. Since its formation in 1902 the United Railroads has increased its assets $15,000,000. The debit side of its ledger has been increased only $9,000,000. During the terrible times following the fire, when this utility was scarcely earning anything, there was never a morning when I went to my office that I did not feel the possibility of being compelled to place the road in the hands of a receiver before night. I was urged to do so, but, through the efforts of the holding company which owns the United Railroad stock, the company held on, paying honest debts as they came due, just as it is now trying to do.

"The gross revenue per year of the United Railroads in 1902, the year of its origin, was more than $5,000,000. The earnings grew to $21,000 per day the first fifteen days of April, 1906. In 1907 there was a deficit of about $1,100,000. That shows what stormy times this utility has passed through. Yet, at the present time the gross earnings of the United Railroads are 6 per cent greater than in 1906."

Following the hearing the commission ruled as follows:

"The books of a corporation in which the details of transactions are at once set down are considered by this commission the best evidence of its financial condition. Sufficient information has not been furnished the commission to enable it to form an intelligent conclusion concerning the financial condition of the United Railroads of San Francisco. The information thus far furnished would lead to unfavorable action on this application. Hence, until the books of the United Railroads are produced, no order will be made authorizing the issue and sale of the securities asked for in this proceeding."

Central Park, North & East River Railroad, New York, N. Y.—The protective committee of stockholders of the Central Park, North & East River Railroad has brought suit in the Supreme Court of New York against Thomas F. Ryan, August Belmont, Theodore P. Shonts and others connected with the old Metropolitan Securities Company to recover the estimated value of the property of the Central Park, North & East River Railroad, sold under foreclosure recently as noted in the ELECTRIC RAILWAY JOURNAL. It is alleged that when the road was leased to the Metropolitan Street Railway it was agreed that the new company should refund or retire the $1,200,000 of bonds outstanding when they became due, whereas after maturity the bonds were held alive in the investment account of the Metropolitan Street Railway and deposited as part collateral for its bonds.

Choctaw Railway & Lighting Company, McAlester, Okla.—Control of the Choctaw Railway & Lighting Company is reported to have passed to other interests, and Russell Palmer, Mobile, Ala., has been elected president of the company to represent the new owners.

Cleburne (Tex.) Street Railway.—The Cleburne Street Railway, control of which recently changed hands, has elected new officers as follows: Daniel Hewitt, president

and general manager; A. M. Morgan, vice-president; John F. Floore, Sr., second vice-president; Lawrence Hewitt, secretary-treasurer; Daniel Hewitt, J. M. Moore, Brown Douglass, Lawrence Hewitt and John F. Floore, Sr., directors.

Cleveland (Ohio) Railway.—The operating receipts of the Cleveland Railway for November, 1912, were $565,426, as compared with $519,306 for November, 1911. The actual surplus shown by the statement was $7,461, while the ordinance surplus was $25,883. In November, 1911, there was an actual deficit of $30,499 and an ordinance deficit of $18,833. The number of car miles increased 4.11 per cent over November, 1911, while there was an increase of 9.82 per cent in the number of passengers and 8.88 in the receipts from fares. The number of passengers carried during the month was 24,423,531, which was a gain of 2,183,115 over November, 1911.

Ephrata & Lebanon Street Railway, Ephrata, Pa.—The entire $250,000 of bonds recently authorized by the Ephrata & Lebanon Street Railway have been sold to J. A. Vandegrift, representing a New York syndicate, which also took over 3340 unsold shares of common stock of the company. The company expects to finish the line by Sept. 1, 1913. Of the 23 miles of proposed line 7½ miles have been completed at a cost of $135,000. The Ephrata plant of the company is to be enlarged and a new plant is to be built at Lebanon.

Hendersonville (N. C.) Traction Company.—C. A. Carlson, Red Bank, N. J., is reported to have purchased the property of the Hendersonville Traction Company, which operates about 4 miles of line in Hendersonville.

Hoosick Falls (N. Y.) Railroad.—On Dec. 30, 1912, the Public Service Commission of the Second District of New York heard the application of the Vermont Company, which seeks approval of the lease of the Hoosick Falls Railroad. For the Vermont Company Attorney J. Garfield and for the Hoosick Company Attorney George E. Greene said that the lease would result in economy in operation and the rendering of more efficient service. Mr. Greene said that with the credit of the Vermont Company the Hoosick Falls Railroad intended to renew its overhead system and inaugurate express service on its line. Decision on the application was reserved by the commission.

Interborough-Metropolitan Company, New York, N. Y.—The collateral trust 6 per cent notes of the Interborough-Metropolitan Company have again been extended for six months, to July 1, 1913. These notes, which now amount to $2,039,520, were extended in 1908, 1910, 1911 and 1912, the last time until Jan. 1, 1913.

International Traction Company, Buffalo, N. Y.—The International Traction Company has announced that the coupons on the $18,335,000 of fifty-year 4 per cent collateral trust bonds of the company due on Jan. 1, 1912, July 1, 1912, and Jan. 1, 1913, will be paid at the office of J. P. Morgan & Company, New York. Pending the readjustment of the finances of the International Railway, interest on these bonds was deferred, but the financial reorganization of the subsidiary corporation having been completed the past due interest can be paid. Steps will be taken to replace the present 4 per cent collateral trust bonds of the International Traction Company with new collateral trust bonds as provided in the agreement of the committee representing the bondholders.

Pawcatuck Valley Street Railway, Westerly, R. I.—The property of the Pawcatuck Valley Street Railway was sold under foreclosure recently to Harry M. Verrill, Portland, Maine, for $10,797, subject to a mortgage of $50,000. Confirmation of the sale by the court is opposed by John W. Sweeney and John Champlin.

Pottsville (Pa.) Union Traction Company.—A special meeting of the stockholders of the Pottsville Union Traction Company will be held on Jan. 27, 1913, for the purpose of voting upon a proposed increase in the company's indebtedness from $1,250,000 to $2,250,000.

Youngstown & Ohio River Railroad, Youngstown, Ohio.—The directors of the Youngstown & Ohio River Railroad have declared a quarterly dividend of 1⅛ per cent on its preferred stock, which will make 4½ per cent for the year, as compared with 4 per cent last year.

Dividends Declared

Auburn & Syracuse Electric Railroad, Syracuse, N. Y., quarterly, 1½ per cent, preferred.

Aurora, Elgin & Chicago Railroad, Wheaton, Ill., quarterly, 1½ per cent, preferred; quarterly, three-fourths of 1 per cent, common.

Bay State Street Railway, Boston, Mass., 3 per cent, first preferred.

Boston Suburban Electric Companies, Boston, Mass., quarterly, $1, preferred.

Cincinnati, Newport & Covington Light & Traction Company, Cincinnati, Ohio, quarterly, 1⅛ per cent, preferred; quarterly, 1⅜ per cent, common.

El Paso (Tex.) Electric Company, 3 per cent, preferred.

Ohio Traction Company, Cincinnati, Ohio, quarterly, 1 per cent, common.

Stark Electric Railroad, Alliance, Ohio, quarterly, three-fourths of 1 per cent.

Thirteenth & Fifteenth Streets Passenger Railway, Philadelphia, Pa., $6.

Washington, Baltimore & Annapolis Electric Railroad, 4½ per cent, preferred.

Western New York & Pennsylvania Traction Company, Olean, N. Y., 3 per cent, first preferred.

ELECTRIC RAILWAY MONTHLY EARNINGS

BATON ROUGE (LA.) ELECTRIC COMPANY.

Period.			Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
1m.,	Oct.	'12	$13,315	*$7,638	$5,677	$1,730	$3,947
1 "	"	'11	10,593	*6,894	3,699	1,730	1,969
12 "	"	'12	143,664	*85,470	58,194	20,763	37,431
12 "	"	'11	117,066	*75,370	41,696	20,675	21,021

BROCKTON & PLYMOUTH STREET RAILWAY COMPANY, PLYMOUTH, MASS.

1m.,	Oct.,	'12	$9,595	*$8,023	$1,572	$1,028	$542
1 "	"	'11	9,336	*7,818	1,518	1,025	493
12 "	"	'12	120,365	*89,988	30,270	12,511	17,769
12 "	"	'11	118,743	*90,490	28,253	13,112	15,141

CAPE BRETON ELECTRIC COMPANY, LTD., SYDNEY, N. S.

1m.,	Oct.,	'12	$31,133	*$16,340	$14,794	$5,619	$9,175
1 "	"	'11	31,650	*15,769	15,881	5,653	10,228
12 "	"	'12	353,635	*193,950	159,686	68,047	91,639
12 "	"	'11	334,626	*180,176	154,449	67,833	86,616

COLUMBUS (GA.) ELECTRIC COMPANY.

