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Of this issue of the Street Railway Journal, 10,000 copies are printed. Total circulation for 1906 to date, 336,700 copies, an average of 8212 copies per week.

Our Convention Souvenir Issue

Our convention issue this year differs from any which we have published in previous years in that it takes up analytically the practice of the electric railways in a special section of the country, rather than in one city. The national association, in arranging the program for the Columbus convention, has made the subject of interurban railway practice—particularly in the States of Ohio, Indiana and Southern Michigan—the key note of the meeting. For this reason, our convention issue this year is devoted to interurban railway practice—not in the way of publishing descriptions of interurban lines, but in summarizing the methods of twenty-six different roads in construction and operation. In this analysis it has been impossible, of course, to cover the entire range of interurban practice within the covers of a single issue of this paper. A selection of subjects had, therefore, to be made, and this was done by the inclusion of the following topics: Way and way matters, rolling stock design and equipment, generation and transmission of power, lines and cables, car houses, schedules, speeds, limited service, fares, freight and express, interurban railway economics, and particulars of the apparatus used in the territory under examination.

It was manifestly impossible to include all of the interurban roads in this district in the investigation, and a selection of roads, as well as of subjects, had to be made. In choosing the twenty-six roads treated in the tables and the text, the publishers realize that they have omitted many important roads whose methods are well worthy of attention and study. But our space did not permit us to take all, and in making a choice, certain systems in Ohio, Indiana and Southern Michigan were selected which were considered to be typical and representative of all departments. All of the roads covered in the convention issue were personally visited by the editors of this paper for the purpose of securing the data upon which the tables and conclusions are based.

It will be noticed that the analyses in the text are largely based on groups of roads. For instance, the practices in Ohio, Indiana and Michigan have been treated more or less independently, and in the tables a further division of the roads into groups has been made in the case of the Ohio properties. This treatment has been followed for several reasons. Primarily, the territory to be covered is so extensive that a grouping of roads was thought advisable, both for the convenience of the compiler and the reader, and that by States seemed the most logical and natural. This treatment also serves to bring out the fact that the development of interurban work has been from certain centers out into the adjoining territory, and is almost comparable to the enlarging circles on a body of water. We find, therefore, considerable similarity in practices among the roads around each center, the differences growing more pronounced as we get away from the centers of the circles. And, as the methods of different States are taken up, the differences become more pronounced. These variations are particularly noticeable in such matters as handling freight and express, schedules, limited service, rates of fare, despatching, etc. For this investigation, seventeen roads were selected in Ohio, seven in Indiana and two in Michigan.

Of course, Columbus, as the convention city, will be of special interest, and one chapter has been devoted to a description of the city system, and another to an account of the

operating practices of one of the latest interurban roads extending out of that city. The city system of Columbus is a prosperous one, and will be found well worthy of study by the convention delegates next week. It possesses additional interest from the fact that it is historical ground from an electric railway standpoint. It was on the Columbus system, in 1887, that the late Professor Sidney H. Short, then a comparatively recent graduate of the Ohio University, constructed about two miles of electric road on his original series system. This was one of the first Short trolley lines, and, while the series system did not prove as desirable as the parallel method of power distribution for electric railways, this early road excited great interest at the time, and can logically be regarded as the progenitor of the vast system of interurban lines which center in Columbus.

In the chapter of the convention issue, following the description of the Scioto Valley system, a brief outline is published of the district and the roads treated. The maps presented of various sections showing the interurban railway systems have been prepared largely from original sources, and are believed to be as nearly accurate as is possible, in view of the many changes that are constantly taking place in interurban development in this territory. In the fifty-two plates of half-tone engravings will be found many interesting views illustrating different phases of interurban work. In arranging these illustrations, the endeavor has been made to group the views, in so far as possible, so as to set forth clearly and comparatively the latest ideas with regard to each subject treated.

It may not be out of place to say a word about the part that the manufacturers and supply houses have played in supplying the needs of the interurban systems of the Central West. The unprecedented development of these systems has brought to the front many problems calling for special materials and apparatus in every phase of the work, and the manufacturers and supply houses, as well as the railway companies, may well feel proud of the results that have been secured in the Central West. A note on this point should also perhaps here be inserted by way of explanation. In handling the subject matter of our convention issue, no attempt has been made to mention every item of equipment used on every road, and, in fact, scant reference has been made to trade names. This omission is due not to any lack of appreciation, but primarily to the lack of space, and also to the impossibility of doing justice to all in the space available.

We believe our convention issue this year is something more than the current issue of a weekly publication, and, whatever its shortcomings, will be used as a comprehensive treatise and book of reference for some time to come. So far as we know, it is the most complete practical handbook on interurban practice that has yet been attempted.

Rolling Stock Design and Equipment

While the latest practice in rolling stock design among the interurban roads of Ohio, Indiana and Southern Michigan presents many points of similarity, there are differences equally as wide which do not seem to be entirely warranted by the existing conditions. In fact, a study of the rolling stock of the territory under consideration indicates that, as in other branches of the work, standards in design are by no means entirely settled. The interurban electric railway is so modern that it is not surprising that the best type of car for limited and local service should not have been absolutely determined, and the article on this subject in our convention issue indicates changes in sentiment and opinion even during the five or ten years in which interurban railroads have been in use as to the proper length of cars, the most desirable kinds of seats, and in many other points. In certain directions, on the other hand, there has been an easily recognized unanimity of opinion, and here there is an indisputable approach toward steam railroad practice.

One of the first points of difference between the interurban and the city car which strikes attention, outside of dimensions and external appearance, is the height of the floor above the rail. The necessity for a high-speed truck has forced up the car floor fractions of an inch at a time, and has deepened the step until the floor has reached the height standard in steam practice. This has resulted in increasing the height of the first step above the rail to more than double that of the horse car, which was considered to be as high as it could possibly be made with comfort to passengers and without actually cutting down the patronage. This subject has recently attracted the attention of the New York State Association, by which an attempt has been made to standardize certain heights for each of the different steps. A comparison of this standard with those used in the roads in the Central West will show that the New York standard is not used on any of the roads under consideration, where a low riser, or no riser at all, is used between the platform and the car floor, and where several companies have adopted the three-step idea. It should be remembered, however, that the Ohio and Indiana cars are designed for longer runs and higher speeds than the majority of those in New York State, so that a difference of conditions prevails, and that there is not the same necessity for keeping down the car-body or avoiding the use of three steps to the platform. Another point which strikes the observer in this connection is that the heights of the car floors above the rail range from 26½ ins. to 54 ins., with possibly a majority in the neighborhood of, though not exactly at, 40 ins., and that the highest cars are not always the longest, showing that the evolution is not yet complete.

A more serious variation in dimensions, so far as practical service is concerned, is in the width over all, and to this the interurban railway managers of the Central West have devoted a great deal of consideration. As shown in the table, these widths vary from 8 ft. 1 in. to 9 ft., and the narrower dimensions have been adopted, as explained in the text, because of the narrow devil strips between the city tracks in the terminal cities in which the cars run. This variation has formed such an obstacle to the operation of through cars that upon occasions, when wide foreign cars have occasionally been run over roads with narrow devil strips, the expedient has been adopted of mounting the car-body a few inches off center to allow the cars to pass. It seems difficult to introduce any reform in this direction, because such a step would necessitate a change in the location of the city tracks, which would not only be very expensive, but would require permission from the city authorities, and this exemplifies one instance only of the difficulties under which the interurban managers in Ohio and Indiana have labored.

The tables show, however, certain directions in which more uniform practice might be adopted to advantage, and this is perhaps especially manifest in the choice of wheel

diameters. Speaking broadly, there is no reason why a uniform wheel diameter should not be used upon all of these cars; yet we find this dimension ranging from 33 ins. to 39 ins. The larger diameter wheel was evidently adopted to secure more easy running, but it is doubtful whether the advantages to be gained by it are not lost in other ways. Thus, one road uses a 33-in. cast-iron wheel with a weight of 450 lbs., while a steel-tired, 39-in. wheel used elsewhere weighs 900 lbs., adding 100 per cent to the cost and weight to be accelerated. Apparently, too, no final decision has been reached as to the metal best suited to the wheel for interurban work, for cast iron is still decidedly holding its own, though the steel-tired and the solid-steel wheel are very much in evidence. It is evident also that the light flange in use on ordinary street traffic has been found to be inadequate to the interurban work with heavy cars, for we find a variation of depth of flange from ¾ in. to 1 5-16 ins., a thickness of flange from ⅞ in. to 1¼ ins., and a width of tread from 2½ ins. to 4½ ins. These dimensions are, of course, set largely by the type of rail used in the city tracks, but the Central Electric Railway Association has recently recommended as standard a tread of 3 ins. and a flange ⅞ in. deep and 1 3-16 ins. thick. At present the table shows no apparent consistency so far as actual strength of wheel flange is concerned, for we find a ¾-in. flange under a 32-ton car in one instance and one of 1¼ ins. under a 35-ton car.

A final point of interest in connection with the wheels is the estimated life that is given. This ranges from 40,000 miles for a cast-iron wheel to 350,000 for one with a steel tire. Even taking the life of a cast wheel at 50,000 miles, the difference is seven to one in favor of the steel, a point that cannot fail to attract attention wherever renewals and the service of a car is of value. The probability is that if another review of this subject upon these same roads were to be made five years from now, we would find a much greater uniformity of practice, and that the striking variations to which attention has been called will have passed away as the result of intervening experiences.

Coming now to the electrical equipment, we find that four-motor equipments are practically universal, and that there is a decided tendency toward the adoption of multiple-unit controllers. This method of control has been selected evidently not for its primary object of ability to couple the cars into trains, but almost entirely owing to the fact that the circuits are broken by contactors under the car, and the danger from controller burn-outs is eliminated. So far, the use of the multiple-unit controller has not had the effect of running the cars in trains, principally on account of the difficulty encountered in city service, but whether this will prove a bar in the future is another question.

Line Construction for Railway Transmissions

Our analysis of railway transmission practice throws considerable light on the subject of high-tension power transmission in general. The common practice of carrying the high-tension feeders on the same poles which support the trolley wire removes the pole line itself from special consideration, its spacing and dimensions being determined rather with reference to the trolley structure and heavy low-tension feeders than according to the requirements of the high-tension circuits. The occasional deviations from this rule of common use of the pole lines are mainly due to the necessity of dodging local difficulties in the way of crowded streets and large shade trees. The high-tension lines themselves present considerable variations in general arrangement. Perhaps the greatest variation from special transmission practice lies in the spacing of the lines. The ordinary railway transmission by reason of the common use of poles for several purposes allows less space between wires than is generally found desirable. All high-tension line work has suffered from too close adherence to the old precedents set by telegraph and telephone lines with their multiplicity of light wires. Of course, it is possible to operate with 10,000 volts to 15,000 volts even on the old 14-in. spacing, but as experience has been gained in high-voltage work, the spacing has gradually increased, for various reasons. So far as mere striking distance is concerned, moderate spacing is sufficient, even taking surging into consideration. It is found, however that a widely spaced line is much safer from accidents than one laid out on less liberal principles. Twigs blown from trees would many times shut down a line with 18-in. spacing, where one with 36-inch spacing would escape, and the same principle holds for various other casual sources of short circuiting.

It is well, therefore, that railway practice is changing, as we have pointed out, in the direction of wider spacing. With respect to the location of the wires upon the poles, most roads adhere to the usual triangular construction. Some recent lines have put all the wires in the same horizontal plane, however, acting on the principle that the advantages of the other arrangements are largely theoretical. So far as railway transmission goes, the electrical difference between the two arrangements is probably negligible, and in so far the change in construction is quite justified. There is, however, a considerable practical gain in the triangular arrangement with the vertex up in immunity from short circuits. A flat rank of wires at the top of the pole affords altogether too good a chance for the lodgment of things that will produce short circuits. The same things would often fall through the triangular arrangement without holding an arc long enough to do any material damage. At the voltages commonly used in railway transmissions the triangular spacing with not less than 3 ft. between wires would seem to be generally advisable, and 4 ft. is safer than 3 ft. As regards the pole material, it is worth noting that pins on these systems are exclusively wooden; in the later lines, extra long, and treated with insulating material. This is in general good practice, although very many lines are now built with steel pins, and for that matter, with steel poles. The railway transmission systems here considered use, however, exceptionally small conductors and rather moderate voltages. The mechanical and electrical strains are therefore rather small, and there is no need of insulators too massive to be readily supported on wooden pins, and no very great strain due to the weight of the lines themselves. There has been, therefore, no object in going to steel construction, since the wooden one is amply strong and possesses some advantages in the way of extra insulation. The voltage of most of the railway transmission lines here considered is hardly high enough to bring up the difficulty sometimes encountered by the disintegration of wooden pins, even were they not treated. Apparently there has been some little difficulty with burning, however, which

may be expected, since few of the lines are specialized for high voltage beyond the insulators and pins.

The modest voltage of most railway transmissions is quite sufficient excuse for the lack of noticeable novelties in the transmission work. Most of the voltages are under 20,000, and so easily taken care of with very little specialization. One hardly need expect any extraordinary difficulties below 40,000 volts or so, and hence unusual precautions are unnecessary. Even in the matter of lightning protection nothing out of the ordinary is recorded so far as the high-tension lines are concerned. Altogether, power transmission at 20,000 volts or so has become so much of a commonplace that it is rare to find novelties. The coming of a. c. railway motors will probably bring high-voltage work into greater prominence, and will doubtless produce plenty of engineering novelties. For the present, transmission lines vary most in the soundness of the mechanical design.

Standard Voltages for Transmission

Examination of the tables summarizing the practice of the railway transmission plants shows a most extraordinary variation in the voltages employed. In considering this variation, we have indicated some of the causes which operated to produce it. We are not over enthusiastic on the question of standardization, for experience has often shown that people get together and settle upon standards just about the time that improvements come along and sweep the standards away. Yet it is certainly desirable that there should be some accepted course of practice in such a matter as transmission voltages to facilitate the interchange of current when necessary, if for no better reason. It certainly seems needless to find eleven different transmission voltages on a total of twenty-two transmission systems. The upward progress of voltage on strictly railway transmissions has been rather slow. As appears elsewhere in the discussion of this subject, most railways carry their transmission lines on the same poles that also bear the trolley-wire supports and the low-tension feeders. Such pole lines of necessity follow the railway in its course through towns, and meet considerable obstructions in the way of trees, to say nothing of frequent objection to the stringing of high-tension wires. As a matter of fact, such objections are generally ill founded, since transmission lines are, from the necessity of the case, constructed with especial care and with large factors of safety, and very rarely have caused any trouble by breaking and falling upon other wires. When other wires break and fall, it matters little whether they hit 5000 volts or 25,000 volts, and experience shows that the most generally dangerous circuits are those for arc lights, which run all over a city at small elevation and through an indefinite number of trees. But a feeling of caution has certainly kept railway transmission down to exceptionally low figures as compared with others installed for work over similar distances.

Transmissions for interurban railways are, upon the whole, rather above the average in length, and naturally call for high voltage. The extreme difficulty of getting a clear, straight-away line while utilizing the trolley poles is the limiting factor. This, more than anything else, accounts for the common use of pressures as low as from 10,000 volts to 13,500 volts. The variation through this range really marks the successive improvements in high-voltage generators, and the upper limit is at the present time safe and conservative. There is little object in using raising transformers at this pressure, and for the work of roads of moderate length it is sufficient and particularly easy to operate. When a great system is to be considered, requiring for economy the transmission of power 20 miles to 40 miles from the generating stations, and in emergencies even more, these moderate means are insufficient. General transmission practice indicates that after leaving voltages which can be generated directly it is good policy to go well up in the scale, certainly into the region between 30,000 volts and 40,000 volts, unless there are specific reasons to the contrary. There are fifty or more American plants working at above 30,000 volts, and their experience has been altogether favorable. Fully half this number are working at above 40,000 volts with excellent results. Whenever an independent pole line can be used so as to give a line that can readily be kept clear there is no good reason why railway transmission should not be pushed as high as any other. Nobody has now or at any time paid much attention to the A. I. E. E. so-called standards of 10,000, 15,000 and 20,000 at the receiving end of the line, the actual tendency being, perhaps on account of the 10:1 transformer ratio in general use for lighting to run to somewhat higher figures. The receiving end of the line is certainly the proper basis for comparison, since the pressure at the sending end varies with the intended drop, which may be 5 to 15 per cent according to the economic conditions. The really important matter is unification of the sub-station voltage so that from whatever source current may be derived that pressure may be uniform within operative conditions. Something, of course, depends on the nature of the rotaries and the varying trolley voltages desired, but on a 30:1 ratio with primaries conveniently arranged to go from multiple to series and give 60:1 most of the conditions could be fairly well met.

The two obvious shifts with transformers are from parallel to series primaries and from Δ to Y connection. Starting from the ordinary requirement of 375 to 400 volts at the sub-station secondaries one reaches in the parallel stage the common range of voltage for high-tension generators, i. e, 12,500 to 13,500 volts. The next or series stage comes after the high-tension generators are out of the game, and gives a transmission at say 25,000 - 27,000 volts initial. The voltage resulting from Y connection of primaries in parallel, i. e., about 22,000 volts, is not enough lower to help out much in insulation, but hits a not uncommon transmission voltage in plants for general service. The final stage brings the transmission voltage to a little above 40,000, but still well below the debatable ground where special difficulties are likely to be encountered. In other words, it seems worth while in leaving the pressure which can be readily generated in a dynamo to go at once to double voltage. Intermediate pressures have very little to recommend them from any point of view; 40,000 - 45,000 volts is a figure high enough for any ordinary interurban network. It would usually require a separate pole line, which indeed is desirable as a matter of convenience upon any circuit above 10,000 to 15,000 volts. More and more large railway systems will come to using separate transmission circuits to save distance, as stations are likely to serve networks composed of lines running in various directions and not necessarily radiating from the sta-

tion. All small variations of voltage can be taken upon transformer taps, so that a comparatively simple general equipment can give all the necessary range of voltage. The tendency of working pressures in power transmission is steadily upwards. Sixty thousand is the highest figure yet reached in regular working, and the cases are few in which more can be advantageously used, for at this figure the mechanical strength of the line already indicates a conductor capable of transmitting a great amount of energy, far more than is likely to be needed in a single set of high-tension feeders from a railway generating station. Railways are likely to come in touch with such voltage only in taking power from distant hydraulic plants, and such cases are, and are likely to be for a long time to come, exceptional enough to call for special treatment. It must not be forgotten that the coming of alternating-current motors for railway service is not unlikely to overset the accepted canons of voltage and overhead construction, so that one should just at this time go rather cautiously in advising any extensive changes tending toward standardization. A few years may make very considerable differences in the average requirements of power transmission.

Other Matters Treated

Space will not be taken here to comment upon all of the subjects covered in our Souvenir issue. As a matter of fact, the different chapters themselves are virtually comprehensive reviews of the various matters treated, and in the preparation of the text endeavor has been made to point out what may be considered standard practices, or at least to indicate the trends of practice toward uniformity. Where this could not be done, we have contented ourselves with pointing out the differences in practice.

As far as track construction is concerned, we will not be contradicted in saying that most of the interurban roads are now well built. Possibly this statement would have been open to question a few years ago. The interurban roads as a class, in the territory under discussion, have just emerged from a vital metamorphosis. Like the early city railway properties and like the steam roads before them, the modern electric interurban has had to pass through a stage when the ideas of the promoter were apt to outweigh the recommendations of the engineers. Speaking frankly, all too many of the early interurban roads were built to sell, and operation was more or less of a secondary matter. This, of course, was not true by any means of all the early roads, but there are unfortunately a number of properties that are just recovering from the effects of misguided economy in their early stages. Happily, broader gage views are now in the ascendency, and the development in interurban work has in the last year or two been little short of marvelous.

As pointed out in the chapter on way and way matters, the 70 or 72-lb. T-rail A. S. C. E. section is now looked upon with the greatest favor by interurban operators and builders and may almost be considered the standard. The old-fashioned fish-plate seems still to hold its own, although various forms of mechanical joints are coming into favor as giving promise of reducing the cost of track maintenance.

Comment should also be made upon the decided tendency toward locating interurban roads upon their own private right of way at some distance from the highways. Although the development to the present-day high-speed interurban from the early interurban road, which was nothing more than a spur or branch from some city system, has been so rapid as to obliterate to some extent the relation between the two, a bit of retrospection will show the various steps in the evolution. The suburban road was usually built in the highway. As the demand for longer distance runs and higher speeds increased, the tracks were laid along one side of the highway, but it seemed difficult for the interurban builders to get away from the fact that the electric road must depend upon the pick-up business along the highway. In the latest development of the strictly interurban road it is now recognized that a more profitable traffic, formerly believed to belong entirely to the steam roads, awaits electric interurban roads, which while keeping reasonably close to the homes of the country people can at the same time give a fast and frequent service between the larger centers of population. For this reason the latest roads have left the highway and the builders now endeavor to locate on purchased right of way directly across country, near enough to the highways to be within easy reach, but far enough away to give high speeds and more direct routes.

Another conspicuous feature about the interurbans of the Central West is the greater attention that is being paid to safety precautions. There is still much to be done in this direction, but there is a widespread recognition of the need for making safety the first consideration and there is an honest endeavor to introduce rules and devices that will give a higher factor of safety in the operation of the roads. For instance, although most of the roads are still single track, there is a growing tendency toward double-tracking the heavier portions of the line and to formulate precautionary rules for the guidance of crews at turnouts. A number of roads, including the Schoepf properties, have recently put in force the rule that cars must head in and back out of switches. This operation takes more time than when cars run straight through, but it is believed it ensures greater safety. Derailers and other precautions at railroad and highway crossings are now the rule instead of the exception. In the same direction a great deal of thought is being given to methods of despatching, and while some of the methods still appear somewhat crude, great progress has been made in this direction.

A conspicuous feature about schedules is the fact that but few of the companies have regarded anything but hourly schedules as practical. We are somewhat at a loss to explain this practice of sticking to hourly service seemingly regardless of length of line or volume of traffic, except perhaps that the turnouts were originally located for hour intervals and it would be inconvenient to change. Perhaps, too, most of the operators have felt that it was a big advantage to have cars leave terminals on the even hour or on the even half hour, as a matter of public convenience. This practice is quite contrary to the prevailing idea in the East, where under normal conditions it is generally assumed a road should not be built unless it will warrant at least a half-hour service at the start with a fifteen-minute schedule as an early possibility.

In this matter of schedules one is also impressed with the higher rates of speed now common in interurban operation. Schedule speeds of 30 miles an hour calling for running speeds of 60 and 65 miles an hour are general, especially where limited cars are in service.

THE WHEELING TRACTION SYSTEM

From early in its history Wheeling has occupied an important position in the field of commerce and manufacture. It is the metropolis of West Virginia, which is now the fuel State of the Union, being first in the production of natural gas and petroleum and second in the output of coal. Located, as Wheeling is, upon the Ohio River, with cheap and abundant fuel, excellent shipping facilities by railroad and water, and with large markets to both East and West, it is not surprising that the city should enjoy remarkable prosperity. The city proper has a population of about 45,000 inhabitants, but this does not fairly represent its size, inasmuch as it is surrounded by numerous thriving suburbs which are practically a part of the city but are not included within its corporate limits. Some of these towns are on the West Virginia side and some on the Ohio side of the river, and added to the population of Wheeling give 85,000 people in the immediate vicinity and 125,000 within a radius of 25 miles, which will take in Martins Ferry, Bridgeport, Bellaire, Barton, St. Clairsville and Steubenville in Ohio and Wheeling, Benwood, Moundsville and Wellsburg in West Virginia.

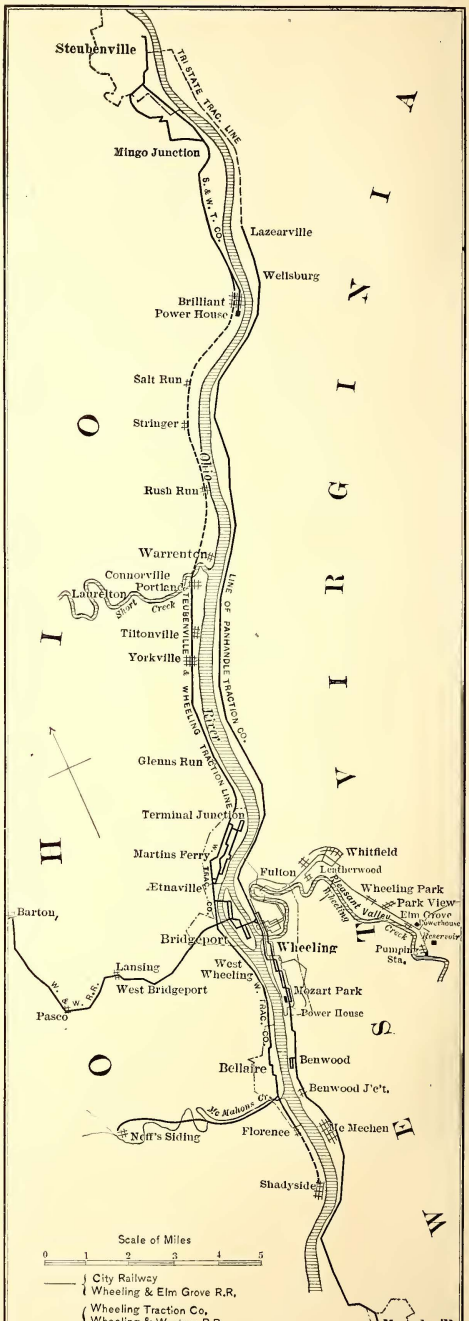
The products for which the city is best known are those connected with iron, steel and tin industries, and the manufacture of glass, pottery and tobacco, the latter particularly in the form of stogies.

The Ohio River in this part of its course flows past bluffs of considerable height, which confine the manufacturing and residential districts to a comparatively narrow strip along the bank, so that the district around Wheeling is an excellent one from a street railway standpoint. In this respect it is similar to the territory just north of it, served by the properties centering about East Liverpool and Steubenville, which were described in a recent issue of this paper.

The city of Wheeling is divided by the main channel of the Ohio River, on the east side of which the business and manufacturing districts, together with the larger part of the population, are located. The west side of the main channel of the river is what is known as Wheeling Island. This island is about 1.6 miles long by ½ mile wide, and is almost exclusively residence property. The back river forms the boundary line between West Virginia and Ohio, and directly opposite Wheeling Island on the Ohio side Bridgeport is located. Four public bridges span the river in and from Wheeling, and are owned by two different companies, that is, each company owns a bridge over each channel. One of the bridges from Wheeling to Wheeling Island, owned by the Wheeling & Belmont Bridge Company, is a suspension bridge 1400 ft. in length, and is maintained for ordinary vehicle and pedestrian traffic alone. Over the other three bridges the Wheeling Traction Company operates its cars under leases. The city of Wheeling is served by two electric railway systems, as shown on the accompanying map, but this article will describe only the system of the Wheeling Traction Company and its allied corporations, shown by the heavy line on the map.

THE WHEELING TRACTION COMPANY

The Wheeling Traction Company has been in existence since 1900, when it was incorporated under the steam railroad laws of the State of West Virginia for the purpose of effecting a consolidation of several independent street railways then operating in the city of Wheeling and surrounding country. The corporate names of these several companies were: Wheeling Railway Company; Citizens' Railway Company; Moundsville, Benwood & Wheeling Railway Company, and Bellaire, Bridgeport & Martins Ferry Railway Company. In 1901 the Wheeling Traction Company purchased all of the capital stock of The Steubenville, Mingo & Ohio Valley Trac-

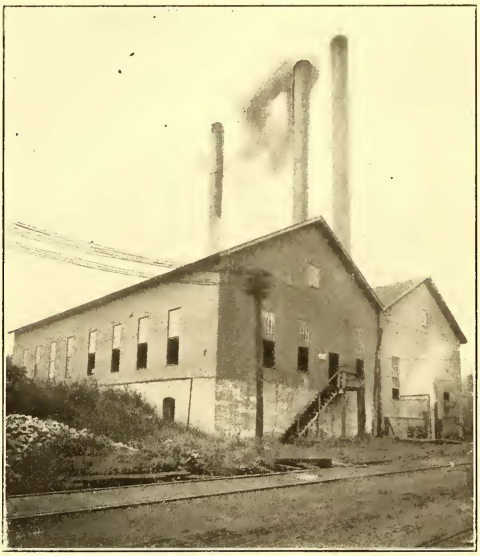


tion Company, an interurban line extending from Steubenville, Ohio, to Brilliant, Ohio, which will form an important link in the through line from Wheeling to Steubenville now under construction along the west side of the Ohio River from a connection with the Wheeling Traction Company in Martins Ferry to Brilliant. This new line is being built by the Steubenville & Wheeling Traction Company, an Ohio corporation, of which all capital stock to be issued will belong to the Wheeling Traction Company.

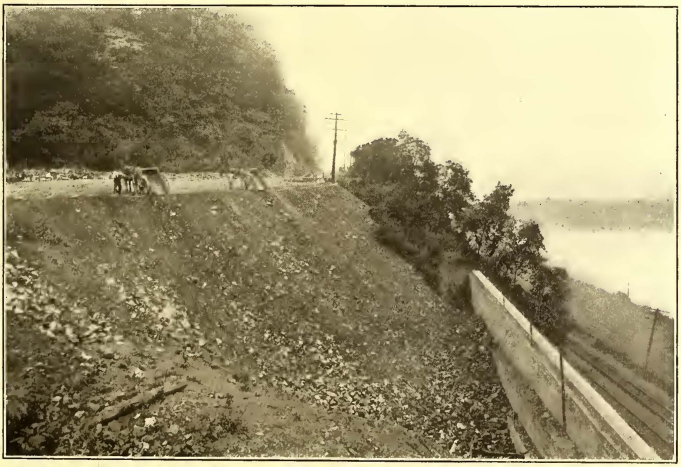
Another line, now partially completed, virtually a part of the Wheeling Traction Company's system and operated under lease, but controlled by interests friendly to Wheeling Traction Company, extends from a connection with the Wheeling Traction Company at Wheeling Creek, Ohio, to Barton, Ohio, and contemplates in the near future an extension to St. Clairsville, the county seat of Belmont County, Ohio. The above system when completed will embrace a total of 85 miles, single track, and will operate in two States and four counties, connecting the four county seats. It will serve thirteen municipalitics, with an aggregate estimated population of 125,000 and so distributed as to render unusual conditions for street railway operations. The companies' lines are operated with the following car service:

Line.	Distance Round Trip S. T. Miles.	Running Time Round Trip, Minutes.	Maximum Regular Headway.	No. Regular Cars Operated.
Benwood & North Wheeling	10.31	77	6	13
Benwood & F. Gds	10.15	77	20	4
Moundsville	26	160	20	8
Wheeling Island	.85	8	4	2
Wheeling & Martins Ferry via North Bridge	8 67	64	16	4
Martins Ferry & Wheeling via Bridgeport	8.77	64	13	6
Wheeling & Bellaire	14.25	100	10	10
Wheeling & Barton	20.32	120	30	4
Steubenville & Brilliant	19.	120	20	6
Wheeling & Wellsburg	35.	120	30	4

The fares are charged on the zone system with 5 cents as the minimum fare. The company does not give transfers in the city of Wheeling. The fare to the towns within three or four miles of Wheeling, like Benwood, Bellaire, Bridgeport, Martins Ferry, Wheeling Creek, is 5 cents. On the Wheeling and Barton line three fares are collected, aggregating 20 cents from Wheeling, Bridgeport, Martins Ferry or Bellaire to Barton. On the Moundsville line three fares are collected, aggregating 15 cents from Wheeling, Benwood or McMechen to Moundsville. During Chautauqua and camp meeting at Moundsville special round-trip tickets are sold from Wheeling to camp grounds, 25 cents; from Benwood to camp grounds, 20 cents. Transfers are issued in Bridgeport on 5-cent fares from Martins Ferry to Wheeling Creek or Bellaire, or vice versa. This is the only transfer point on the system.