1m.,	Oct.	'12	$54,913	*$22,434	$26,332	$18,952	$7,380
1 "	"	'11	49,362	*22,469	21,982	18,361	3,621
12 "	"	'12	542,593	*268,726	266,799	225,021	41,778
12 "	"	'11	545,857	*233,765	250,135	182,701	67,435

HOUGHTON (MICH.) COUNTY TRACTION COMPANY.

1m.,	Oct.	'12	$24,853	*$13,203	$11,650	$5,677	$5,973
1 "	"	'11	24,250	*14,597	9,652	5,227	4,425
12 "	"	'12	303,790	*173,860	129,930	66,270	63,660
12 "	"	'11	301,979	*179,014	122,965	62,640	60,325

JOPLIN & PITTSBURG RAILWAY, PITTSBURG, KAN.

1m.,	Nov.,	'12	$47,488	$28,287	$19,201	$12,541	$6,660
1 "	"	'11	39,060	22,160	16,900	12,911	3,989
12 "	"	'12	528,136	312,742	215,394	153,134	62,260
12 "	"	'11	464,964	272,255	192,709	152,359	40,350

NORTHERN TEXAS ELECTRIC COMPANY, FORT WORTH, TEX.

1m.,	Oct.,	'12	$201,567	*$89,710	$111,857	$24,940	$86,917
1 "	"	'11	168,512	*82,549	85,962	20,978	64,984
12 "	"	'12	1,727,037	*916,645	810,392	258,756	551,636
12 "	"	'11	1,593,749	*875,257	718,492	244,559	473,933

PADUCAH (KY.) TRACTION & LIGHT COMPANY.

1m.,	Oct.,	'12	$24,643	*$16,389	$8,253	$7,388	$815
1 "	"	'11	21,775	*13,783	7,992	7,399	593
12 "	"	'12	283,399	*188,298	95,100	85,857	9,243
12 "	"	'11	260,824	*157,758	103,067	80,232	22,835

PENSACOLA (FLA.) ELECTRIC COMPANY.

1m.,	Oct.,	'12	$24,759	*$15,858	$8,901	$6,377	$2,524
1 "	"	'11	24,415	*15,409	9,006	5,014	3,992
12 "	"	'12	286,942	*178,167	108,775	75,184	33,591
12 "	"	'11	286,794	*178,583	108,211	59,189	49,022

PUGET SOUND TRACTION, LIGHT & POWER COMPANY, SEATTLE, WASH.

1m.,	Oct.,	'12	$715,378	*$396,814	$318,564	$169.366	$149,198
10 "	"	'12	6,877,898	*3,969,420	2,908,478	1,633,997	1,274,481

TAMPA (FLA.) ELECTRIC COMPANY.

1m.,	Oct.,	'12	$65,640	*$33,782	$31,858	$4,475	$27,383
1 "	"	'11	59,328	*33,246	26,082	4,482	21,600
12 "	"	'12	751,601	*392,919	358,682	53,532	305,150
12 "	"	'11	655,118	*365,016	290,102	59,363	230,739

*Includes taxes.

Traffic and Transportation

Accidents on Interstate Electric Railways

The Interstate Commerce Commission, Washington, D. C., has issued a summary for the year ended June 30, 1912, of the casualties to persons on the electric railways which come under its jurisdiction. This statement as issued by the commission contains the following statistics which did not appear in the quarterly bulletins of the commission, the reports from which they are taken having been received after the quarterly bulletins were printed: 8 collisions, 72 passengers and 1 person not trespassing injured; 2 derailments, 2 passengers injured. Accidents other than those to trains and roadway resulted in the following casualties: 1 passenger and 1 other person not trespassing killed, and 92 passengers, 7 employees on duty, 7 other persons not trespassing and 3 trespassers injured. Industrial accidents resulted in injury to 14 employees, making a total of 10 train accidents, 2 killed and 198 injured. From a statement of the commission which is appended there have been eliminated the columns which give the records of employees not on duty who were injured and the records of trespassers who were injured. The record of casualties to employees not on duty shows 1 killed and 24 injured, while the record of casualties to trespassers shows 100 killed and 128 injured. The summary of accidents as contained in the bulletin of the commission, with the eliminations which have been mentioned, follows:

Causes.	Number of Accidents.	Passengers Killed.	Passengers Injured.	Employees on Duty Killed.	Employees on Duty Injured.	Other Persons Not Trespassing Killed.	Other Persons Not Trespassing Injured.	Total Persons Killed.	Total Persons Injured.
Collisions	159	7	1,208	13	96	..	1	20	1,316
Derailments	102	..	242	1	41	..	6	1	289
Accidents other than collisions, derailments and boiler explosions	8	..	12	..	7	..	..	..	19
Total train accidents	269	7	1,462	14	144	..	7	21	1,624
Accidents to roadway or bridges not causing derailment	11	..	..	..	..	..	..	..	..
Coupling or uncoupling cars. (Does not include accidents with air or steam hose)	..	..	..	2	18	..	..	2	18
While doing other work about trains or while attending switches	..	..	..	6	124	..	..	6	124
Coming in contact while riding on cars with bridges or other fixed structures above or at side of track	..	2	14	..	22	..	..	2	40
Falling from cars or engines	..	6	67	8	49	1	1	16	119
Getting on or off cars or engines	..	16	1,002	5	47	1	19	24	1,090
Other accidents on or around trains not here named	..	..	199	..	10	1	16	3	231
Being struck or run over by engines or cars at stations or yards	..	2	7	3	6	6	9	17	38
Being struck or run over by engines or cars at highway grade crossings	..	1	3	..	..	63	388	71	400
Being struck or run over by engines or cars at other places	..	..	8	5	9	45	192	130	281
Other causes	..	1	100	3	10	1	27	8	147
Total other than train accidents	..	28	1,400	32	295	118	652	279	2,488
Total accidents, exclusive of industrial accidents	..	35	2,862	46	439	118	659	300	4,112
Industrial accidents to employees[1]	..	..	..	24	550	..	..	24	550
Grand total	..	35	2,862	70	989	118	659	324	4,662

[1]"Industrial" accidents are those which do not involve train operation, but occur to railroad employees other than trainmen on railroad premises.

The bulletin of the commission also contains the following statement of employees in the service of the interstate electric railways on June 30, 1912:

Class of Employees.	Number of Persons.
Employees specially exposed to railway accidents:	
Trainmen, road service (enginemen, firemen, motormen, conductors, brakemen, rear flagmen, train baggagemen, train porters performing duties of trainmen)	17,501
Other persons employed on trains (dining-car employees, train porters not performing duties of trainmen, etc., when actually employed by the respondent carrier)	179
Yardmen (all employees in yard train work and switching—enginemen, firemen, conductors, brakemen, foremen, droppers, fieldmen, hostlers, hostler helpers, yardmasters, etc.)	718
Switch tenders, crossing tenders and watchmen	506
Bridgemen and trackmen	13,618
Other employees specially exposed to railway accidents (station and miscellaneous employees, shopmen, etc., excluding all officers, clerks, indoor employees, and others engaged in work in which they are not specially exposed to railway accidents)	8,777
Total number of employees specially exposed to railway accidents	41,299
Employees not specially exposed to railway accidents (includes officers and other employees specifically excluded from item No. 6 above)	9,174
Total number of persons employed on June 30, 1912	50,473

Pension System Announced by San Francisco-Oakland Terminal Railways

The San Francisco-Oakland Terminal Railways, San Francisco, Cal., announced the establishment on Jan. 1, 1913, of a pension fund for the benefit of its employees which is to extend to all branches of the service. The fund is to be administered by a board of directors to be composed of the following officers of the company: E. A. Heron, president; W. R. Alberger, general manager; Harmon Bell, chief counsel; F. W. Frost, secretary, and B. W. Fernald, auditor. The following rules have been adopted to govern the employees who may be retired or pensioned:

"All officers and employees who have attained the age of seventy years shall be retired. Such of them as have been continuously in the service twenty years or more shall be pensioned. Motormen, conductors, train collectors, towermen, dispatchers, boat captains and other deck officers and marine engineers who have attained the age of sixty-five years may be retired. Such of them as have been continuously in the service twenty years or more shall be pensioned if and when retired.