MAIN POWER STATION



FILL ON CUT-OFF TO STEUBENVILLE, WITH CONCRETE RETAINING WALL AT FOOT

WHEELING POWER STATION

The main power house of the company is located on the Ohio River bank at Forty-Second Street, in South Wheeling. It is a well-constructed brick building, 100 ft. x 115 ft., with heavy brick walls, stone trimmings, wood and steel truss with slate roof. A brick wall divides the building into boiler room and engine room respectively, a small office finished in natural wood being provided for the superintendent's office in the northwest corner of the engine room. An octagonal brick stack 80 ft. high and three 70-ft metal stacks give draft to six boilers of the Stirling water tube type, arranged as follows: Two 360-hp boilers operating as a battery, and one 342-hp and three 550-hp boilers operating singly, all connected with the same steam main, initial steam pressures being

kept at 140 lbs. High-pressure gate valves are provided between the boilers and the steam main. In addition to the above the boiler-room equipment consists of one 2000-hp Webster vacuum feed water heater, two Snow duplex feed water pumps 14 ins. x 8½ ins. x 14 ins., one Worthington high-pressure pump, one 8-ft. x 8-ft. steel water tank.

Natural gas is used as fuel with especially designed burners. The fire boxes and grate bars are kept in readiness so that operation by hand firing with coal may be resorted to in an emergency. A supply of coal is also kept in storage at all times convenient to the boiler room. It has not been necessary to resort to the use of coal during the past three years. The water supply is obtained from either one of two driven wells, one located in the river channel and the other just outside of the boiler room. In addition to these wells belonging to the company the station is connected with the city mains, which could be used in case of necessity. Water from the wells is lifted by compressed air into the receiving tank located in the boiler room. All boilers and other machinery in the boiler room were installed in 1903, except one unit of 550 hp which was installed in 1898.

About 5 ft. in the rear of the boilers an 18-in. division wall separates the boiler room from the engine room. The latter is 50 ft. x 115 ft., well lighted with double windows below and single windows immediately above in the end walls. The engine room is equipped with a six-ton Yale & Towne hand-power traveling crane. The main steam line is 85 ft. in length, 20 ins. in diameter and elevated 14 ft. above the floor. It has one division valve at the center. The fittings are of cast steel double extra heavy, and were furnished by the Pittsburg Valve, Foundry & Construction Company. The pipe is also double extra heavy with all peoned flanges.

WORK IN PREPARING NEW ROADWAY ON CUT-OFF

TANGENT ON NEW CUT-OFF

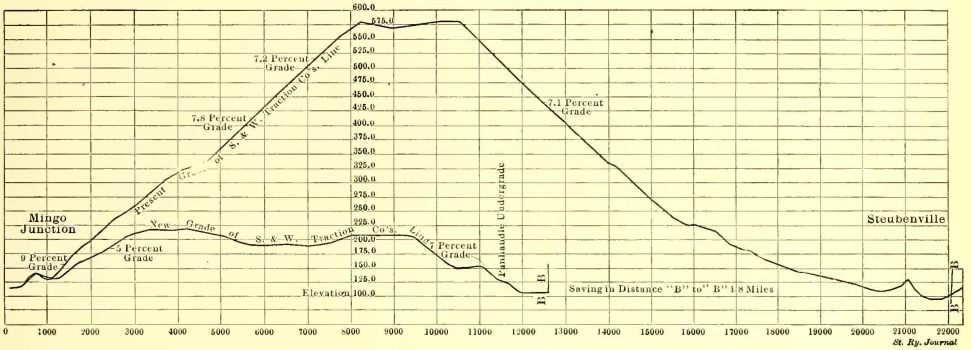
Following are the sizes of all units in the station which are operated in multiple as the load conditions require: One Cooper 34-in. x 60-in. engine, 75 r. p. m., direct connected to an 800-kw Westinghouse compound-wound generator installed in 1898; two Cooper 32-in. x 48-in. engines, 90 r. p. m., direct connected to two 600-kw Bullock compound-wound generators installed in 1903; one 20-in. x 27-in. Russell automatic four-valve engine direct connected to a 175-kw, 600-volt d. c. Westinghouse generator. All engines except the Russell are equipped with butterfly valves to increase the safety of operation. A gravity oil system of lubrication is employed on all engines. In addition to the engines and generators mentioned the engine room contains two steam-driven air compressors of the following makes, which furnish air for pumping and general cleaning purposes about the dynamos and switchboard: One Smith-Vaile air compressor, 12 ins. x 12 ins. x 14 ins.; one Ingersoll-Sergeant air compressor, 10 ins. x. 10 ins. x 10 ins.

The switchboard is of slate and has thirteen panels occupying the south wall of the engine room, and is well lighted front and rear by neighboring windows. There are four generator panels, one totalizing panel and three feeder panels. The switchboard equipment consists of I. T. E. circuit breakers, Weston individual and station ammeters and voltmeters, and projecting Cutler-Hammer rheostats. The totalizing panel has a 5000-amp capacity Thomson recording wattmeter continuously in service. Pedestal equalizing switches are set upon the floor in front of the switchboard. All the interior cables and wiring are arranged under the flooring and along the side walls.

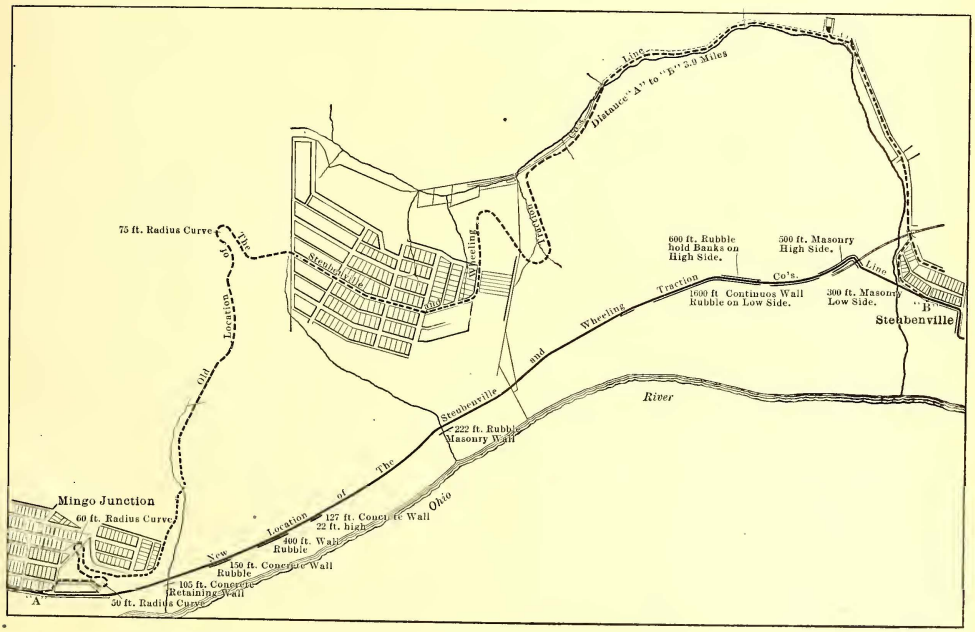
The total rated capacity of the station is 2175 kw, with a maximum demand of approximately 1800 kw and an average load of approximately 1000 kw.

BRILLIANT POWER STATION

The Brilliant power station is located near the south end of the town of Brilliant, from which is furnished current for the Steubenville and Brilliant line, the Pan Handle Traction Company (operating between Wellsburg and Wheeling), the local line in Wellsburg (independent), and all coal mines between Wellsburg and Wheeling. This station will also furnish current for the S. & W. T. Company line when built, and the station belongs to this latter company. The building is 100 ft. x 100 ft., of corrugated iron construction, supported by wooden trusses on heavy concrete foundation, designed to carry brick or stone walls. The space occupied by the boiler-room equipment is 48 ft. x 100 ft., and the equipment consists of three 500-hp. Stirling water tube boilers with independent steel stacks 60 ft. high; two Stillwell-Bierce 12-in. x 7-in. x 15-in. duplex boiler feed pumps; one Worthington high-pressure pump used for pumping water to the coal mine near the station; one 2000-hp Stillwell feed-water heater; one 8-ft. x 8-ft. steel receiving water tank. The steam header, 14 ins. in diameter and 70 ft. long, is located immediately back of the boilers, and all engine leads are taken from this header. The station has two driven wells, one in the river channel and one just outside the boiler room, from which feed water is obtained. The water is lifted direct from the wells to the steel tank in the boiler room by compressed air. Coal is used for fuel, being delivered from a mine back of the station in dump cars.

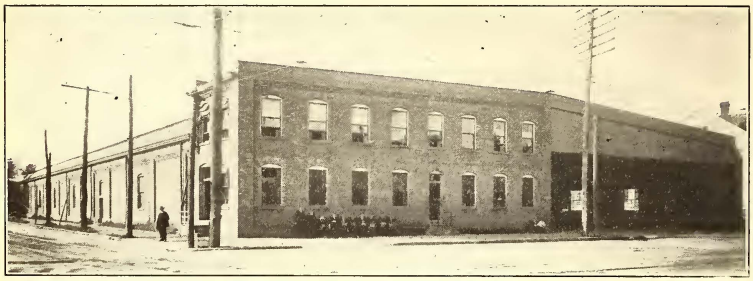


PRIFILES OF OLD AND NEW LINES FROM MINGO TO STEUBENVILLE



MAP SHOWING LOCATION OF OLD AND NEW LINES BETWEEN MINGO AND STEUBENVILLE

The engine room, 52 ft. x 100 ft., contains the following equipment: Two 30-in. x 42-in. Cooper Corliss engines direct connected to two 500-kw, 600-volt d. c. Westinghouse generators; one 20-in. x 27-in. Russell automatic four-valve engine, direct connected to 175-kw, 600-volt d. c. Westinghouse generator; two Smith-Vaile Class A air compressors, 12 ins. x 12 ins. x 12 ins., utilized for lifting water from the river for boiler feed.

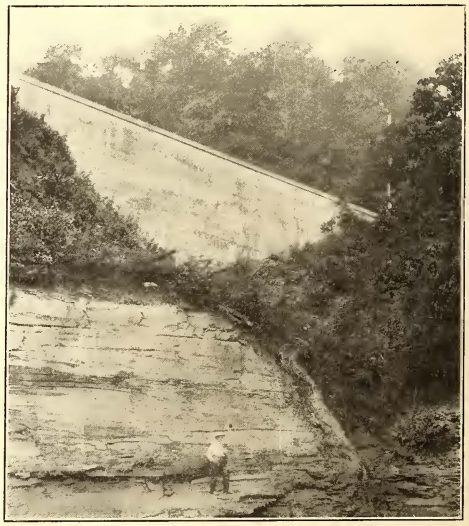


CAR HOUSE AND REPAIR SHOP IN WHEELING

The switchboard consists of six marble panels, three generator, one totalizing and two feeder panels, with Westinghouse breakers and switches, Weston ammeters, voltmeters and recording wattmeters. Equalizers are set on the floor immediately in front of the switchboard. The total rated capacity of the station is 1175 kw, with a maximum demand of 500 kw and an average load of 300 kw.

TRACK CONSTRUCTION

Like every other consolidated company, the Wheeling Traction Company has a large number of types of track construction varying from a 9-in. grooved rail to a 60-lb. T-rail. The latest standard city construction is 9-in. girder rail. During the past three years all tracks in Wheeling and on a greater part of the system in and between other towns, have been rebuilt. The standard construction of the tracks in city streets provide for the paving of the bottom of the trench to its full width (1 ft. in excess of the length of the ties) with brick. From 8 ins. to 15 ins. of crushed limestone and gravel, mixed, is placed under the ties, and the same mixture is filled in between the ties and up to 3 ins. above the ties. This ballast is then all thoroughly rammed and upon it the sand and paving brick are laid. Wood filler is used on either side of the rail to pave against and to prevent the brick from turning end up under heavy wagon loads. The latest type of interurban construction will be described quite fully in a section of this article descriptive of some recent work in eliminating grades and curves.



CONCRETE RETAINING WALLS ON CUT-OFF TO STEUBENVILLE

OVERHEAD CONSTRUCTION

The overhead work is both bracket and span construction. In Wheeling proper as well as in all other municipalities span construction is used almost entirely, while on country roads bracket construction is used. The greater part of the overhead work, including poles, brackets and trolley wire, line breakers, etc., has been renewed during the past two years.

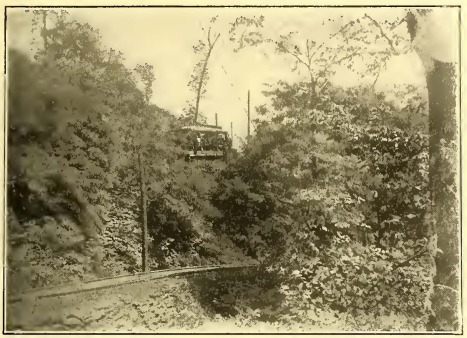
The feeders vary in size from No. 0000 to 500,000 circ. mils, and the company has considerable submarine cable under the Ohio River. There is also a negative submarine cable of 750,000 circ. mils that serves as a return for all lines operating in Ohio. This cable is carried directly into the power house and terminates on a common generator bus-bar at the switchboard.

ELIMINATING GRADES AND CURVES

Owing to its location in the narrow Ohio Valley, the company's lines have a great many curves and grades. Originally the tracks were laid over the hills, but since the consolidation the reduction of these grades has been a matter for a great deal of thought. As a result the company recently inaugurated a policy which, though expensive in initial investment, will effect important economies in operation. This policy consists of reconstructing and in some cases relaying a number of the important lines with the double object in view of giving better schedules and at the same time reducing the number of cars necessary to maintain the service on these

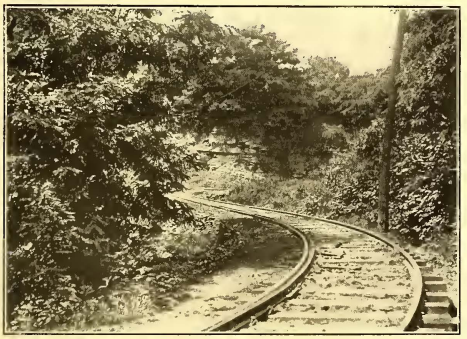
particular lines. In the opinion of the management of the Wheeling Traction Company, this whole question of the amount of money that can be spent prudently and judiciously in reducing grades and curves on any line simmers down to a definite operating proposition and is a matter of capitalizing the saving in operating expenses.

As a noteworthy concrete example of how this policy can be worked out, the following notes are given relative to the



rebuilding of the company's line running from Mingo Junction to Steubenville. In 1902 the company took over a single-track line which had been built in 1901 between Mingo and Steubenville, and which took a very circuitous and hilly route over the mountain. Although the distance by air line between the two cities is only about 2 miles, this route measured 4.2 miles from terminal to terminal, and with the exception of a short stretch on top of the mountain, practically the entire line was built on an average grade of 7 per cent, the heaviest grade being 10 per cent. The plan and profile of this old route are shown on the drawings on page 547. Some of the extraordinary curves and grades encountered on this line are evident from these diagrams.