"Officers and employees between sixty and seventy years of age who have been twenty years or more in the service and who have become incapacitated for the performance of the duties in which they have been engaged and who cannot be transferred to other work which they are able to perform may be retired and pensioned. Officers and male employees under sixty years of age who have been twenty-five years or more in the service and all female employees who have been twenty years or more in the service and who have become permanently disabled may be retired and pensioned.

"Physical examination shall be made of employees recommended for retirement for disability who are under seventy years of age, and a report thereof, with the recommendation of some reputable surgeon to be selected by the board of directors, shall be transmitted to the board of pensions for consideration in determining such cases. Retirement shall be made effective from the first day of the calendar month following that in which the person shall have attained the specified age, or from the first day of a calendar month to be determined by the board of pensions.

"The terms 'service' and 'in the service' will refer to employment upon or in connection with any of the railways owned or operated by the San Francisco-Oakland Terminal Railways, and the service of any employee shall be considered as continuous from the date from which he has been continuously employed upon such railways, whether prior or subsequent to their control, acquisition by or consolidation into the San Francisco-Oakland Terminal Railways."

The pension allowances authorized are upon the following basis:

"For each year of service an allowance of 1½ per cent of the first $50 of the highest average monthly pay of the officer or employee during any consecutive ten years of service, and in addition, 1 per cent of any excess of such highest average monthly pay over $50, provided, however, that in no case shall the allowance made be less than $20 or more than $75 per month, subject to provisions of Rule 8 hereof. Thus, by way of illustration: If an employee has been in the service for thirty years and his highest average

salary or wages for any ten consecutive years was $80 per month, his pension allowance would be $31.50 per month.

"For exceptionally long and unbroken service, with first-class record, or for other good and sufficient reasons apparent to the board of directors, upon recommendation of the board of pensions, the board of directors may, at its discretion, place any officer or employee on the pension list and fix pensions at such amount as may in the judgment of the board of directors be equitable and appropriate. In order to preserve direct personal relations between the company and its retired employees, and that they may continue to enjoy the benefit of the pension system, no assignment of pension will be permitted or recognized. The acceptance of a pension allowance does not debar a retired employee from engaging in any other business which is not prejudicial to the interests of the company, but he cannot re-enter the service of the company.

"No person inexperienced in railway work more than thirty-five years of age, and no experienced person more than forty-five years of age, shall hereafter be taken into the service; provided, however, that under conditions approved by the president or vice-president persons may temporarily be taken into the service irrespective of age for a period not exceeding six months, and that this period may be extended, if necessary, to complete the work for which said persons were originally employed; provided, also, that, with the approval of the board of directors, persons may be employed indefinitely, irrespective of the age limit, where the service to be rendered requires professional or other special qualifications. No person, however, over the age of forty-five who shall hereafter be taken into the service, shall be eligible to the payment of a pension."

Additional Cars Recommended for Los Angeles

As a result of its study of traffic conditions in Los Angeles, Cal., the Board of Public Utility Commissioners of that city has addressed letters in part as follows to the Los Angeles Railway Corporation and the Pacific Electric Railway respectively:

"Our study of the local systems shows that during the coming year there should be added to the car equipment at least seventy-five additional cars of the present seating capacity, also seventy-five cars to be used as trailers during the rush hours and on holidays. These cars should have the same seating capacity and the same style and finish as the cars now in use. These trailers can be bought for 50 per cent less than the regular cars and can be purchased and put in use in much less time than the regular cars. In order to get the regular cars in time to take care of the constantly growing demand, they should be ordered at once, and we therefore wish to inquire if there is any reason why the Board of Public Utilities should not order you to include in your budget for increased investments for next year an item requiring the delivery of the cars mentioned as soon as possible, together with the attendant facilities of additional power, power houses, substation equipments, etc. We will be pleased to receive a communication from you on the subject, and, if necessary, set a day for a hearing covering this very important subject of more cars."

"We must call your attention to the crowded condition of your cars, as well as of the other line, and the necessity of supplying additional car equipment at a very early date. The city of Los Angeles is just as vitally interested in securing good service on the interurban lines as are the surrounding communities, and any congestion which affects the development of its satellite cities in turn hinders the growth and prosperity of the central metropolis. Will you therefore acquaint this board at an early date with the appropriation you are making for additional cars and indicate the probable date of delivery as well as the size and type of cars which you expect to add to your rolling stock equipment during the next year?"

Increase in Wages in Fort Worth.—Trainmen in the employ of the Northern Texas Traction Company, Fort Worth, Tex., have been granted an increase in pay of 1 cent an hour.

Transportation as Prize in Corn Show.—The Indianapolis, Columbus & Southern Traction Company, Columbus, Ind., has awarded six months' free transportation over its lines as the first prize in a corn show and three months' free transportation as the second prize.

Insurance Policies Presented to Employees.—The Pittsburgh, Harmony, Butler & New Castle Railway, Pittsburgh, Pa., has posted a notice to the effect that it has presented each employee with a life insurance policy for $500 in the Equitable Life Assurance Society, without cost, the company paying the premiums. The policies went into effect on Dec. 24, 1912.

Accident at Cincinnati.—On the night of Dec. 27, 1912, a car of the Cincinnati, Newport & Covington Light & Traction Company plunged off the approach of the Central Bridge over the Ohio River on the Cincinnati side. It dropped 30 ft. and landed on end on the river bank. Ten persons, including the crew, were on the car, but only the motorman was seriously injured.

New Transfer Rules in Trenton.—The Trenton & Mercer County Traction Corporation, Trenton, N. J., has issued to the conductors in its employ a new set of rules to be complied with in the future in the issuance of transfers to patrons of the road. Under the new system the company issues transfers from all cars that do not make the entire run of any one line or that run partly on the same line but to different destinations.

Record Passenger Traffic on One of Chicago's Surface Systems.—All previous records of the company for carrying passengers were broken by the Chicago Railways Company on Christmas Eve, the report showing the collection of 1,186,135 cash fares and 830.295 transfers. The company's old record was broken on Dec. 21, 1912, when 1,967,308 cash fares and transfers combined were collected. The record of Dec. 24 was 12.89 per cent over that of the same day a year ago.

Increase in Wages in Atlanta.—On Jan. 1, 1913, the Georgia Railway & Power Company, Atlanta, Ga., put into effect the following wage scale for motormen and conductors: First three months, 17 cents per hour, instead of 16 cents; second three months, 18 cents per hour, instead of 17 cents; remainder of first year, 19 cents per hour, instead of 18 cents; second year, 21 cents, instead of 19 cents; third year, 23 cents; instead of 21 cents; fourth year, 24 cents, instead of 22 cents; fifth year and afterward, 25 cents, instead of 23 cents.

Accidents in Greater New York in November.—Reports of accidents on railroads and street railroads in Greater New York for November, 1912, as made to the Public Service Commission for the First District, show that the total number of accidents was 5783, against 5291 in November, 1911. Of these accidents 3651 involved injuries to persons, against 3221 in November, 1911. The number killed was thirty-two, against thirty-one in November, 1911, and the total number of serious injuries was 192, against 216 in November, 1911.

Inquiry Into Reasonableness of Milk and Cream Rates.—The Public Service Commission of the Second District of New York has instituted an inquiry and investigation into the reasonableness and justice of rates proposed to be charged by the Wallkill Transit Company, Middletown, N. Y., on milk and cream. The company filed with the commission a tariff increasing rates on milk and cream effective Jan. 1, 1913, and a number of complaints have been filed with the commission against the proposed rates. The hearing was set for Jan. 3, at Middletown.

Increase in Fare Asked Between Trenton and Princeton.—On the ground that the present rate of fare between Trenton and Princeton, N. J., is insufficient, Alfred Reed and Sydney L. Wright, receivers for the New Jersey & Pennsylvania Traction Company, the Trenton, Lawrenceville & Princeton Railroad, the Trenton, Lawrenceville & Princeton Extension Railroad and the Princeton Street Railroad, are considering a plan to increase the fare to 15 cents. The fare between Trenton and Princeton has been 10 cents.

Heating Question in Wilmington.—The members of the Board of Public Utility Commissioners of Wilmington, Del., conferred on Dec. 21, 1912, with R. W. Crook, general manager of the People's Railway, Wilmington, about the heating of the cars of the company. Mr. Crook agreed at

the request of the board to place thermometers on a few cars for experimental purposes. Mr. Crook said that all the cars were equipped with electric heaters and that the company had always tried to meet the requirements of the traveling public. The board suggested that the temperature in the local cars in Wilmington should be kept between 50 deg. and 60 deg. Fahr. during the winter months.