On this hill line the company has maintained a 20-minute schedule. In order to enable it to perfect a through route now nearing completion between Wheeling and Steubenville, of which the stretch between Mingo Junction and Steuben-

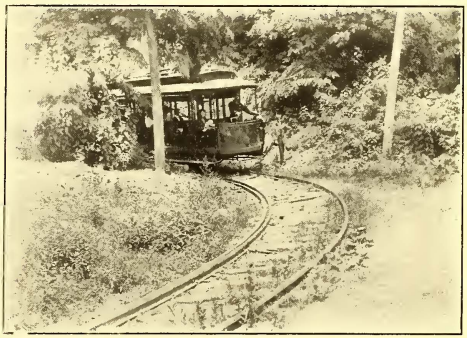


VIEWS ON OLD LINE TO STEUBENVILLE, SHOWING STEEP GRADES AND SHARP CURVES

ville is an important link, and to secure a material reduction in running time, the company has built a cut-off between Mingo Junction and Steubenville and will use this shorter line as a substitute for the hill-line for all travel between these points. The plan and profile of this cut-off are shown on page 547 in comparison with the hill-line, and the saving brought about is strikingly revealed. The distance of the cut-off is 2.1 miles, as against 3.9 miles, which is the length of the hill-line between the same two points, making a saving in distance of 1.8 miles. The reduction in grades and curves is also made clear by these comparisons.

In the building of the line between Mingo and Steubenville, up to Sept. 1 unclassified excavation, that is to say, rock, coal and earth, amounted to 82,233 cu. yds.; masonry, including rubble and concrete, 9105 cu. yds. The estimated amount of excavation yet to be made amounts to 15,000 cu. yds., and the estimated amount of masonry yet to be put in, 600 cu. yds. This covers a distance of 8400 ft. out of the total length of the new extension of 2.27 miles, the remaining distance having been graded and the necessary walls built by the County Commissioners and the traction company some two years ago at a cost of $48,000. The estimated cost of the new connection between Steubenville and Mingo, 8400 ft., is calculated at $150,000. This sum, of course, only covers the building of the track and overhead equipment, and does not include any expense for power station equipment, feeder wire, or rolling stock.

The saving in running time between Mingo Junction and Steubenville made possible by the cut-off amounts to twenty minutes for each trip, as the time can be reduced from forty minutes via the hill-line to twenty minutes by the cut-off.



This enables the company to give exactly the same schedule service with two cars less. For the purpose of working out the policy with respect to grade elimination the management has assumed that it costs $5,000 a year to operate a car over this particular line, or in other words if the same service can be given with two less cars the actual saving to the company will be $10,000 in operating expenses. This is the direct saving. As indirect factors in determining the amount of money that could be profitably spent in building this cut-off, the management also took into consideration the savings that could be made by operating longer and heavier cars on the cut-off, the saving in car mileage and power, and also the reduced accident hazard.

From the preliminary surveys it was found that the building of the cut-off would be rather a difficult engineering problem, as the Ohio Valley is very narrow at this point and the strip of bottom land between the river and the bluffs is already occupied by a steam road and by manufacturing plants, making it absolutely necessary if a new line was to be built to cut a ledge along the face of the hill for practically the entire distance. However, it was estimated that the work could be done for approximately $150,000, which was equivalent to capitalizing the direct and indirect saving of 10 per cent. This was considered a good investment, especially as

the traffic will undoubtedly increase due to faster and better service. Accordingly the work was authorized and is now nearing completion.

The task involved the cutting of a ledge or shelf 35 ft. wide in the hillside for the entire distance of 2 miles, in order to provide width for a single-track line as well as for the highway at the side of the track. This made it necessary to cut into the face of the hill to a height above the roadbed ranging from a few feet to 80 ft. in order to give banks with an average slope of from 1½ to 1. This required some rock cutting, but the greater part of the distance was shale formation which required extra precautions to prevent the side of the hill from sliding on to the roadway in the future, and also to guard against possible cave-ins on the lower side of the roadbed. At all places where the formation gave indication of future trouble, retaining walls were built, and and is 55 ft. high with a width of 22 ft. at the bottom and 5 ft. at the top and is 150 ft. long. This wall was built of concrete reinforced with old 7-in. girder rail, cost $16,000, and retains a fill of 20,000 cubic yards. These particular situations under other conditions would perhaps have called for bridges, but in view of the fact that there was no place to dispose of the material excavated from the hillside without long hauls, it was deemed expedient to use this material for filling at these locations.

The same principle of capitalizing estimated economies in operation and making the necessary investments to bring about these economies is being applied on several other lines in the system. For instance, on the Moundsville line running between Wheeling and Moundsville the company is entirely reconstructing the track with heavier rails in order to permit of a faster schedule. It is also relocating the switches and

APPROACH TO STEUBENVILLE ON CUT-OFF

the difficult nature of the work will be understood from the fact that in the stretch of two miles it was necessary to build in all 3000 ft. of retaining walls, equivalent to one-fourth of the total distance. These walls range from 100 ft. long to the longest, which is 1600 ft. long, and from 9 ft. to 55 ft. high. The heaviest walls were formed of mass concrete and the lighter walls were built of masonry.

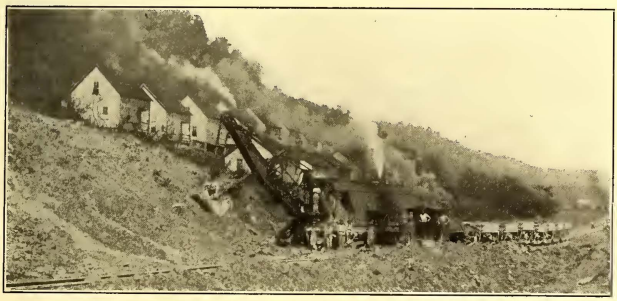
The available location for the line also made necessary a number of heavy fills, one in particular at a point known as "Callagan's Crossing" probably being one of the heaviest fills ever undertaken in the construction of an electric railway. The gulch at this point required 30,000 cu. yds. of material to bring the road to grade. To hold this filled material in place a masonry retaining wall 250 ft. long and 35 ft. high was built along the lower side. Another wall deserving of mention on account of its dimensions and unusual cost in electric railway construction is located at Whiteman's Leap

building a long stretch of double track midway between the terminals in order to equalize the schedule and eliminate some of the delays caused by cars waiting on turnouts. This work is being carried out at an approximate cost of $50,000, but when finished it will save the operation of one car without changing the headway, by reducing the running time from one hour and twenty minutes to one hour and ten minutes. It will thus be seen that the investment is being made to save ten minutes on each trip, but it so happens that the saving of this ten minutes will, as stated, permit of the same schedule with one less car. It is also estimated that the traffic on the line will be considerably increased by reason of the faster running time. At another location plans have been made for building a bridge over the back channel of the Ohio River at an expenditure of $125,000 in order to reduce the running time and save the operation of one car on the line from Wheeling to Bellaire. The building of this bridge will give

a cut-off which will shorten the length of the line from 46 minutes to 36 minutes.

In building new interurban or suburban lines, the company has adopted the policy of acquiring a private right of way, and using the highways only where the topography of the country renders it absolutely necessary. It has the only entrance possible into Martins Ferry from the north and into Steubenville from the south, mostly over private right of way which gives it the undisputed possession of the territory between Wheeling and Steubenville on the Ohio side of the river. In the construction of this line, right of way sufficient in width for double track has been secured, although but a single-track line is being built at this time. The construction is of the heaviest and most permanent throughout. All bridges are of steel, with concrete foundations, no wood being used whatever for bridges or trestles. Culverts are all of concrete, and in the eight-mile section of the line nearing completion there will be but one highway crossing at grade, all others being overhead.

The standard construction consists of 85-lb. A. S. C. E. rail, laid on from 12 ins. to 18 ins. of crushed stone; white oak ties 6 ins. x 8 ins. x 8 ft., spaced 2 ft. centers; 10-in.



STEAM SHOVELS AT WORK ON CUT-OFF

No. 0000 rail bonds, with compression terminals, placed under 36-in. six-bolt angle-plates, with a No. 0000 cross-bond placed every 500 ft.

The overhead work is of ordinary type of bracket construction, with No. 000 round trolley and 500,000-circ.-mil, weather-proof cable on highways and bare copper cable on private rights of way.

CAR HOUSES AND SHOPS

The company has one storage and three operating car houses located in Wheeling, McMechon, W. Va., and Steubenville, Ohio, with the following capacities. The largest car house of the system, located at the corner of Zane and Huron Streets, on Wheeling Island, with the general repair shops in the rear, to be described later. The building occupies a space of 120 ft. x 300 ft., is built entirely of brick and steel trusses, with tar and gravel roof; it is divided by a fireproof wall into bays, the north bay being used for operating purposes only, with six tracks its full length, of which four tracks have pits 190 ft. long. This bay has a capacity of 60 cars averaging 30 ft. in length, and accommodates all cars of the different divisions of the system operating in Wheeling and suburbs, with the exception of the Moundsville division. Bay No. 2 is used for storage purposes and has six tracks with no pits. At the north end of this bay, occupying the corner of Zane and Huron Streets, is the general office building of the company, which consists of a two-story brick building with conductors' room, despatcher's office, superintendent and engineering offices on the first floor, and the manager and accountants' offices on the second floor. The car house building is well lighted from windows and skylights, and is equipped with several fire hydrants and hose, special fire alarm box and fire extinguishers to comply with the Board of Fire Underwriters' Rules.

The car shops are located in the rear of the Island car house. They are of brick with slate roof, being 60 ft. x 120 ft., and are divided by fireproof walls into five departments, known as the blacksmith and machine shop, armature room, woodwork and paint shop. These different departments are fully equipped with necessary tools and motor-driven machinery for keeping up all classes of repairs incident to the operation of the system, and include the following: One New Haven Manufacturing Company 16-in. swing screw and thread-cutting lathe, taking 10-ft. work and operating at four speeds; one New Haven Manufacturing Company 10-in. swing, screw and thread cutting lathe, which takes 5-ft. work; one drill press from Dietz, Lange & Co.; one emery wheel from Diamond Machine Company; one shaper from Gould & Eberhardt, of Newark, N. J.; one hydraulic wheel press, 80 tons on 6-in. ram, from the J. T. Schaffer Manufacturing Company, Rochester, N. Y.; one band saw, one drill press and mortising machine and one grindstone, all from the American Wood Working Machinery Company, New York City; one variety saw table from Frank McClement Company, Rochester, N. Y.

The McMechen car house is located in the town of McMechen, W. Va., about equal distances from Wheeling and Moundsville, from which cars of the Moundsville & Wheeling Division are operated. The building, 80 ft. x 80 ft., is of corrugated iron with steel trusses supported by brick piers. Only one-half of this building is now used, but will be entirely equipped for operation in the near future. All present tracks, eight in number, accommodating 24 cars, one-half of which have pits their full length, and all small repairs on cars operating on the Moundsville division are made at this car-house.

The storage car house is located at Forty-Second Street in the city of Wheeling, built of tile, wood trusses with corrugated iron roof, 50 ft. x 100 ft., is used for storage purposes only, and has a capacity of twenty-four cars.

The Steubenville car house is located in Steubenville, Ohio, from which are operated the cars of the Steubenville & Brilliant line, built of brick with steel trusses and slate roof, 70 ft. x 100 ft., and divided with fireproof wall into two bays, one being used for operating and the other for shops. The office building, a one-story brick building, is located on the same lot as the car house, and provides facilities for the superintendent and despatcher. The capacity of the car house is eleven cars. All the shops are equipped for making small repairs.

CARS

The company owns 133 car bodies which have been supplied by the St. Louis Car Company, John Stephenson Company, Jewett Car Company, J. G. Brill Company, American Car & Foundry Company and others. Its standard type of double-truck car is Brill's grooveless semi-convertible, 40 ft. 9 ins. over all and equipped with a Germer hot-water heater. The single-truck cars are mounted on 21-E Brill, Columbia and Peckham trucks, and the double-truck cars on the 27-G Brill truck with 4-ft. 6-in. wheel base. The motor equipments represent types 52, 67, 800 and 1000 of the General Electric Company; No. 38, No. 49, No. 12 and No. 101B

of the Westinghouse Company, and No. 13 of the Lorain Steel Company.

PARKS

The company owns one amusement park located on Altamont Hill, between Steubenville and Mingo. The site is one of the most attractive for an amusement resort obtainable along the Ohio River.

MANAGEMENT

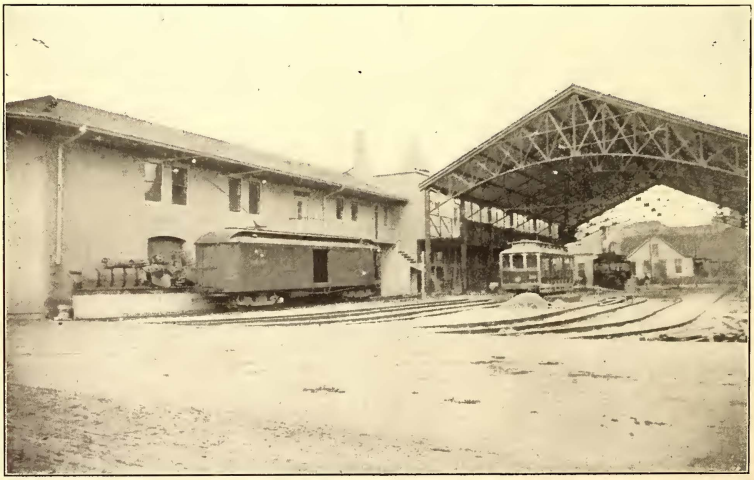
The management of the property for the past three years has been in the hands of Geo. O. Nagle, formerly general manager of the Savannah Electric Company and previously superintendent of the Chicago City Railway Company. The road is owned largely in Wheeling, Philadelphia and Cleveland. The other officers are: T. H. Conderman, president; B. W. Peterson and J. J. Halloway, vice-presidents; W. A. Shirley, secretary and treasurer; C. M. Marsh, superintendent of transportation; W. A. Underwood, superintendent of tracks; J. P. Alexander, purchasing agent; A. G. Mersing, chief engineer of power station; J. H. Crawford, master mechanic; C. W. Fawcett, chief civil engineer of construction, and Louis Lipphardt, right of way and claim agent.

THE NEW TERMINAL BUILDING OF THE INDIANA UNION TRACTION COMPANY AT MUNCIE, INDIANA

The Indiana Union Traction Company is erecting very complete passenger and freight stations in several of the cities at junction points on its lines. Thus, a freight and passenger station was completed at Tipton during the present year; a terminal station has just been completed at Muncie, and another station will be constructed at Logansport within a short time.

The terminal station at Muncie is probably the finest of its kind to be found, with the exception of those in the larger cities, such as Indianapolis, Toledo and Milwaukee. It serves as a passenger and freight terminal for the four interurban lines radiating from Muncie, three of which are operated by the Indiana Union Traction Company. The fourth line, which runs northeast out of Muncie to Portland, Ind., is operated by the Muncie & Portland Traction Company. The station also contains the division offices of the Indiana Union Traction Company and a portion of it is rented for stores and offices. Its location, which is on East Mulberry Street between South Charles and East Howard Streets, is at practically the center of the business district of Muncie.

ENTRANCE TO TERMINAL BUILDING ON SOUTH MULBERRY STREET



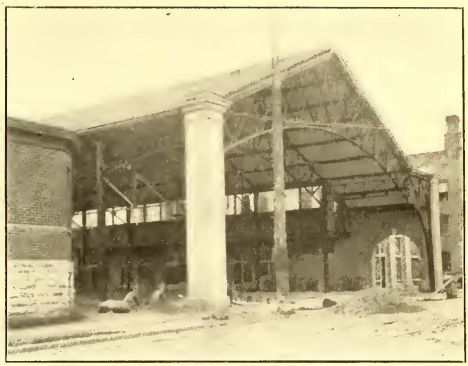
GENERAL VIEW OF STATION FROM EAST HOWARD STREET

The passenger station proper is built on a plan resembling in general features the plan of the interurban terminal station at Indianapolis. Waiting rooms, ticket offices and stores occupy a building on one side of the train shed. Baggage and freight rooms as well as the division offices of the company are located in an extension south of the passenger terminal building proper. The passenger terminal building measures 100 ft. x 50 ft. It is of steel construction with walls faced with Columbus hydraulic pressed brick of

a dark gray color. Provision has been made in the strength of the foundation and in the design of the structural steel work for a building six stories high, but at present it consists of two stories and a basement only. The exterior lines are simple and dignified, and in general architecture may be said to follow the simpler lines of the Renaissance period.