Fare Questions on the San Francisco-Oakland Terminal Railways.—The Hayward Chamber of Commerce has filed a complaint against the San Francisco-Oakland Terminal Railways, San Francisco, Cal., charging excessive and irregular rates between Oakland and points as far as Hayward. H. G. Walker filed a complaint against the company charging that illegal conditions had been inserted in the commutation book contract issued for transportation between San Leandro and Hayward. On the other hand, the company has applied to the commission for permission to increase the rate of fare between San Leandro and Hayward from 10 cents to 15 cents. The company has collected 15 cents instead of the published rate of 10 cents. It asserts that the rate of 10 cents as published was a clerical error.

Children Who Ride Free Not to Occupy Seats.—The Twin City Rapid Transit Company, Minneapolis, Minn., is enforcing the rule against children occupying seats while older persons stand. Heretofore an adult has been allowed to take three children of six years and under on cars of the company without paying fare. The rule which is now being enforced is as follows: "Children under six years of age, when accompanied by parent or guardian, provided not more than three such children are in the care of one person, will be allowed to ride free. Should more than three children be in charge of one guardian, a full fare will be collected for each child in excess of that number. Should conductor see free-riding children occupying seats while other passengers are standing, he will ask the parent or guardian either to take the child on his or her lap, have the child stand, or else pay full fare on account of each occupied seat."

Reduction in Fare Ordered.—The Public Service Commission of the Second District of New York has ordered the Syracuse, Lake Shore & Northern Railroad to reduce the fare per passenger for one-way transportation on its line between Stop 31 and Fulton from 10 cents to 5 cents per passenger. This action by the commission followed a hearing held in Fulton by Commissioner Martin S. Decker on Dec. 15, 1912. The company is also ordered to stop its limited train which leaves Oswego at 8:15 a. m. at Stop 31 on signal until the further order of the commission, or until it shall substitute therefor a local service at approximately the same time between Stop 31 and Fulton. The request of the complainant for the running of hourly trains between Fulton and points north of Fulton is denied without prejudice to the filing of new complaints by interested parties. The distance from Stop 31 to the business portion of Fulton is 1.9 miles and the distance from Stop 31 to the southerly end of Fulton is 3.1 miles.

Street Car Delays During Winter.—At the close of last winter, just after the snow had disappeared, the Detroit (Mich.) United Railway published the second of its service of advertisements in the public press prepared for the purpose of acquainting its patrons with some of the problems that have to be met and overcome by the company in keeping up its service. The advertisement referred to was devoted to the topic "Why the Street Cars Sometimes Pass You By." The company has recently deemed it expedient to republish in connection with other matter the following statements made in the previous advertisement which referred to the rule which prohibits cars from passing by those who wish to board them: "The unpleasant feature of street railway transportation is that these exceptions crop out most frequently in the cold and dreary months of the year and this despite the best efforts of the conscientious and hard-working force of superintendents, foremen and car operators. The winter now closing has been the severest upon the employees and property in its existence, with a record of interruptions varying from a half-hour stop, due to trolley wire breaking from the intense cold, to a similar lengthy gap at grade crossings, the result of a steam train becoming stalled."

East Boston Tunnel Tolls Upheld.—Corporation Counsel Corbett of Boston has sent an opinion to Mayor Fitzgerald stating that in his judgment the exaction of a 1-cent toll by the Boston Elevated Railway from patrons using the East Boston tunnel is a legal procedure. A movement has taken shape lately among citizens of East Boston to refuse to pay the toll, and the matter has been brought before the Mayor and the police commissioner. Mr. Corbett says that the evasion of the toll is not a criminal offense before the law, as no penalty is specified in the statute. In a letter to Police Commissioner O'Meara the corporation counsel says that any concerted action by a number of persons determined to evade the tolls established by law would undoubtedly result in disturbances and breaches of the peace. He joins with the officials of the company in requesting the detail of a sufficient number of police officers to preserve order in the tunnel and its stations and to prevent any breach of the peace dangerous to the safety of the traveling public. Mayor Fitzgerald has announced that in his opinion every citizen of East Boston owes it to the honor of the city to pay the toll. The cost of the tunnel was about $3,000,000 and the tolls during the year ended June 30, 1912, aggregated about $150,000, the cost of collection being about $21,000. The sinking fund to meet the cost of the tunnel had reached $468,178 on June 30.

Nine-Hour Day in Force at Boston.—The directors of the Boston (Mass.) Elevated Railway placed a new schedule of wages and working hours in effect on Jan. 1, 1913, in accordance with the terms of Chapter 533, Acts of 1912, which provides for a working day of nine hours in eleven as against ten hours in twelve. The management has announced its intention to give the same pay for a day of nine hours as it formerly gave for ten hours of service, with an allowance of overtime pay for all platform time in excess of nine hours. Beginning with Jan. 1 transportation employees will be paid by the hour and will receive when beginning service 25.6 cents as compared with 22.5 cents as formerly. The company continues the practice of minimum pay, considering eight and one-half hours as a day's work on Sundays and certain holidays, and paying stripe money, except that in the future stripe money, instead of being paid separately, will be included in the regular rate per hour. Motormen and conductors on the surface lines will receive a rate varying from the above minimum to a maximum of 28.9 cents per hour, depending upon the length of service, and on the elevated lines motormen will receive a rate per hour varying from 26.2 cents to 31.7 cents in accordance with the years of service. The company will permit the selection of runs on the basis of seniority.

Announcement of Initial Bank Deposit in Christmas Greeting.—Just before Christmas the Chicago, Ottawa & Peoria Railway, Peoria, Ill., mailed to each of its employees, together with a bank pass book showing a deposit of $2 in each man's favor, a Christmas greeting over the signature of W. B. McKinley, president; H. E. Chubbuck, vice-president executive, and F. E. Fisher, general superintendent. The hope of the company is that the initial deposit made by it will have a tendency to induce the men to acquire the habit of saving a part of their earnings. Nearly all of the banks along the line of the company where these deposits have been made have indicated their approval of the arrangement, agreeing to add 50 cents additional to each account which is left on deposit for a year. The Christmas greeting of the company to the men was as follows: "It having been the custom of this company for years to extend to its employees a small annual remembrance in recognition of their loyal efforts in furthering the interests of the property, the offering this year, herewith inclosed, is in the form of a savings account opened in your favor with the .....Bank of..... The initial deposit is $2, and we trust that you will accept it in the same spirit in which it is offered, and that when another year has rolled around you will have added to the account all you consistently could considering your working conditions. A bank account, no matter how small, is always a source of comfort and satisfaction to the owner. If you already have one this can be transferred to same, and if not—'get the habit.' Thanking you for your assistance and co-operation during the year of 1912, and asking for a like service during 1913, we extend to you and yours the compliments of the season."

Personal Mention

Mr. Russell Palmer, Mobile, Ala., has been elected president of the Choctaw Railway & Lighting Company, McAlester, Okla., to succeed Mr. William Busby.

Mr. Howard Fravel has resigned as auditor of the Scranton & Binghamton Traction Company, Scranton, Pa., on account of ill health. He will make his future home at Cranbury, N. J., where he will engage in manufacture.

Mr. Joseph D. Evans, who has been chief engineer of the Montreal (Que.) Tramways since June, 1911, severed his connection with that company on Jan. 1, 1913, to become construction manager of the Electric Bond & Share Company, New York, N. Y. No announcement has yet been made as to who will succeed him at Montreal.

Mr. Claude O. Weidman, connected with the Otsego & Herkimer Railroad and its predecessors for the past fourteen years and for the past five years superintendent of transportation, has resigned from that company to accept the position of superintendent of the Western Division of the Morris County Traction Company, with headquarters at Dover, N. J., vice Mr. George H. Ross, Jr., resigned. Mr. Weidman's resignation and appointment are both effective on Jan. 1, 1913.

Mr. C. L. Murray has resigned as general manager of the Northwestern Pennsylvania Railway, Meadville, Pa. Mr. Murray was formerly general manager of the Schuylkill Railway, Girardville, Pa. He has had an extended experience in managing electric railways. He was connected with a number of properties controlled by the Railways Company General and was assistant superintendent of construction for J. G. White & Company, Inc., New York, N. Y., for two years and was assistant for two years to Mr. D. A. Hegarty when Mr. Hegarty was general manager of the Little Rock Railway & Electric Company, Little Rock, Ark.