The principal entrance of the building is on Mulberry Street. This entrance leads into a small lobby on one side of which is a stairway leading to the second floor. Opposite the stairway provision has been made for two elevators. These, however, will not be installed until the additional stories contemplated are constructed.

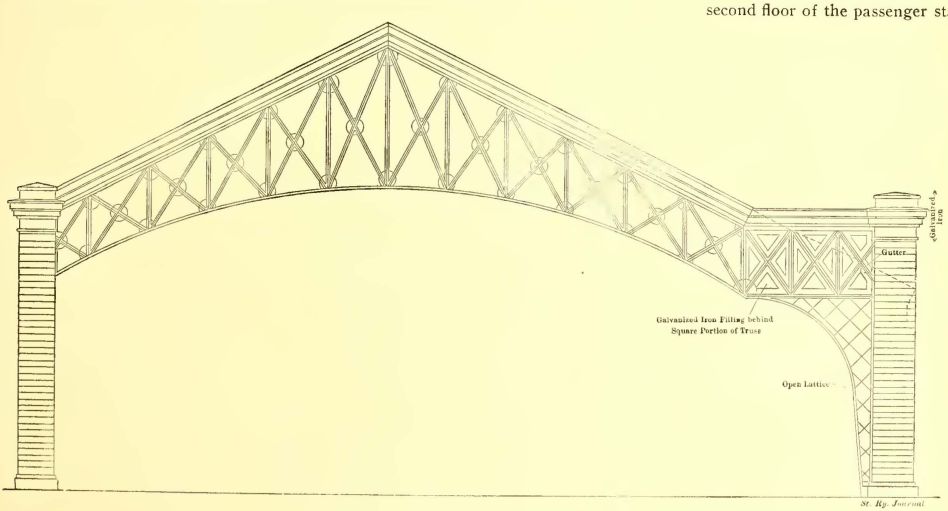
A large portion of the first floor is taken up by a general waiting room which is finished in brick. A ticket office with three windows to the north of the waiting room is so located with reference to the baggage room that the ticket agent can, during a portion of the day, attend to the duties of baggage master. For the convenience of passengers a passageway from the waiting room communicates with the baggage room. Quite a portion of the first floor is taken up by five stores, all of which have show windows and passageways opening out into the waiting room.



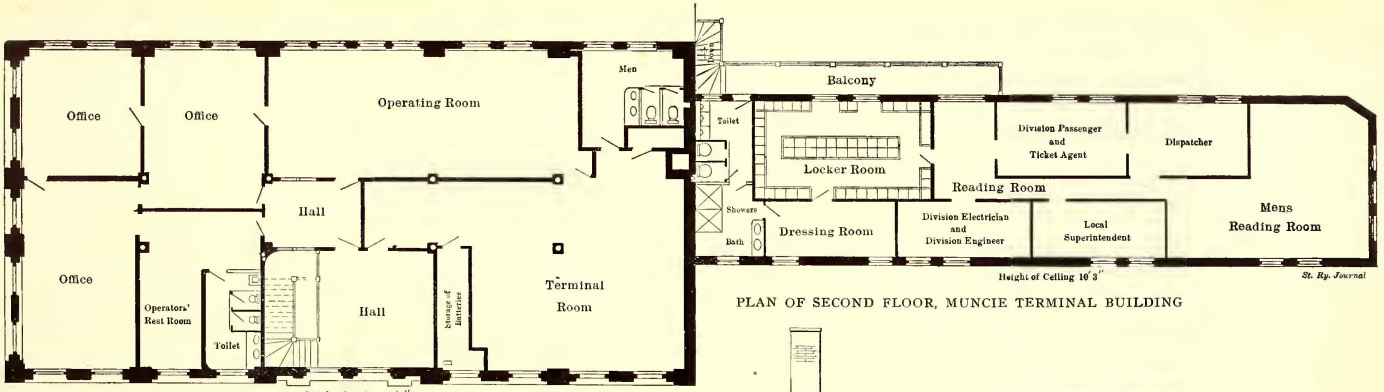
EAST CHARLES STREET FRONT OF TRAIN SHED, SHOWING CANTILEVER CONSTRUCTION OF TRUSS

SOUTH MULBERRY STREET FRONT OF TERMINAL BUILDING AND FREIGHT HOUSE

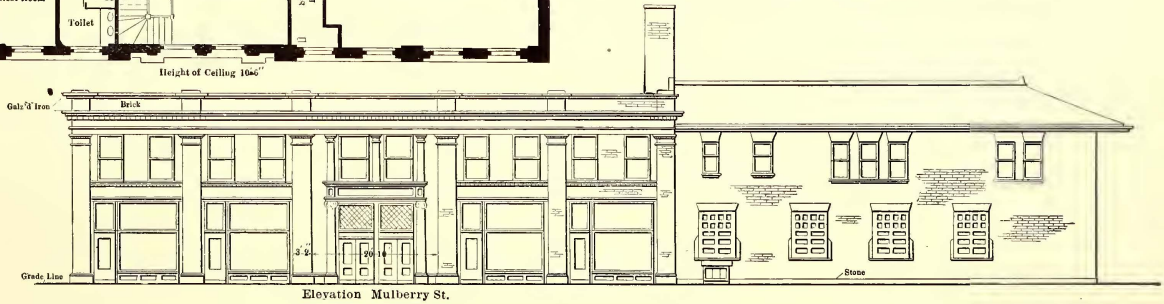
From the waiting room two separate stairways lead to separate ladies' and gentlemen's waiting rooms in the basement. Two stairways are provided with the idea of separating to as great an extent as possible the two waiting rooms. Sanitary drinking fountains are located in each of the basement waiting rooms as well as in the general waiting room on the first floor. In addition to the two waiting rooms the basement contains a boiler for the Norwahl vacuum steam heating system, storage space for fuel, and a room which serves as a general workship. The entire second floor of the passenger sta-



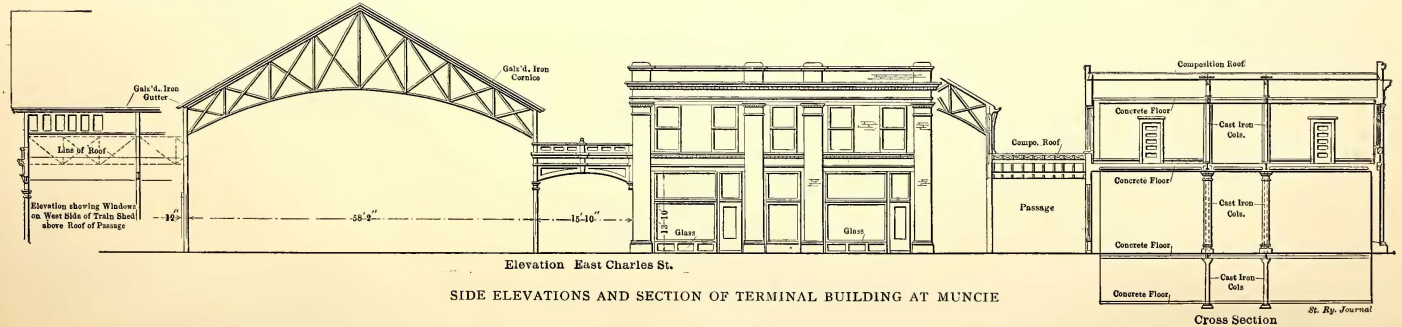
ELEVATION OF TRAIN SHED, MUNCIE



PLAN OF SECOND FLOOR, MUNCIE TERMINAL BUILDING



Elevation Mulberry St.



Elevation East Charles St.

Cross Section

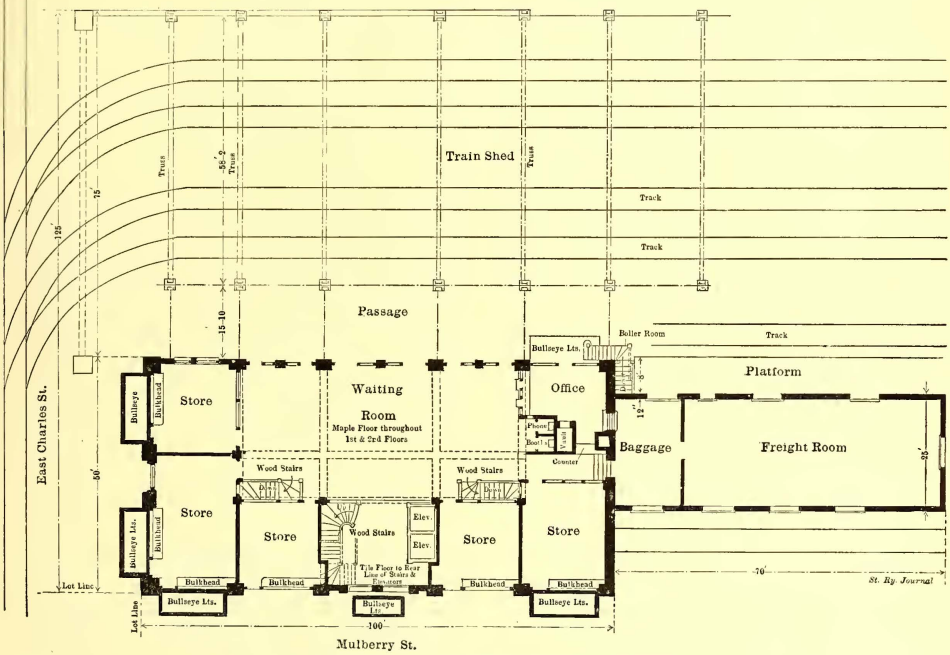
SIDE ELEVATIONS AND SECTION OF TERMINAL BUILDING AT MUNCIE

tion has been leased to the Central Union Telephone Company, and has been arranged especially for the convenience of this company.

A passageway 15 ft. wide separates the train shed from the waiting room. This shed, which is 62 ft. wide and 138 ft. long, contains four tracks. The pitch roof is covered with interlocking tile and is supported by ten light steel trusses resting on steel columns on either side. A peculiar construction was resorted to in the front truss of the train shed on East Charles Street. The fact that the tracks curve towards the west before coming out from under the train shed made it necessary to eliminate one of the supporting columns in order to get clearance of cars, and one end of the first truss is carried by a cantilever construction. In designing the train shed special attention was given to securing proper clearance between columns and cars. This is done to avoid the possibility of accidents at times when excursions are being run and on other occasions when large crowds are being handled. The center line of the outside columns of the train shed is 9 ft. from the outside rail of the adjacent track, and the inside columns are 6 ft. away from the track rail. Between the two centrally located tracks a concrete passageway 13 ft. 6 ins. wide extends the full length of the train shed. The pairs of trucks on either side of this passageway are about 10 ft. between centers. Across the center of the train shed is a concrete walk 24 ft. wide. The remainder of the space between the tracks and rails is paved with brick resting on a cushion of sand and a bed of concrete.

The freight depot, which is two stories high, measures 25 ft. x 98 ft. The greater portion of the first floor is used as a freight room, but a room 14 ft. wide, extending the full width of the building and adjacent to the passenger terminal building, is reserved for baggage. The freight room is served by two tracks, one along each side of the building. On the east side a platform has been constructed to facilitate the unloading of freight from cars. Wagons are loaded and unloaded on the west side and at the north end of the building. The arched doorways through which freight is handled are provided with rolling steel doors.

The floor above the freight room, which contains the division offices of the Indiana Union Traction Company, is reached by way of an outside stairway leading from the passageway between the train shed and the passenger station building. The whole south end of this floor is taken up by a reading room for trainmen and other employees. To the east of a hallway leading to the reading room are the offices of the division passenger and ticket agent and the despatcher's room. In the despatcher's room provision has been made for four despatcher's telephone lines and four general lines.



FIRST-FLOOR PLAN OF MUNCIE TERMINAL BUILDING

The despatcher at this point will despatch cars on the lines east to Union City, west to Anderson and north to Bluffton. Opposite the despatcher's room is the office of the local superintendent, while behind this is the office of the division engineer and the division electrician. This room will be provided with a testing board by means of which tests can be made on all of the telephone lines entering the building. A large locker room for the use of trainmen, dressing room, shower baths and toilet facilities take up the remainder of the second floor. All of the rooms on this floor are finished in hard pine.

Alfred Grindel, of Muncie, was the architect and superintendent of construction of the building, and to him this paper is indebted for much of the information in this article as well as for the drawings of the building.

THE TOLEDO & CHICAGO INTERURBAN SINGLE-PHASE RAILWAY

BY JOHN R. HEWETT

The opening of the Toledo & Chicago Interurban Railway marks another important step in the advancement of high-tension single-phase interurban railways; both the physical and technical characteristics of the road make it from the outset one of the most interesting and useful additions to the excellent system of electric railways existing in the Middle West.

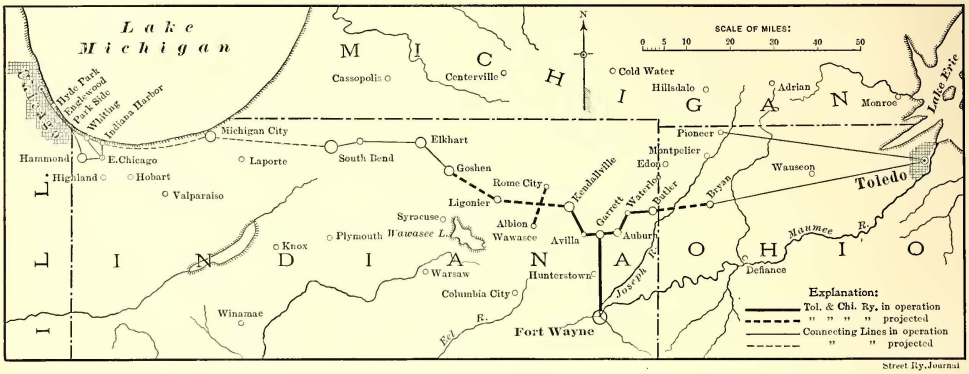


FIG. 1.—MAP SHOWING ROUTE OF TOLEDO & CHICAGO INTERURBAN RAILWAY COMPANY

The map published herewith will serve as a graphical explanation of the physical importance of the road. At present it extends from Kendallville to Garrett via Avilla and from Garrett to Butler via Auburn and Waterloo, while the section connecting Auburn and Fort Wayne has been in daily operation since the middle of May. A new company, the Kendallville & Goshen Traction Company, under the same directorship and involving the same interests, has been incorporated to construct a line from Kendallville to Goshen, with branch lines joining Rome City and Albion. The necessary franchises and rights of way are now being secured for this road. The proposition of connecting Butler and Bryan by the Toledo & Chicago Interurban Railway is now under consideration. There is every possibility, therefore, that within a year or eighteen months Goshen and Bryan will be connected by a high-speed single-phase road operated by the same company. When this is an accomplished fact, Chicago will be connected to Toledo by an unbroken chain of interurban roads, because on the one hand Goshen and South Bend are already connected by the lines of the Indiana Railway Company, and a line is at present under consideration from South Bend to Chicago, and on the other hand the Toledo & Indiana Railway already connects Bryan with Toledo.

GENERAL SCHEME OF ELECTRIFICATION

The general scheme of electrification can be briefly summarized as follows:

Single-phase current is generated in the power house at 3300 volts, at which pressure it is fed direct to the trolley for those sections of the road nearest the power house. For the more distant sections the generator voltage is stepped up by transformers in the power house to 33,000 volts and fed to the sub-stations over the transmission line before being reduced to the trolley voltage.

The equipment of each car consists of four GEA-75-hp compensated motors capable of operating on both a. c and d. c. The road is equipped throughout with General Electric apparatus.