Mr. Charles H. Hile, who became chief of the bureau of maintenance of the Boston (Mass.) Elevated Railway on Jan. 1, 1913, has acted as assistant to the vice-president of that organization since 1905. For about eight years previous to that time he was superintendent of wires for the same company, and prior to that was for three years in charge of underground conduit construction. Mr. Hile was graduated from the Pennsylvania State College in 1892 as a mechanical engineer. He then took a post-graduate course at the University of Wisconsin, making street railway work the chief subject of his studies. He later joined the staff of the Philadelphia (Pa.) Traction Company as an engineer in connection with the electrification of the existing horse-railroad system, and after one year's service entered the employ of the West End Street Railway, Boston, continuing with that organization when it was taken over by the Boston Elevated Railway. He is a past president of the New England Street Railway Club and is well known in American Electric Railway Association circles.

Mr. Dean Treat has resigned as superintendent of District D of the Illinois Northern Utilities Company to become superintendent of the railway department of the Wisconsin Public Service Company at Green Bay, Wis. Mr. Treat entered railway work as a timekeeper with Westinghouse, Church, Kerr & Company, New York, N. Y., during the construction of the Grand Rapids, Grand Haven & Muskegon Interurban Railway, which company he served as substation operator, on the car equipment, in the power plant and as train dispatcher. He was appointed to the last-named position with the company in July, 1903, and continued in that capacity until July, 1907, when he became assistant to Mr. John St. John, constructing engineer for the Comstock-Haigh-Walker Company, which was then building the Milwaukee Northern Railway. On the completion of the Milwaukee Northern Railway, Mr. Treat was appointed chief train dispatcher and a few months later was made operating superintendent in charge of interurban operation. He resigned from the Milwaukee Northern Railway in August, 1910, to become superintendent of the Sterling, Dixon & Eastern Electric Railway. On Jan. 1, 1912, Mr. Treat was made manager of the Lee County Lighting Company in addition to superintendent of the railway. Upon the purchase of the property of the Lee County Lighting Company and the Sterling, Dixon & Eastern Electric Railway by the Illinois Northern Utilities Company, Mr. Treat was made district superintendent of District D of the Illinois Northern Utilities Company, which includes all of the company's holdings in Whiteside and part of Lee County.

OBITUARY

Hugh Grant, roadmaster of the Flint division of the Detroit (Mich.) United Railway, died at his home in Orion, Mich., on Dec. 25, from cancer of the throat which is believed to have originated from a severe bruise received while in the employ of the old Northern Railway, now a part of the Canadian Pacific Railway. Mr. Grant was born in Scotland fifty-five years ago and had been roadmaster of the Flint division ever since the line was built. Previous to becoming connected with the Detroit United Railway he helped to build the Pontiac, Orion & Northern Railway between Pontiac and Caseville.

Col. D. B. Dyer, who was president of the Augusta Railway, now part of the Augusta-Aiken Railway & Electric Corporation, Augusta, Ga., died at his home in Kansas City, Mo., on Dec. 22, 1912, after a lingering illness. Col. Dyer had been soldier, pioneer, frontiersman, journalist and capitalist. For many years he was United States Indian agent in Kansas and the Indian Territory. The street railway system in Augusta which he financed is said to have been the first in that section of the country to be operated by electricity generated by water power. Col. Dyer was born in Joliet, Ill., on March 21, 1849. At the age of fifteen years he entered the United States Army. It was through his association with the Indians and the Indian police, however, that he acquired his title of colonel. He became connected with railway work in Augusta in 1889. In 1891 he built the first modern office building in the city. In 1901 he bought the gas property at Augusta and did much to improve it. A few years ago Col. Dyer and his associates bought the Augusta *Chronicle,* and he was elected president of the company which publishes the paper. His other interests, however, demanded so much of his time that two years ago he disposed of his holdings in the paper to the present management.

Metropolitan Railway of London to Be Operated Independently

Since the consolidation of the Central London Railway with the Underground Railways much interest has been shown in regard to the future of the Metropolitan Railway. The directors of the Metropolitan Company state that after long and careful consideration of all the circumstances they have concluded that the interests of the company will be best served by the maintenance of a position of complete financial independence. The negotiations that were proceeding with the Underground company have therefore been discontinued, although an understanding exists between the Metropolitan company and the various companies controlled by the Underground company that they should co-operate in order to eliminate unnecessary competition and to afford the public, as far as possible, all the advantages that would have accrued from the working of the two systems as one. The Metropolitan company has also acquired the Great Northern & City line, a tube railway which extends from Moorgate to Finsbury Park Station, immediately under the main line of the Great Northern Railway. It is proposed to extend that line to connect with the Waterloo & City Railway, a short tube connecting Waterloo Station with the City, at the Bank, and with the existing Metropolitan line in the neighborhood of Liverpool Street. This consolidation of interests ought to increase traffic for the Metropolitan Railway, and the electrification of the East London line ought to give valuable through connections between the Metropolitan system in the northwest and all the stations of the South Eastern and the Brighton Railways in the southeast. The junction with the Great Northern & City Railway will afford a through route between Finsbury Park, in the northern portion of London, and New Cross, on the South Eastern Railway. The fact that the underground lines of the Great Northern & City Railway are so constructed that they will accommodate ordinary railway rolling stock is an advantage.

Construction News

Construction News Notes are classified under each heading alphabetically by States.

An asterisk (*) indicates a project not previously reported.

RECENT INCORPORATIONS

California Railway & Power Company, San Francisco, Cal.—Chartered in Delaware to take over the property of the United Railroads, San Francisco, the Sierra & San Francisco Power Company, the Coast Valley Gas & Electric Company and the San Francisco Electric Railways. Capital stock authorized, $60,000,000. Offices, San Francisco and New York. [E. R. J., Dec. 14, '12, page 1210.]

***Wisconsin Railway, Light & Power Company, Chicago, Ill.**—Incorporated in Illinois to take over the properties of the La Crosse Water Power Company, the La Crosse City Railways and the Winona Light & Railway Company. Capital stock, $1,200,000.

Indiana Railways & Light Company, Kokomo, Ind.—Incorporated in Indiana to take over the Kokomo, Marion & Western Traction Company, the Kokomo, Frankfort & Western Traction Company and the Kokomo Public Utility Company. The company plans to extend its lines into Wells, Huntington, Miami and Carroll Counties. Capital stock, $3,000,000. Directors: George J. Marott, John H. Holliday, A. R. Holliday, Henry Kahn, Lee Hall, T. C. Reynolds and L. J. Kirkpatrick. [E. R. J., Dec. 14, '12.]

***Southern Interurban Company, Terre Haute, Ind.**—Incorporated in Indiana to build electric railways and carry on a general construction business. Capital stock, $25,000. Directors: W. L. T. Rawlins and S. B. Boggs.

***Inter-Ocean Railway, New York, N. Y.**—Application for a charter has been made by this company in Delaware to build electric railways and operate other public utilities. Capital stock, $5,000,000. Incorporators: Ludwig de Leopold, Paul J. Huelser and Walter E. O. Schultz, all of New York City.

***Brazil, Devil's Lake & Minneapolis Electric Railway, Devil's Lake, N. D.**—Incorporated in North Dakota to build an interurban line east and west from Devil's Lake. The company has bought the Devil's Lake & Chautauqua line and plans to build to Minneapolis on the east and to Williston, N. D., on the west. The company will operate gasoline-electric cars.

***Fairmont & Veblen Railway, Veblen, S. D.**—Incorporated in South Dakota to build a 50-mile interurban railway from Fairmont, N. D., south to Veblen, S. D. Capital stock, $25,000. Incorporators: Julius Roshall, L. R. Roshall and C. A. Paulson, Minneapolis, and George H. Anderson and P. S. Hanson, Veblen, S. D.

FRANCHISES

Birmingham, Ala.—The Kelly Company has asked for a new franchise from the Council in Birmingham. The plans of the original franchise have undergone considerable change. [E. R. J., Nov. 16, '12.]

Birmingham, Ala.—The Highland Lake Land Company has received a franchise from the Council for a line from the terminus of the Owenton line of the Birmingham Railway, Light & Power Company in Birmingham southwest to Tuxedo. The line will be constructed by the Birmingham Railway, Light & Power Company. [E. R. J., Dec. 14, '12.]

Phoenix, Ariz.—The Salt River Valley Electric Railway has received an extension of the time fixed in which to begin the construction of its line in Phoenix. It will connect Phoenix, Scottsdale, Tempe, Mesa, Chandler, Alhambra, Glendale and Peoria. S. C. Lewis, president. [E. R. J., Dec. 21, '12.]

Antioch, Cal.—The Oakland, Antioch & Eastern Electric Railway has asked the Council for a franchise in Antioch.

Los Angeles, Cal.—Emmet H. Wilson, Los Angeles, has received a twenty-one-year franchise for an electric railway on Vernon Avenue from Dalton Street to the westerly city limits. [E. R. J., Dec. 14, '12.]

Richmond, Cal.—The Southern Pacific Company, San Francisco, has asked the Council for a fifty-year franchise in Richmond.

Riverside, Cal.—The Pacific Electric Railway has received a franchise from the Board of Supervisors over the northerly driveway on Magnolia Avenue from the Riverside city limits westward. The company plans to extend its Riverside Magnolia Avenue line as far as Corona in the direction of La Habra.

Stockton, Cal.—The Tidewater & Southern Railroad has received a franchise to cross several other lines in Stockton. This company has entered into an agreement with the Central California Traction Company whereby it is to secure half the use of the Central California Traction Company's Pilgrim Street and Weber Avenue lines in Stockton.

Killingly, Conn.—The Attawaugan Street Railway has asked the Council for an extension of two years in which to begin the construction of its line in Killingly. It will connect Dayville, Attawaugan, Williamsville, Ballouville and Pineville. E. L. Darble, president. [E. R. J., Aug. 19, '12.]

New Britain, Conn.—The Connecticut Company has asked the Council for a franchise to build a line through the Fifth Ward in New Britain.

Norwalk, Conn.—The Connecticut Railway & Lighting Company will ask the Council for a franchise for a number of extensions in Norwalk, South Norwalk, New Britain, Berlin and Ansonia and a line from Bridgeport to Nichols. The company asks for a revival of rights to build northward from Milford to the tracks of the New Haven & Derby Railroad.

St. Augustine, Fla.—T. R. Osmond, St. Augustine, general manager of the St. Johns Light & Power Company, has received a thirty-year franchise to build a new line in St. Augustine from Bernard along Rivera Street extension to De Haven Street. The line will connect Jacksonville and St. Augustine.

Martinsville, Ind.—The Capital Circuit Traction Company, Indianapolis, has asked the City Council for a three-year extension to its franchise in which to build its line in Martinsville. It is the intention of the company to build an electric line encircling Indianapolis and taking in all the towns within a radius of 30 miles. [E. R. J., April 13, '12.]

Cheboygan, Mich.—The Cheboygan Electric Light & Power Company has received an extension of eighteen and one-half years on its franchise from the Common Council in Cheboygan. The line will connect Cheboygan and Petoskey, via the Mullet Lake and Burt Lake districts. [E. R. J., Dec. 14, '12.]

St. Joseph, Mo.—The Kansas City, Clay County & St. Joseph Railway has received a franchise from the Council in St. Joseph.

Freeville, N. Y.—The Ithaca-Cortland Traction Company, Ithaca, has asked the Council for a franchise in Freeville. The line will connect Ithaca and Cortland, via Varna, Etna and Freeville. [E. R. J., Sept. 7, '12.]

Irondequoit, N. Y.—The Public Service Commission, Second District, has authorized the Rochester & Suburban Railway to exercise franchises granted by the town of Irondequoit for an additional track in and along the Ridge Road between Portland Avenue and Woodman Road, and upon and across Woodman Road at a point where said Woodman Road and the Ridge Road intersect in Rochester.

Columbus, Ohio.—The Columbus Railway & Light Company has received a franchise from the Council to extend its Leonard Avenue line in Columbus to Shepard.

Newberg, Ore.—The Portland, Eugene & Eastern Electric Railroad has received a six months' extension of time on its franchise in Newberg.

Fulton, Pa.—The Pittsburgh, Steubenville & Wheeling Street Railway has asked the Council for a franchise in Fulton.

Wyomissing, Pa.—The Reading Transit Company has received permission to double-track its Pennsylvania Avenue line through Wyomissing.

Nashville, Tenn.—The Nashville Railway & Light Company has received permission from the City Council to allow the Nashville-Gallatin Interurban Railway the use of its tracks in Nashville.

Beaumont, Tex.—The Jefferson County Traction Company, Beaumont, has received a franchise from the Council in Beaumont. This 20-mile line will connect Beaumont and Port Arthur. C. W. Kellogg, Jr., Dallas, represents Stone & Webster, Boston, who will build the line. [E. R. J., Aug. 24, '12.]

Houston, Tex.—The Houston Electric Company has received a franchise from the Council to lay T-rails on most of its lines in Houston and to repave and double-track several of its lines.

Salt Lake City, Utah.—The Utah Interurban Electric Company has asked the County Commissioners for a franchise from the southern boundary line of the county into Salt Lake City. The line will connect Salt Lake City, American Fork, Pleasant Grove, Provo, Springfield and Spanish Fork. W. C. Orem, Salt Lake City, president. [E. R. J., Dec. 21, '12.]

Asotin, Wash.—F. L. Sturm, South Bend, Ore., has asked the Council for a franchise in Asotin. He has secured franchises in Lewiston and Clarkston. [E. R. J., Dec. 14, '12.]

Seattle, Wash.—The Puget Sound Traction, Light & Power Company, Seattle, has received permission to reconstruct its Madison Street line from Broadway to Pike Street in Seattle.

Vancouver, Wash.—The Northwestern Electric Company has asked the Council for a fifty-year franchise to build an electric line in Vancouver.

Wenatchee, Wash.—The Wenatchee Valley Railway & Power Company has secured a six months' extension to its franchise in Wenatchee. The line will connect Wenatchee, Leavenworth and Cashmere. A. J. Linville, president. [E. R. J., Dec. 21, '12.]

TRACK AND ROADWAY

San Pedro Street Railway, Los Angeles, Cal.—The Board of Public Works has advertised for bids for the construction of the first link of this municipal railway in Los Angeles on San Pedro Street from Aliso Street to Ninth Street. This line is to be a three-rail system, so that it can be used by both the Pacific Electric Railway and the Los Angeles Railway. Bids are to be opened on Jan. 10.

***Madera, Cal.**—J. S. Harker, Coarse Gold, and the Madera Chamber of Commerce are considering plans to build an electric railway from Madera to Yosemite Valley. It is proposed to store the waste waters of the North Fork watersheds and utilize them for developing electric power for this line. Surveys will soon be made.

Geary Street Municipal Railway, San Francisco, Cal.—This company has placed in operation its 4-mile line in San Francisco from Kearney Street downtown to Golden Gate Park. The company will soon complete the line from Golden Gate Park to the ocean beach.

Wilmington & Philadelphia Traction Company, Wilmington, Del.—This company's line to Hope Farm from the Cedars, via Marshallton and Newport Turnpike, has been completed and will soon be placed in operation.

St. John's Light & Power Company, St. Augustine, Fla.—This company has placed in operation its line between St. Augustine and New Augustine.

Georgia Railway & Electric Company, Atlanta, Ga.—It is reported that this company will spend $1,250,000 in 1913 for double-tracking some of its lines. Work has been begun by the company on the extension of its old Decatur line to Stone Mountain, a distance of 16 miles.

Americus, Tifton & Atlantic Railway, Tifton, Ga.—Preliminary surveys have been begun by this company on its line from Americus through Sumter County to the Flint River. I. W. Myers, Tifton, president. [E. R. J., Nov. 23, '12.]

Valdosta (Ga.) Street Railway.—This company has decided to change its name to the Valdosta Traction Company and to build two extensions of 1½ miles to 2 miles each. The capital stock will be increased from $60,000 to $125,000.

East St. Louis, Columbia & Waterloo Railway, East St. Louis, Ill.—This company has placed in operation its line in Waterloo. Its railway extends through Columbus, Dupo, Prairie du Poe and East St. Louis.

Kankakee & Urbana Traction Company, Urbana, Ill.—This company has completed its line between Kankakee and Urbana. G. M. Bennett, Urbana, president. [E. R. J., March 16, '12.]

Union Electric Company, Dubuque, Ia.—This company has been asked to consider plans to extend its line from Dodge Street and South Locust Street south to South Dodge Street, making a loop with the Dodge Street line in the lower section of Dubuque.

***Taylorsville, Louisville & Jeffersontown Railway, Taylorsville, Ky.**—This company has been organized at Taylorsville and is completing a survey of an interurban line from Jeffersontown to Taylorsville. I. F. Jewell, Rowland Cox, B. D. Cook and J. A. Stone, Taylorsville, are members of the company, which will ask the Louisville Railway to undertake the extension.

Springfield (Mass.) Street Railway.—Plans are being made by this company for an extension across the bridge in Chicopee Falls.

Detroit (Mich.) United Railway.—Work will soon be begun by this company to double-track its line from Detroit to Mount Clemens.