POWER HOUSE

The power house is situated at Kendallville. It was put into commission on July 1, and will be, in all probability, when finished, the most complete and up-to-date single-phase railway power house in existence. Fig. 2 is an external view. The principal dimensions are as follows:

	Ft.
Total length of power house	110
Total width of power house	95
Length of turbine room	110
Width of turbine room	46
Height of turbine room	43
Length of boiler room	110
Width of boiler room	49
Height of boiler room	41

FIG. 2.—EXTERIOR OF POWER HOUSE

At present two Curtis turbines are installed, and a third will be put in operation when the conditions demand. Each turbine is rated at 800 kw when running non-condensing and 1000 kw when condensing. These machines have four stages, each consisting of two rows of revolving buckets and one of stationary blades. They are designed to run at 1500 r. p. m., and to take steam at 150 lbs. pressure.

The guaranteed steam consumption is 21 lbs. per kw-hour when the turbine is supplied with dry saturated steam at 150 lbs. pressure, and the absolute exhaust pressure is equal to 2 ins. of mercury.

The generators connected to these turbines are two-pole revolving field machines. They are "Y" connected and generate current at 3300 volts. Although the windings are of the three-phase type, the generators are normally connected for single-phase operation. While by this arrangement only two-thirds of the copper is active, there is a spare phase for use in case of an accident to any winding.

The exciter sets consist of 25-kw Curtis turbines of the horizontal type, direct-connected to two-pole General Electric d. c. generators running at 3600 r. p. m. and delivering 200 amps. at 125 volts at normal full load.

The boilers are of the Stirling water tube type; three have already been installed and provision has been made in the boiler room for the reception of three similar units. Each boiler is rated at 415 hp, has 4135 sq. ft. of heating surface, and a grate area of 71 sq.. ft. The smoke connections are made at the bottom in the rear of the settings, the gases pass through dampers to an underground flue which leads to the stack outside the building. At present the boilers are hand fired, but it is planned to install mechanical stokers later.

The condensers were built by the Worthington Company. They are of the surface type, constructed to produce a high vacuum, and are provided with an inner cooler for dealing with the air and other non-condensible gases. Each condenser has 2800 sq. ft. of cooling surface. The condensed steam is removed from the hot well by a 2-in., two-stage turbine pump located beneath the condenser and driven by a 3-hp induction motor which runs at 1500 r. p. m. These pumps discharge directly into the feed water heater, and make-up water is supplied from the service water line. Air is removed from each of the condensers by a 6-in. x 12-in. x 12-in. dry vacuum pump with mechanically operated air valves, and the discharge is connected to the main atmospheric exhaust line The circulating water for each unit is handled by a 10-in horizontal volute pump direct-connected to a 7-in. x 10-in. Russell enclosed engine which is self-oiling; both pump and engine are mounted on a common iron subbase.

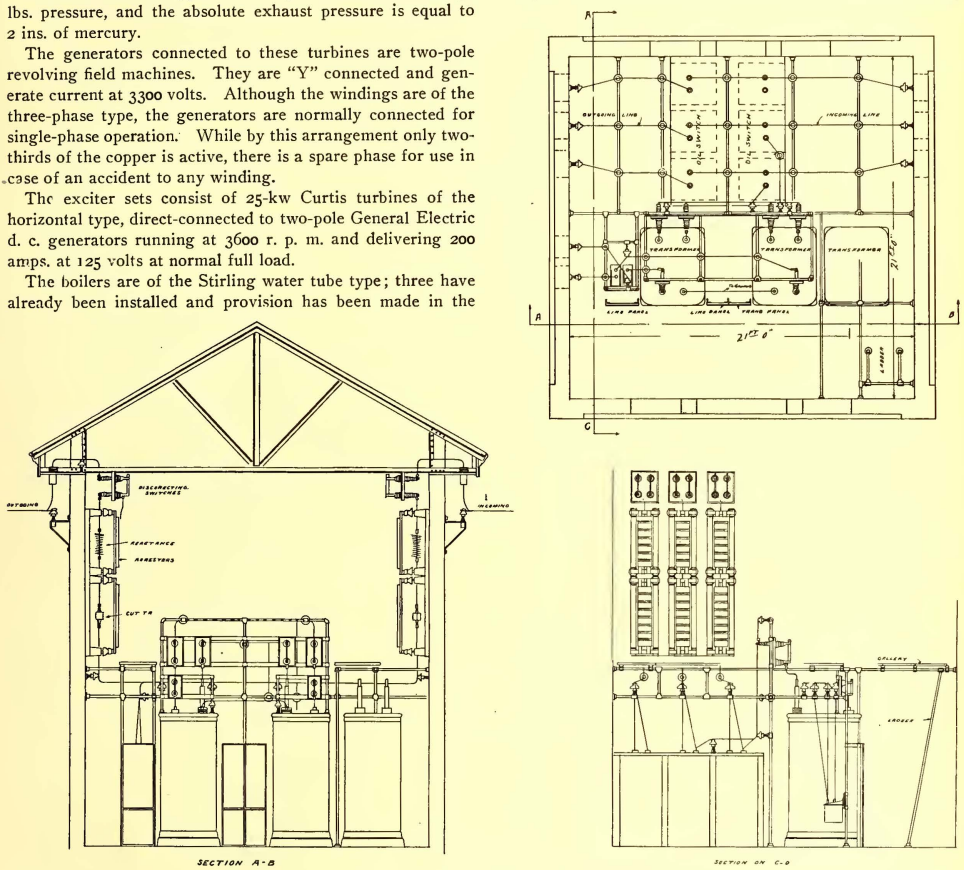


FIG. 4.—PLAN AND SECTIONAL ELEVATIONS OF SUB-STATION

A standard Cochrane feed water heater and purifier has been installed and is of sufficient capacity for the present boiler equipment. It receives exhaust steam from all the auxiliary machinery and the water from the condensers.

The boiler feed pumps, two in number, are of the Laidlaw-Dunn-Gordon Company's make. Each has a 12-in. steam cylinder, 7-in. plunger and a 10-in. stroke. They are duplex pumps with outside center packed plunger, and each is capable of feeding boilers of 1600-hp capacity when operating at 25 per cent overload.

The stack seen so prominently in Fig. 2 is of the self-supporting steel type with an internal diameter of 90 ins., and

is 160 ft. high. The base is flared to a diameter of 16 ft. A protective lining of fire brick is built inside the stack for a height of 60 ft. The design of the power house building was made by the Arbuckle-Ryan Company, of Toledo, Ohio, and this company was also the contractors for the installation of the boilers, auxiliary machinery and piping.

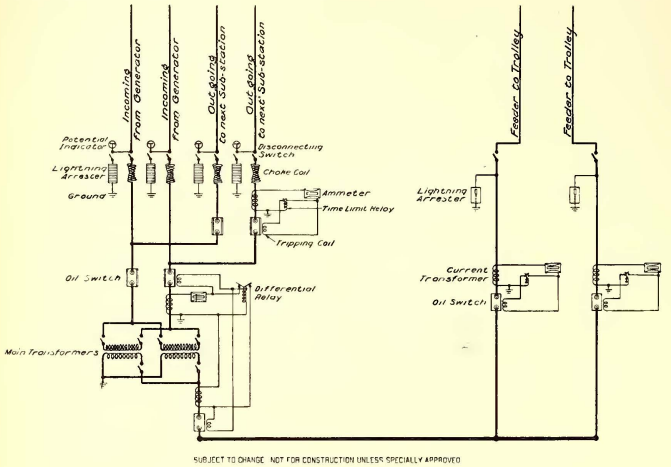


FIG. 5.—WIRING DIAGRAM OF SUB-STATION

SUB-STATION

A typical sub-station of the Toledo & Chicago Railway is illustrated in Fig. 4. Ultimately there will be four sub-stations situated respectively at Garrett, Hunterstown, Waterloo and Albion, but at present only one has been built. The Garrett sub-station has been in operation since July 1. The equipment of these sub-stations consists of—

Two 200 kw, 33000/3300-volt oil cooled, 25-cycle transformers, room being provided for a third transformer of like rating.

Type K-6 oil switches for the 33,000-volt line.

Type K-2 oil switches for the 3300-volt trolley.

The necessary complement lightning arresters.

The scheme of connections is shown in Fig. 5. A three-phase transmission will ultimately be employed on the Toledo & Chicago road, but for the sake of clearness the third phase is omitted in the illustration; the third phase simply passes through the sub-station and has an oil switch in circuit to enable its being broken if required.

THE TRACK

The track when completely ballasted will be free from any severe grades, as the maximum incline amounts to 1 per cent. With but one exception there will be no severe curves, This exception occurs in the town of Garrett where the line branches to Fort Wayne, and excluding this there is no curve of less than 10 per cent on the whole system.

The rails are of the standard A.S.C.E. cross-section. General Electric rail bonds are employed throughout. These bonds are 10 ins. in length, have a current-carrying capacity equal to that of a No. 0000 trolley wire, and are furnished with solid copper terminals 7/8 in. in diameter. The ties,

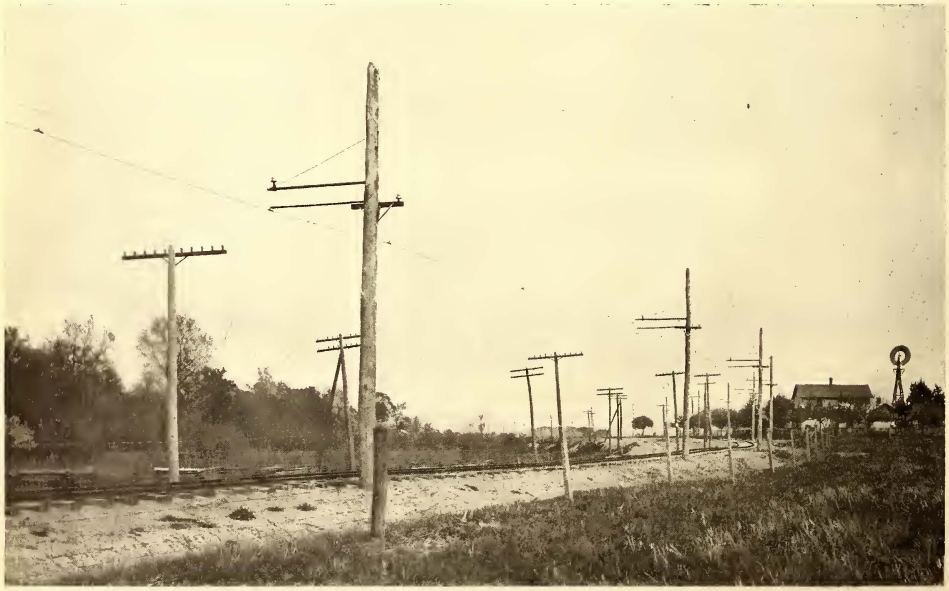


FIG. 6.—CATENARY CONSTRUCTION ON SIDE BRACKETS

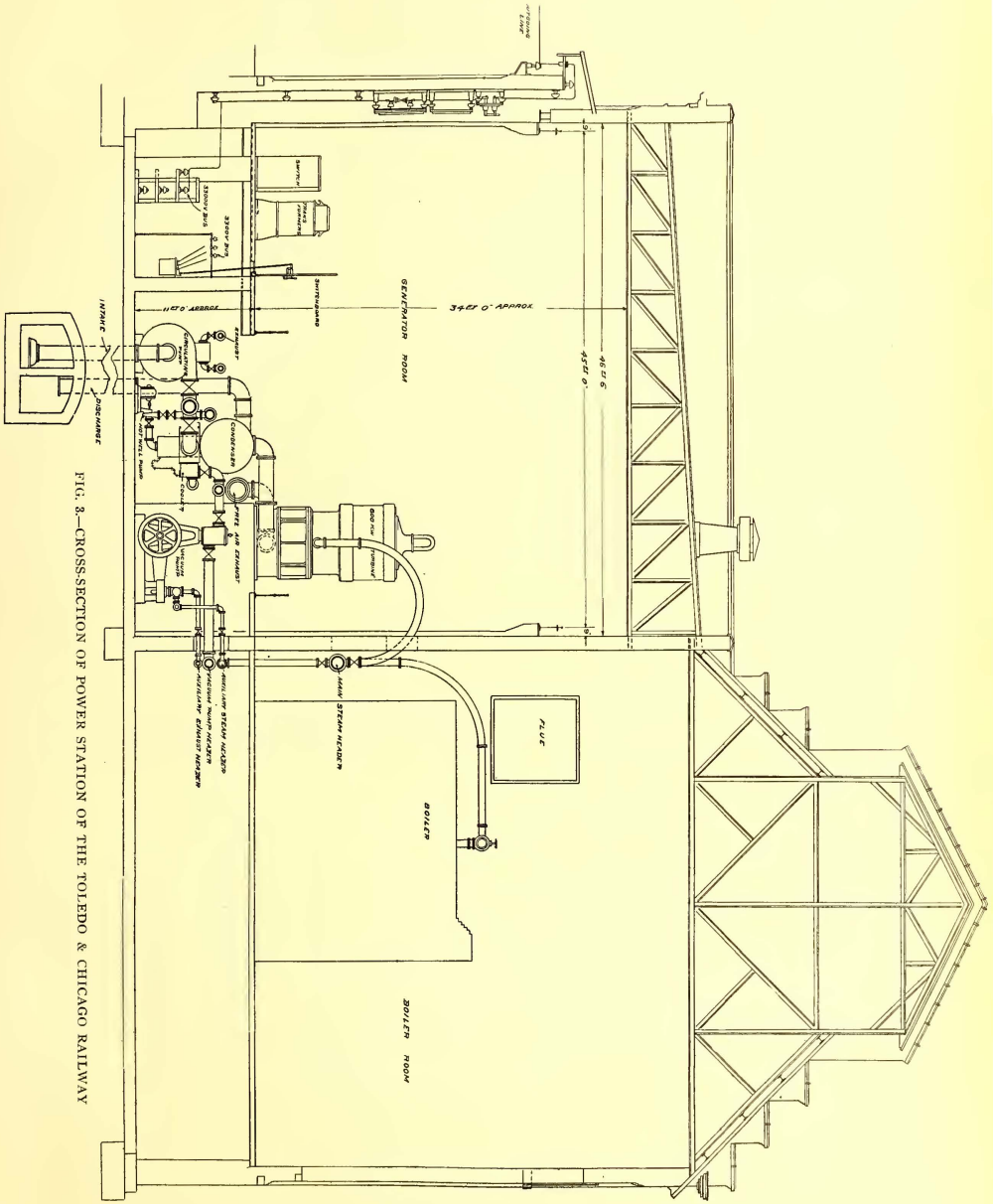


FIG. 3.—CROSS-SECTION OF POWER STATION OF THE TOLEDO & CHICAGO RAILWAY

which are of oak and cypress, are of standard dimensions, 6 ins. x 8 ins. x 8 ft. There are from 2640 to 3000 ties per mile of track. The line is constructed for single track only, and turn-outs and sidings are provided where necessary. The track is well ballasted. The company owns a large gravel pit on the Fort Wayne section of the road, and it is expected when all construction work is done the ballasting will be completed in a manner that will compare favorably with steam railroad practice.

OVERHEAD CONSTRUCTION

The overhead construction is typical of a modern high-speed interurban road. The trolley wire is of the catenary

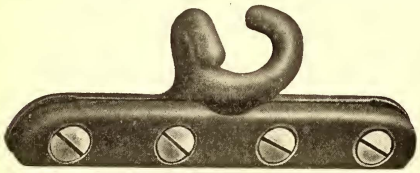


FIG. 7.—SISTER HOOK—MECHANICAL CLIP

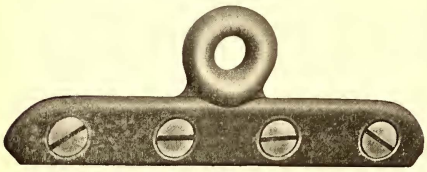


FIG. 8.—EYE HOOK—MECHANICAL CLIP

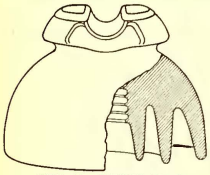


FIG. 11.—INSULATOR

suspended type and is insulated to withstand a test pressure of 40,000 volts, although the working pressure is but 3300. A very considerable saving is effected by the adoption of this type of construction, an important factor being that the poles are spaced at 150 ft., whereas 100 ft. is the usual spacing in d. c. operation.