Saginaw-Bay City Railway, Saginaw, Mich.—This company has been asked to consider plans to extend several of its lines in Saginaw.

Electric Short Line Railroad, Minneapolis, Minn.—Preliminary surveys are being made by this company for its line through Dawson. It has secured right-of-way for 36 miles of line out of Minneapolis. Earle D. Luce, president. [E. R. J., Oct. 19, '12.]

Twin City Rapid Transit Company, Minneapolis, Minn.—It is reported that this company has decided to build an extension in St. Paul from the Agricultural College to the Belt Line bridge to connect there with the Como-Harriet line. The plan is for the university to build the track, operate the line and pay the company for the power and use of its equipment.

St. Louis, Lakewood & Grant Park Railway, St. Louis, Mo.—This company, which is building a line southwest from St. Louis, has secured sufficient funds to extend it to Fenton. Rails have been laid ½ mile west of its former terminus at Lakewood and nearly all the right-of-way to the Merimec River has been contracted for.

***Twin Bridges, Mont.**—The Waters Tunnel Company plans to build an electric line from a point on the Northern Pacific Railway midway between Sheridan and Lauri to its mines located in Tobacco Root range. It is stated that the company has secured financial backing for the project.

***Seneca Falls, N. Y.**—A company has been formed to build a power plant in Seneca Falls to provide power for a proposed electric railway to connect Lodi, Interlaken and Covert, a distance of about 30 miles. Plans are being made to secure a private right-of-way for the line, which will eventually be extended north to Clyde and Lyons. No names have yet been given of those interested in the project.

Hendersonville (N. C.) Traction Company.—The line and franchise of this company have been purchased by C. A. Carlson, Red Bank, N. J., and the new owner states that if he can secure the co-operation of the townships between Hendersonville and Asheville he will extend the line to the latter point and also encircle the lakes and other points near Hendersonville.

Newbern-Ghent Street Railway, Newbern, N. C.—This company has completed and will soon place in operation its 5-mile electric line between Newbern and Ghent. E. C. Armstrong, Newbern, is interested. [E. R. J., Aug. 10, '12.]

Fargo & Moorhead Street Railway, Fargo, N. D.—Plans are being considered by this company to extend its lines 40 miles into northwestern Minnesota.

Toledo Railways & Light Company, Toledo, Ohio.—This company has been asked to consider plans to build a crosstown line to connect with the Cherry Street line on the north and the Broadway line on the south in Toledo and also to extend its Wayne Street line to the city limits.

Consolidated Electric Railways, Tulsa, Okla.—This company advises that it will begin construction about Jan. 10, 1913, on its 70-mile line to connect Tulsa, Sapulpa, Broken

Arrow, Coweta, Porter and Muskogee. Capital stock authorized, $10,000, to be issued at once. Officers: A. A. Small, president, and A. B. Davis, secretary and treasurer, all of Tulsa. [E. R. J., Nov. 23, '12.]

Ottawa & Morrisburg Electric Railway, Ottawa, Ont.—This company has received permission from the Ottawa Electric Railway to use certain divisions of its tracks for a period of fifteen years, so that the Morrisburg cars can enter Ottawa. The Ottawa-Morrisburg Electric Railway will pay the city at the rate of $450 per mile on unpaved streets and $1,000 per mile on paved streets, and also 10 per cent of revenue on business within the city limits. [E. R. J., Dec. 7, '12.]

Central Pennsylvania Traction Company, Harrisburg, Pa.—This company announces that the only extension contemplated for 1913 is that from Fort Hunter to Dauphin, and this is contingent upon obtaining the necessary right-of-way grant of the old canal bed from the Pennsylvania Railroad.

Hagerstown, Greencastle & Mercersburg Railway, Middleburg, Pa.—This company has voted to increase its capital stock from $100,000 to $600,000 and has arranged to mortgage its property to secure an issue of $600,000 of bonds to provide funds to complete the construction of the railway during 1913. The following officers have been elected: John E. Ensign, Cleveland, Ohio, president; C. M. Hoffman, Greencastle, vice-president and secretary; Alexander Hamill, New York, treasurer; James W. Rice, Greencastle, and S. A. Roth, Hagerstown, directors. [E. R. J., Dec. 21, '12.]

Pittsburgh, Steubenville & Wheeling Street Railway, Pittsburgh, Pa.—This company is reported to have completed surveys for a route from Pittsburgh through Burgettstown, Avella, Independence, Bethany, West Liberty, Greggsville, Fulton and Wheeling. Construction will be begun in the spring. W. H. Hildebrand, Pittsburgh, president. [E. R. J., Dec. 1, '12.]

Pottstown & Reading Street Railway, Pottstown, Pa.—Plans are being made by this company to build three extensions in Phoenixville.

***Pottsville, Pa.**—Plans are being developed to build an electric line in Schuylkill County to connect the Mahanoy Valley through Frackville with the Eastern Pennsylvania Railways lines south of the Broad Mountain at St. Clair. This proposed 9-mile line will unite more than 50 miles of electric railway operated by the Eastern Pennsylvania Railways with 30 miles of track owned by the Schuylkill Traction Company north of the mountain, running through the Mahanoy Valley, Shenandoah, Mahanoy City, Girardville and Ashland.

Charleston-Isle of Palms Traction Company, Charleston, S. C.—This company has asked the United States Senate to authorize the construction of a bridge over the Cooper River at Charleston and also another bridge across Shem Creek to Mount Pleasant, S. C. James Sottle, president. [E. R. J., Nov. 30, '12.]

Jackson Railway & Light Company, Jackson, Tenn.—Plans are being considered by this company to extend its line up Porter Street to Winter's Grove.

Jefferson County Traction Company, Beaumont, Tex.—This company has increased its capital stock from $600,000 to $1,000,000. The line will connect Beaumont and Port Arthur. [E. R. J., Aug. 24, '12.]

Southern Traction Company, Dallas, Tex.—This company's reports from the field engineers show 59 miles of roadbed completed, ready for ballast, with 39 miles of roadbed more than 80 per cent completed. The above is in addition to the roadbed graded between Ferris and Waxahachie. The contractors have completed driving piling for thirty-one trestles. They have completed sixteen concrete culverts and they have completed masonry abutments for the following structures: Ten-Mile Creek, on the Corsicana line, and at White Rock, Richland, Mill and Chambers Creeks on the Waco line. During the last month the contract has been awarded for the superstructure for the Waxahachie viaduct. About 98,000 ties have been received and over 20,000 ties are now in transit. About 170 tons of rail have been received. Specifications have been prepared and bids are now being received for track laying and for overhead material.

***Houston, Tex.**—Announcement has been made by the Alderson-Stille-Force Company, Houston, that construction will be begun at once on the electric line to extend from the end of the Liberty Avenue line in Houston, where it will turn into Schwartz Street and run on Odin Avenue and east to the Houston Harbor Addition. Arrangements have been made with the Houston Electric Company to operate this line when completed. A. D. Alderson is interested.

SHOPS AND BUILDINGS

British Columbia Electric Railway, Vancouver, B. C.—This company plans to build a new five-story building on the corner of Main Street and Prior Street in Vancouver for its trainmen. The company also plans to build a station for the Lulu Island lines at the south end of Granville Street bridge. The cost is to be about $10,000.

San Francisco, Vallejo & Napa Valley Railroad, Napa, Cal.—This company has awarded the contract to build its new depot at Calistoga to E. W. Doughty, Napa.

Crescent City Railway, Riverside, Cal.—Work has been begun by this company on the construction of three new passenger stations. The structures will be of concrete construction and will be located at points between Riverside and Crestmore, namely, at Fairmont Park, at Strong Street and at the junction with what is known as the Jurupa ditch.

Washington-Virginia Railway, Washington, D. C.—This company plans to build a new freight station in Alexandria.

Terre Haute, Indianapolis & Eastern Traction Company, Indianapolis, Ind.—Plans are being considered by this company to build a new station on School Street in Clearmont on the Ben-Hur route.

Grand Rapids (Mich.) Railway.—This company has opened its new carhouse in Grand Rapids. The structure is 187 ft. x 200 ft.

Bay State Street Railway, Boston, Mass.—An addition will be built by this company to its office building at the corner of North Montello Street and Elliot Street, Boston. The structure will be one story in height and 56 ft. x 40 ft., with concrete foundations.

Mesaba Electric Railway, Duluth, Minn.—This company has awarded the contract to Augustus Anderson for the erection of its new depot in Chisholm. The structure is of frame construction and will provide for passengers, freight and express.

Kansas City, Clay County & St. Joseph Railway, Kansas City, Mo.—Work will be begun at once by this company on its new express station and ticket office in St. Joseph.

POWER HOUSES AND SUBSTATIONS

Washington-Virginia Railway, Washington, D. C.—This company plans to build a new substation in Alexandria.

Terre Haute, Indianapolis & Eastern Traction Company, Indianapolis, Ind.—The Vandalia Coal Company, the Coal Bluff Mining Company and the Western Indiana Mining Company are reported to have contracted with the Terre Haute, Indianapolis & Eastern Traction Company for current to be supplied by transmission lines for which the company has secured a franchise along most of the public highways in Vigo County.

Kentucky Utilities Company, Winchester, Ky.—This company plans to build soon a new power plant in Somerset. The cost is estimated to be about $75,000. A new filter and pumping station is now being constructed by the company.

East Liverpool Traction & Light Company, East Liverpool, Ohio.—Final arrangements have been made by this company and the Ohio Valley Scenic Route Railway to build a power plant 1 mile north of Smith's Ferry on Beaver Creek at the Island Run mines. The cost is estimated to be $2,000,000.

Eastern Pennsylvania Railway, Pottsville, Pa.—This company plans to build a new substation at Frackville, and work has been started on a high-tension line from Pottsville to Frackville to feed the substation.

Southern Traction Company, Dallas, Tex.—This company has awarded a contract to the General Electric Company for all necessary electrical equipment for all substations of its lines. The contract awarded totals between $250,000 and $300,000.

Manufactures and Supplies

ROLLING STOCK

General Electric Company, Schenectady, N. Y., has ordered from the Wason Manufacturing Company two CE-68-B-10 cars.

Lynchburg Traction & Light Company, Lynchburg, Va., has ordered from The J. G. Brill Company one 40-ft. construction car body with Brill 50-E-1 trucks.

Oakland & Antioch Railway, Oakland, Cal., has ordered from the Wason Manufacturing Company four 56-ft. combination passenger and baggage cars, and one 58-ft. parlor car.

TRADE NOTES

Standard Roller Bearing Company, Philadelphia, Pa., has disposed of its iron foundry to the P. Kennedy Foundry Company of Baltimore, Md.

H. M. Byllesby & Company, Chicago, Ill., have appointed W. R. Thompson, formerly assistant chief engineer, as manager of engineering and construction, effective Jan. 1, 1913.

Pyrene Manufacturing Company, New York, manufacturer of fire extinguishers, has appointed the Gorham Engineering Company, San Francisco, Cal., its representative on the Pacific Coast.

Dearborn Chemical Company, Chicago, Ill., announces that Warren P. Sayers has joined the sales department of the company. Mr. Sayers will assist Daniel Delaney, manager of the Cincinnati office, in the surrounding territory.

Pressed Steel Pole Company, Pittsburgh, Pa., has disposed of its plant at Mount Pleasant, Pa., to Pittsburgh men. Officers have been elected as follows: W. H. Schoen, president; Harry D. McCutcheon, vice-president; John D. Wilson, treasurer.

Ottawa Car Company, Limited, Ottawa, Ont., is adding a new machine shop to its present plant at Ottawa. This building is 66 ft. x 135 ft., four stories and basement, and is of solid brick and fireproof construction. The company is now running to its full capacity.

Jones & Laughlin Company, Pittsburgh, Pa., has appointed F. B. Hufnagel general superintendent of the Aliquippa department to succeed W. H. Lewis, who has resigned to engage in business for himself. Mr. Hufnagel has been general superintendent of the South Side works of the company.

A. H. Framhein, who has been connected for about five years with the Chicago sales department of the Railway Steel-Spring Company, has resigned, effective Jan. 1, to introduce in that city Latheroil cleaning products, manufactured by the Heinrich Fischer Company of Cincinnati, Ohio. Latheroil is a liquid soap, new in that field, which has given unusual satisfaction elsewhere, and is especially efficient for cleaning railway and street cars. Mr. Framhein will be located at Room 440, Marquette Building, Chicago, Ill.

The J. G. Brill Company, Philadelphia, Pa., has received the following orders for trucks: Lehigh Valley Transit Company, Allentown, Pa., six Brill 27-MCB trucks and eight Brill MCB-3X trucks; Georgia Railway & Power Company, Atlanta, Ga., fifty Brill 39-E trucks; General Electric Company, Schenectady, N. Y., two Brill 50-E-2 trucks; Parkersburg, Marietta & Interurban Railway, Parkersburg, W. Va., four Brill 50-E-2 trucks; Washington-Virginia Railway, Washington, D. C., four Brill 23-D trail trucks; Cumberland County Power & Light Company, Portland, Maine, two Brill 27-GE trucks.

Tool Steel Gear & Pinion Company, Cincinnati, Ohio, has announced a special guarantee for trial orders covering a mileage six times as great as from ordinary gearing, four times as great as from oil-treated and twice as great as from case-hardened material. The company suggests the equipment of a car with two grades of material so that comparative records can be simply and accurately kept and agrees to refund in cash to cover any deficiency in connection with the guarantee, the records which it is said to have established indicating that the results with the company's products will greatly exceed the guarantee.

Drake Railway Automotrice Company, Chicago, Ill., calls attention to an error which appeared in the issue of this paper for Dec. 21, 1912, quoting the consumption of gasoline on that company's motor car during the run from St. Louis to Chicago. The run was made on an average of 2½ to 3 car miles per gallon of gasoline instead of on 2½ to 3 gal. of gasoline per car mile. The rest of the trip, from Chicago to Kansas City over the Chicago Great Western and from Kansas City to Muskogee over the Missouri, Kansas & Texas Railroad, was equally successful, there being absolutely no trouble of any kind. The run from Chicago to Kansas City was made on Sunday, Dec. 15.

H. W. Johns-Manville Company, New York, N. Y., has completed its new plant at Manville, N. J., which is to begin operations this year. The plant consists of nine buildings, which, together with their products, are classified as follows: A—textile and packing; B—rubber plant, electrical specialties and printing department; C—pipe coverings; D—paper mill; E—magnesia; F—roofing; G—mastic and waterproofing; H—roofing coatings, power plant and pump house. Each building has an average length of 1000 ft., and is a separate factory in itself. The total combined floor area of all the buildings is about 1,000,000 sq. ft. About 3000 men will be employed at this new plant, making a total of about 7000 who are now employed by the company.

ADVERTISING LITERATURE

Dossert & Company, New York, N. Y., have reprinted in pamphlet form an article from the *Signal Engineer* entitled "The Use of Dossert Connectors in Signal Work."

Standard Underground Cable Company, Pittsburgh, Pa., has issued a folder in which attention is called to the various brands of Standard rubber insulated wire manufactured by the company.

C. F. Pease Company, Chicago, Ill., has printed a thirty-two-page booklet entitled "Everything for Blue Printing," which briefly describes and illustrates its line of automatic blue-printing machinery.

H. M. Byllesby & Company, Chicago, Ill., has issued a map of the United States showing the cities which are headquarters for the principal operating properties under its management. A complete list of all towns in which service is supplied is given under the heading of "Operating Companies," which are listed alphabetically.

American Vanadium Company, Pittsburgh, Pa., has issued *American Vanadium Facts* for December, 1912, which contains service records, results of drop tests and specifications of heat-treated chrome-vanadium steel tires. It also contains a list of steam railroads which will use vanadium steel in the construction of their new locomotives.

Chicago Pneumatic Tool Company, Chicago, Ill., has issued several new bulletins which are descriptive of its products: Bulletin E-22 describes and illustrates heavy duty electric drills for alternating current; Bulletin E-26 describes Universal electric drills operating on direct or alternating current; Bulletin E-27 describes heavy duty electric drills; Bulletin No. 34 G describes air receivers, aftercoolers, air line drain traps, reheaters and economizers.

The London County Council has decided not to proceed with the scheme of tramways along Edgware Road from the Marble Arch to Cricklewood. It was shown that with street widenings the scheme would cost more than £425,000, and would require assistance from the rates to maintain. It was also shown that as all four local authorities over whose roads the tramways would pass opposed the scheme, there was not much chance that it would pass Parliament, especially as there was ample motor omnibus accommodation along the route. In the meantime the returns from the London County Council trams are steadily decreasing, the receipts for the week ending Dec. 4, for instance, being £2,700 lower than those for the corresponding week last year, so severe is the motor bus competition. The Council is considering the question of enlarging the capacity of its generating station at Greenwich by withdrawing four 3500-kw reciprocating engines and installing in their place four steam turbines of 8000 kw each, with an adequate increase in the boilers and condensing plant.