The trolley line consists essentially of a grooved copper wire and a steel messenger cable. The former is of No. 000 hard-drawn copper and the latter is composed of seven strands of No. 11 steel wire. The diameter of the messenger cable is ⅜ in. and it is made of a special grade of steel having a tensile strength of 70,000 lbs. per sq. in. The trolley is suspended every 50 ft. from the messenger cable by means of the mechanical clips, of which two forms are used. That illustrated in Fig. 7 supports the trolley midway between the poles, at the point where the amount of messenger sag is a maximum, and is attached to the messenger by means of the sister hooks seen. That shown in Fig. 8 is used at other points and is suspended from the messenger by means of flexible steel wire or rigid distance pieces.

The bracket arms are made of 2¾-in. external diameter structural steel piping. They are fastened to the poles by means of a flange and two lag screws, and are supported by a ⅝-in. guy rod. Fig. 9 gives all the essential details of the bracket construction as now installed, and Fig. 10 shows the form of construction to be adopted on the new section of the road. In both of these illustrations the "Steady brace" device is also shown. The trolley is supported 20 ft. above the track. Fig. 11 is an illustration of the type of insulator used. It is of porcelain, 5 ins. in diameter and 3⅞ ins. in height, and has a surface distance of 7½ ins. These insulators weigh 3 lbs. each and were tested to withstand 40,-

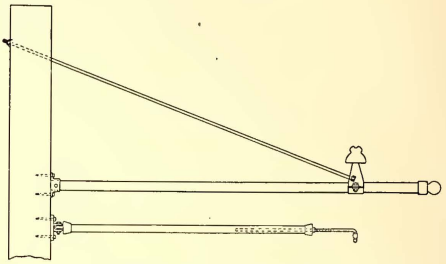


FIG. 9.—BRACKET AND STEADY BRACE USED NOW

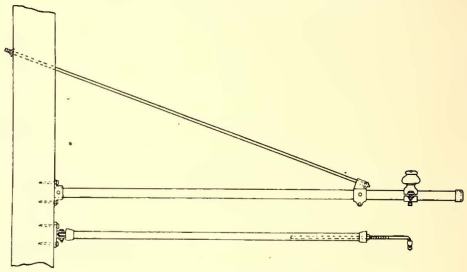


FIG. 10.—BRACKET AND STEADY BRACE FOR USE ON EXTENSION

FIG. 12.—HICKORY STRAIN INSULATOR

000 volts pressure. They are attached to the malleable iron pins by means of cement.

All guy and anchor wires are insulated by means of special wooden strain insulators, as shown in Fig. 12. The body is of selected hickory subjected to a special compound vacuum process which impregnates every portion of the wood, and not only excludes all moisture and prevents the absorption of moisture, but also increases the strength and toughness of the wood. The wood of which these insulators are made is split into sticks before being turned to insure a straight grain. The ends are furnished with eyes of malleable iron which are attached to the shank by hydraulic pressure. As shown in Fig. 13, these insulators are also used for city work where the span construction is adopted.

Lightning arresters are installed at intervals of approximately half a mile.

The poles are 35 ft. and 40 ft. in length, the longer being used where the telephone line is carried on the same poles. The poles are planted to a depth of 6 ft. or 7 ft., according to the nature of the soil.

MOTORS

It has been previously stated that each car is equipped with four GEA-605-A motors, which are a modification of the GEA-604 motor. They are of 75 hp each, and are wound

for a maximum of 250 volts. The air gap of these motors between the armature and pole piece is somewhat smaller than the standard d. c. motor of the same output, and the speed as compared with a standard d. c. machine of the same rating is about 10 per cent higher. No trouble whatever has occurred owing to operating with a small air gap. This is undoubtedly owing to the fact that the increase in armature speed is small.

FIG. 13.—SPAN CATENARY CONSTRUCTION USED THROUGH TOWNS

Considering the armature more in detail, it is of the iron-clad type and bar wound with one turn per coil and three coils per slot, the bars being connected to form a series drum winding. It is removed from the field frame by removing one of the frame heads.

The field structure is quite different from that of a d. c. motor, as there are no inwardly projecting poles, and the entire field winding can be removed and readily replaced by a duplicate set of windings should any accident result in their being damaged. This feature will be understood from an examination of Fig. 14, which shows the motor casing open and the inner portion of the field removed. The two outer steel castings, on being bolted together, hold the inferior field ring rigidly in position. This inner portion of the field is a metal ring built up of laminations insulated from one another by japan and securely bolted together by long through bolts. The punchings are of such shape as to form four poles of the requisite size. Slots are provided in the poles for the reception and retention of the compensating windings.

The exciting windings are of copper strip. They are connected in parallel for a. c. running, and therefore reduce the self inductance at high currents, and are connected in series for d. c. running to increase the torque per ampere and to permit the motors being run two in series when operating on standard 600-volt circuits.

The compensating winding, the function of which is to counteract the armature inductance, provides a relatively high power factor throughout the range of a. c. operation, and further improves the commutation on both a. c. and d. c. operation. It also reduces the field distortion. As the exciting windings are connected on the grounded side of the circuit in series with the armature, they take current at a low potential and therefore do not require to be heavily insulated. The motor is oil-lubricated and has four brushes. Fig. 15 shows a GEA-605 motor complete and ready for mounting on the truck.

The characteristic curves of the GEA-605 motor, as in operation on the Toledo and Chicago roads, are given in Figs. 16 and 17.

The following data will give the more important weights and characteristics of these motors:

Weight complete with gear and gear case, 4500 lbs.

Weight of motor without gear and gear case, 4200 lbs.

Weight of armature alone, 1200 lbs.

Clearance with 36-in. wheels, 4.875 ins.

Clearance with 33-in. wheels, 3.275 ins.

Maximum diameter of axles, 5.5 ins.

Net efficiency when operating alternating current, 80 per cent.

Net efficiency when operating direct current, 83.5 per cent.

THE CONTROLLER

Fig. 19 illustrates the controller, which is of the T-33 type. For d. c. operation the control is rheostatic and therefore needs no description. When operating on an a. c. section of the line "potential control" is used, that is to say, a variable potential is applied to the motor terminals through the medium of a step-down transformer or compensator. Five taps are brought out from the compensator winding, reducing the trolley voltage of 3300 volts to 400, 490, 590, 690 and 800 volts, and as all four motors are connected in series, each will take one-quarter of these pressures during acceleration. No starting resistance is used for a. c. operation, and therefore each point of the controller is in a running position. A small section of cast grid rheostat is put in circuit during the transition from step to step to prevent short circuiting a section of the compensator when between points. The d. c. trolley finger in the controller is insulated for 5000 volts to withstand the high-tension alternating voltages. Fig. 18

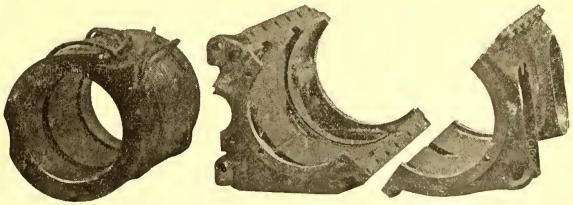


FIG. 14.—HOUSING AND INNER RING OF MOTOR

shows the arrangement of all the controlling apparatus in the cab.

COMMUTATING SWITCH

For transferring from an a. c. to a d. c. section of the line and vice versa, a commutating switch is employed to change the connections from the rheostatic leads to the compensator taps and also to make all necessary changes in the lighting, heating and air compressor circuits, as well as to put the exciting fields of both the main and air compressor motors in series or parallel as the case may be. As can be seen in Fig. 18, this switch is located in the cab beside the controller and is operated by the reverse handle.

COMPENSATOR

The compensator is illustrated in Fig. 20.

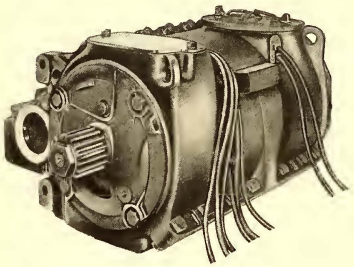


FIG. 15.—MOTOR COMPLETE

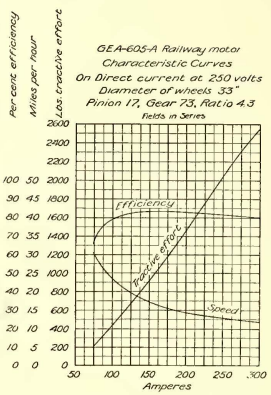


FIG. 16.—CHARACTERISTIC CURVE

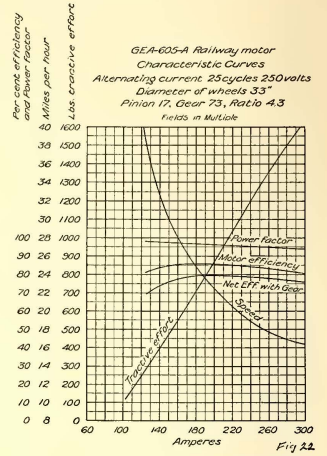


FIG. 17.—CHARACTERISTIC CURVE

It consists of a transformer with both primary and secondary windings connected in series. It is oil-cooled and is contained in an iron case. The ends are made of cast iron, and the sides of corrugated sheet metal. The several taps are brought out through the cast-iron ends and made oil tight by means of stuffing boxes. Special insulation is used to prevent damage by vibration.

SWITCHES AND PROTECTIVE DEVICES

Two motor cutout switches are furnished, one for each truck. They are placed beneath the car adjacent to the motors they govern. They are operated by the reverse handle of the controller.

The main a. c. switch is a standard oil-cooled switch adapted to the requirements of the service. This switch was illustrated in the STREET RAILWAY JOURNAL of May 6, 1905, page 814. It is enclosed in a sheet-iron box and suspended beneath the car. It is closed by hand and is retained closed by a coil energized from the 400-volt tap of the compensator. The main d. c. switch is also contained in a sheet-iron box and suspended beneath the car; it is closed by hand from the cab and is retained closed by the line current. This switch, which is illustrated in Fig. 21, is somewhat similar to an electrically-operated circuit breaker, minus the overload device, with its line terminal insulated for the high-tension a. c. voltage. The circuits for both the main a. c. and d. c. switches are interlocked in the commutating switch and are controlled by a double-pole, single-throw switch located in the cab. Either switch will open automatically on approximately one-third line voltage, and either may be operated at any time by the double-pole, single-throw switch in the cab.

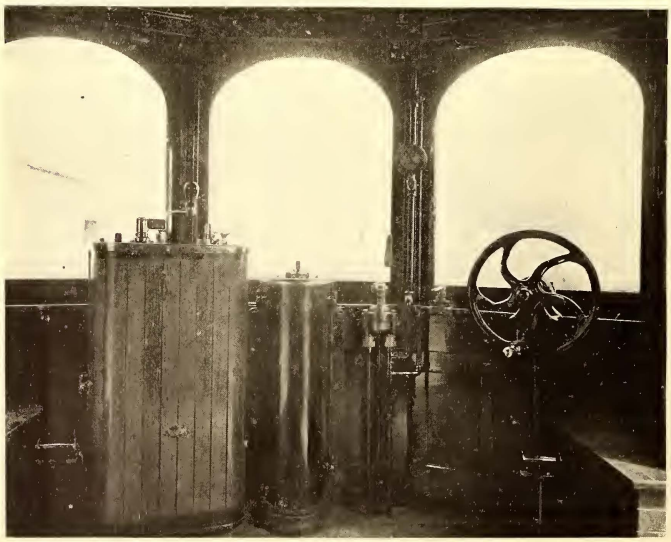


FIG. 18.—CONTROL APPARATUS IN CAB

The high-tension alternating current line is protected by an expulsion fuse of the type shown in Fig. 22, which is located on the roof of the car, while the d. c. circuit is protected by magnetic blowout copper ribbon fuses also on the roof. The common circuit, that leading from the controller to the motor, is protected by another magnetic blowout copper ribbon

fuse placed beneath the car which is designed to open in case of any motor trouble. The auxiliary circuits have individual fuses of the cartridge type. Both the a. c. and d. c. circuits are protected by suitable lightning arresters.

CHANGING FROM A. C. TO D. C. OPERATION

Changing from a. c. to d. c. operation or vice versa is accomplished by means of a dead section in the trolley wire which is made as long as possible without exceeding the span on the two trolley poles. At the instant the car enters this dead section, whichever main switch is closed will open, owing to the fact that the circuit energizing its retaining coil is broken. The car can run over this dead section at full speed, and all the motorman has to do to make the proper connections is to throw the commutating switch and close the main a. c. or d. c. switch, as the case may be.

In the event of the motorman closing the wrong main switch it will open the moment his hand is removed, since its retaining coil will not be energized. No harm will result from a motorman's closing the wrong main switch. If the a. c. switch is closed on the d. c. trolley the high-tension fuses will immediately open the circuit. Again, if the d. c. switch is closed on the a. c. trolley, resulting in the trolley fingers of the commutator switch being subjected to 3300 volts, no damage can be done, as they are insulated for 5000 volts.

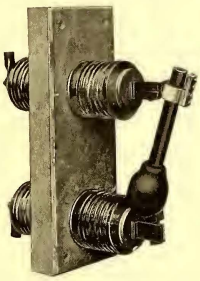


FIG. 22.—EXPULSION FUSE (HIGH-TENSION A. C.)

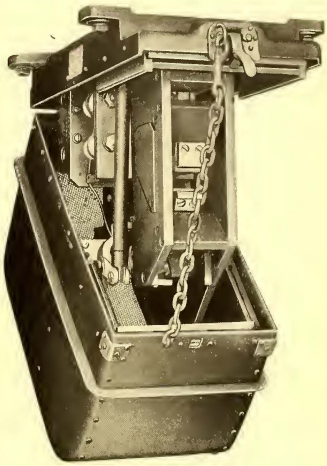


FIG. 21.—MAIN D. C. SWITCH

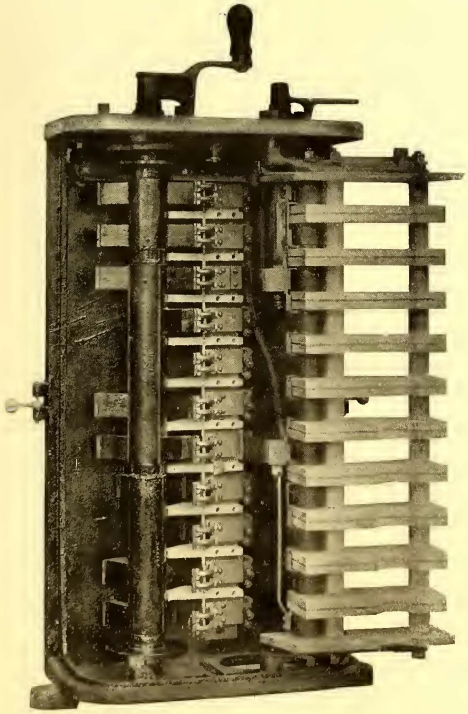


FIG. 19.—T-33 CONTROLLER

WIRING

All cables subjected to high-tension alternating current have suitable rubber insulation and are further protected by a double cotton waterproof braid. They are installed in brass piping, all of which is carefully grounded. The other cables are insulated according to ordinary practice.

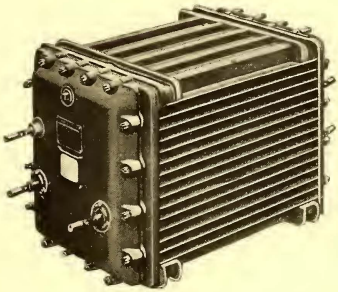


FIG. 20.—COMPENSATOR

TROLLEYS

The trolley base, poles and wheels are of the standard US-6 type. Special insulation is provided for the base, which has a sub-base of impregnated wood, mounted on molded insulators designed for 10,000 volts.

AIR BRAKES

The air-brake system comprises a standard General Electric straight air-brake equipment with all its necessary adjuncts. The compressors are of the CPA-52-A type with herring-bone gears. The motors are designed to operate with both a. c. and d. c. current, and the governors are GE standard d. c. governors which have already been described in these columns.

CARS

At the present time the rolling stock of the Toledo & Chicago Railroad consists of ten fully equipped cars—six 52-ft. passenger cars, two 45-ft. passenger cars and two express cars. The car bodies were supplied by the Niles Car & Manufacturing Company, of Niles, Ohio.

Fig. 23 illustrates one of the 52-ft. cars. They are of handsome appearance, being painted with Pullman green.

Each of the 52-ft cars has a seating capacity of forty-six persons, and their general dimensions are as follows:

	Ft.	Ins.
Length over buffers	52	
Length over vestibule	50	
Length between corner posts	40	
Width over panels	8	6
Weight of body, about 28,000 lbs.		

These cars are mounted on Baldwin Locomotive M. C. B. trucks of type No. 167, each weighing about 8500 lbs., and designed for a working load of 25,000 lbs. The wheels are 33 ins. in diameter and the wheel base is 6 ft. 10 ins.

The 52-ft. passenger cars are single-ended, and the forward vestibule is of sufficient capacity for handling baggage and light express. A smoking compartment and toilet is provided on each car. The roofs and hoods are of steam coach pattern and the ceilings of the semi-empire style, handsomely

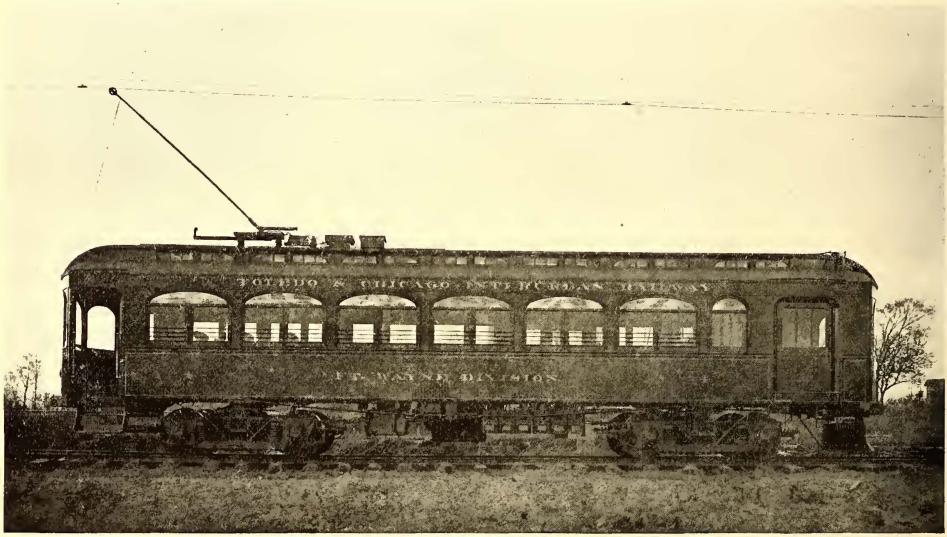


FIG. 23.—STANDARD CAR

decorated. The lamps are placed singly in the roof to insure an even distribution of light. The 45-ft. cars are double-ended and one is provided with a baggage compartment. The express cars are 52 ft. in length and are double-ended.

The Toledo & Chicago Railway Company anticipates doing a considerable business in freight haulage, and has secured both passenger and freight terminals in Kendallville, Garrett, Auburn and Fort Wayne. The General Electric Company is now building a freight equipment for use on an electric locomotive which will be capable of hauling at least twenty-five loaded freight cars.

CONCLUSION

In conclusion it is interesting to note that the work of constructing the line was under the direct supervision of the general manager, and no contractors were employed with the exception of those already cited when dealing with the power house. The officials of the Toledo & Chicago Interurban Railway are as follows: President, Arthur B. Shepard; general manager and treasurer, F. Perkins; secretary, F. L. Welsheimer.

SINGLE-PHASE EQUIPMENT FOR THE WASHINGTON, BALTIMORE & ANNAPOLIS RAILWAY

The announcement that the Washington, Baltimore & Annapolis Railway has finally adopted the single-phase system and has placed contracts for the entire electrical equipment required for this line will attract considerable interest in engineering and railway circles, not only on account of the fact that this is one of the most important orders placed for alternating-current equipment in this country, but also because the original promoters of this line were the first to adopt the single-phase system. The original contracts for the construction of this line were let some three years ago, but due to financial difficulties the road was not built at that time and has since passed to other owners.

Some 60 miles of road will be operated by the new company. The main line will be that between Baltimore and Washington, with a branch from a point on the main line near Odenton, extending to Annapolis. This station on the new line will be known as Academy Junction. Over the main line between Baltimore and Washington an express and local service will be established, express cars being operated under a fifteen-minute headway and making the run in seventy-two minutes. The roadbed will be double-tracked throughout, with sidings arranged at suitable intervals so that the locals may be side-tracked to enable the expresses to maintain schedules. The rolling stock equipment is to be very complete. Nineteen express cars, capable of making 60 m. p. h. on a tangent level track, will be operated. In addition two work-cars will be equipped, each sufficiently powerful to haul a train of five ordinary passenger coaches at 45 m. p. h., while four lower powered cars will be used for local service. These last mentioned cars will be run at a speed of 45 m. p. h. The express and work-cars will each be equipped with four GEA-603 (125 hp each) a. c.-d. c. motor equipments with the Sprague-General Electric type-M train control. The local cars will be similarly controlled but will be driven by two instead of four GEA-603 motors.

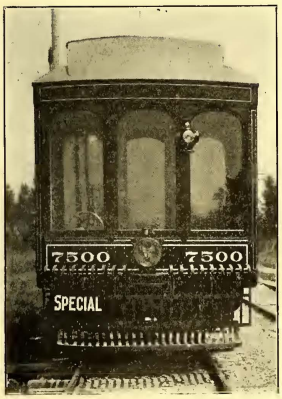
Power for the new road will be purchased from the Potomac Electric Company at Washington, D. C., and will be delivered by that company at 6600 volts three-phase to a transformer sub-station located about 3 miles from Chesapeake Junction. In order to obtain a balanced load on the three-phase generators, the current as received at the sub-station will be changed from three-phase to two-phase by groups of two transformers connected, three-phase on the 6600-volt primary side and two-phase on the secondary side. Half of the transformers will have the secondaries wound for 6600 volts and the other half for 33,000 volts. The 6600-volt windings will all be connected in parallel on the same phase supplying single-phase current to the trolley as far as Academy Junction. The 33,000-volt secondary windings will all be connected in multiple on the second phase to the 33,000-volt transmission line, which will supply current to a step-down sub-station located at Academy Junction. The Chesapeake Junction sub-station will contain seven 800-kw, water-cooled transformers, three with 33,000-volt secondaries and four with 6600-volt secondaries, one of the latter transformers forming a reserve.

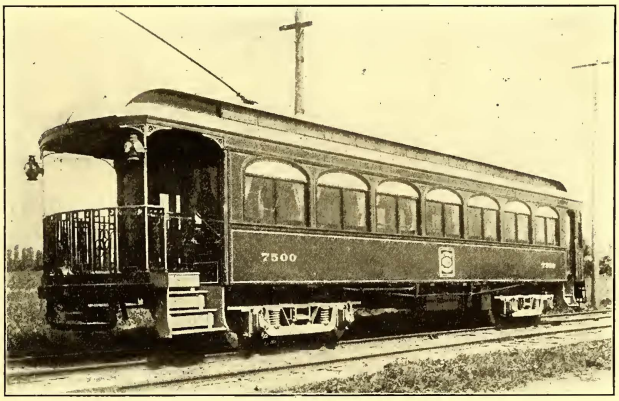
At Academy Junction there will be four water-cooled transformers, 25 cycles, 800 kw, reducing the single-phase, 33,000-volt current of the transmission line to 6600-volt current suitable for delivery to the cars. These transformers will supply the current necessary for the Baltimore and the Annapolis sections of the line.

The sub-station at Academy Junction will be located adjacent to the car houses. For greater safety in inspecting and handling the cars, all of the trolley circuits in the car house will be arranged for 600-volt direct current, and for this purpose two 300-kw motor generator sets will be installed in the transformer sub-station, changing the 6600-volt alternating current to 600 volts direct current. The motor end of these motor generator sets will be connected direct to the trolley circuits, one phase being fed from the trolley coming from Chesapeake Junction and the other from the Academy Junction transformers. A feeder regulator will be placed in one phase so that the motor generator sets will act as balancers, permitting the Academy Junction transformers connected on phase B to feed into the trolley line supplied by the Chesapeake Junction transformers on phase A. In addition to acting as balancers and to supplying current to the cars in the car houses, the motor generator sets will also supply direct current to the motors in the repair shops located at this point.

Government regulations within the District of Columbia prohibit the use of the track return, so that within this section the cars will be operated with a double trolley. This portion of the tracks, as well as that within the city of Baltimore, is at present operated by direct current, and the new cars are designed to operate on direct current over these sections of the line.

As already stated, the present Washington, Baltimore & Annapolis Railway Company which is constructing the line is quite distinct from the initial corporation. The new company, under the head of its president, Geo. C. Bishop, has considerably broadened the former plans. Land has been purchased for a wider right of way along the route, and new bridges are being built so that the roadbed will be excellent. The engineering work is in charge of the Roberts & Abbot Engineering Company, of Cleveland, Ohio, and contracts have been placed with the General Electric Company for the complete electrical equipment. The construction and operation of this road will be watched with great interest, as it is one of the largest and most important installations of the single-phase railway system ever undertaken.





END AND SIDE VIEWS OF DETROIT PARLOR CAR

PRIVATE CAR OF THE DETROIT UNITED RAILWAYS

In the construction of the private car of the Detroit United Railways the mistake of dividing the car into too many compartments, and thereby destroying the roominess and comfort of the car, has been avoided. This car was recently constructed in the shops of the Detroit United Railways for use of the officials of the system. It is 51 ft. 10 ins. in length over bumpers, and 8 ft. 4 ins. in width over all. A large observation room takes up the greater portion of the front of the car. Behind this, and opening into a side aisle, is a bed room measuring 7 ft. 9 ins. by 5 ft. 5 ins., and to the rear of this is an office of the same size. A fully equipped kitchen measuring 34½ ins. by 5 ft. 5 ins., as well as a toilet room is provided.

The rear platform is 6 ft. 2 ins. long, and is provided with a grilled bronze balustrade surmounted by a brass rail. A swinging gate on one side closes the platform.

The car is mounted on Baldwin trucks equipped with steel-tire wheels. It is provided with four Westinghouse No. 121 motors and Westinghouse electro-pneumatic control system.

NEW ALL STEEL CARS

Since the adoption of all steel cars by the Interborough Rapid Transit Railway Company in its subway service the advantages of the steel car as to strength, resistance and ultimate operating economy have attracted the attention of many surface and elevated railway managements. The first strictly city railway to install a steel car was undoubtedly the New York City Railway Company, but since that was put in operation other practical examples of the all steel car have appeared for surface and elevated traction. Several of these, built by the Pressed Steel Car Company, of Pittsburg, are illustrated herewith.

The first car turned out of the new plant of this company was completed in the early spring of the present year for the United Railways of San Francisco, an all steel street car of the "California" type. This car so greatly resembles a wooden car in outside appearance that it requires a practiced eye to distinguish one from the other. This similarity of external appearance was effected by covering practically all the rivets on the outside of the car body with special drawn moldings and graining all the steel parts such as posts, panels, etc., to conform to the ordinary wood finish. Fig. 1 gives a general view of the car, which seats forty persons, and the general dimensions are as follows:

Length over all, 40 ft. 6 ins.
Length over closed part of car, 13 ft. 2 ins.

FIG. 1.—STEEL BODY FOR COMBINATION CAR, SAN FRANCISCO

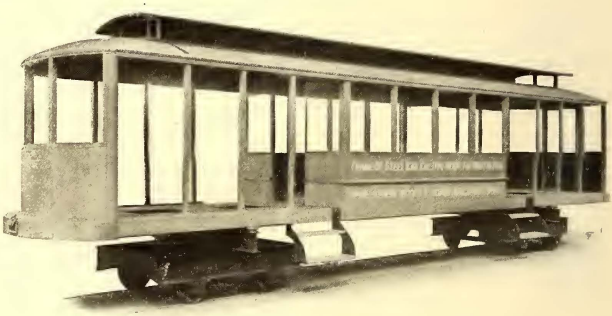


FIG. 2.—STEEL FRAMING OF SAN FRANCISCO CAR

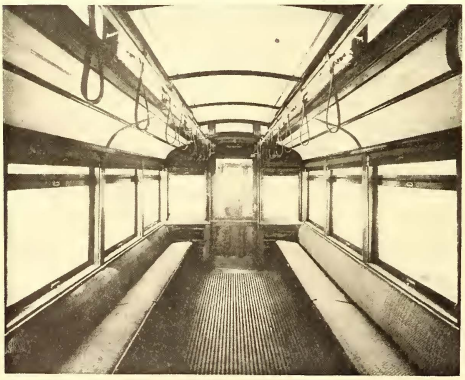


FIG. 3.—INTERIOR OF CLOSED COMPARTMENT OF SAN FRANCISCO STEEL CAR

Distance from center to center of trucks, 23 ft. 6 ins.
Width over side sills, 7 ft. 10½ ins.
Width over side sheets at belt rail, 8 ft. 2¼ ins.
Height from top of rail to top of roof, 11 ft. 5½ ins.

The underframe, side sheets, outside finish to eaves of closed section of car and the platform posts in open sections are made of steel in the form of plates, rolled or pressed to suit requirements. The interior finish, such as doors, window sash, floor mats and deck moldings, are of wood. The floor is of 3-32 steel plates with one course of wooden flooring; the lower and upper-deck ceilings consist of steel sheets. The carlines and purlins are made of rolled angles. The underframe consists of 6-in. rolled center sill channels. The side sill construction is built up of Z-bar and pressed angle plates; the bumper is of 8-in. rolled channel pressed to shape.

To carry the load and weight of the car entirely on the side construction, care had to be taken in providing openings for steps next to the closed car section between trucks without weakening the car at these particular points. This part has been successfully worked out by placing reinforcing angles along the side of the step opening extending past the body bolster. The longitudinal seat supports in closed car section are built up of steel plates and angle construction. The body bolster is made of steel truss construction, and to take Peckham 14-B-3S trucks and 33-in. wheels. The equipment also includes Wood's patent gates, walkover cross seats in the

open-car sections, and longitudinal rattan seats and backs in the closed compartment.

The next steel cars built in the new passenger car plant of the Pressed Steel Car Company consisted of three steam railway passenger coaches for the Southern Railway, all of which have been delivered, and forty all steel passenger car bodies for the Philadelphia Rapid Transit Company, the greater part of which have now been completed and delivered. The trucks for the latter were built by the Tate Manufacturing Company and applied by the railroad company.

One of the Southern Railway coaches was exhibited at the convention of railway mechanical officials at Atlantic City in June, and was illustrated and described in that connection in the Street Railway Journal for June 23. End and interior views are presented in Figs. 4 and 5. In this case the purchaser desired wooden finish above the window rail, but the framing of the car throughout is of steel, the vestibules all steel and outside sheathing to window rail of steel plate.

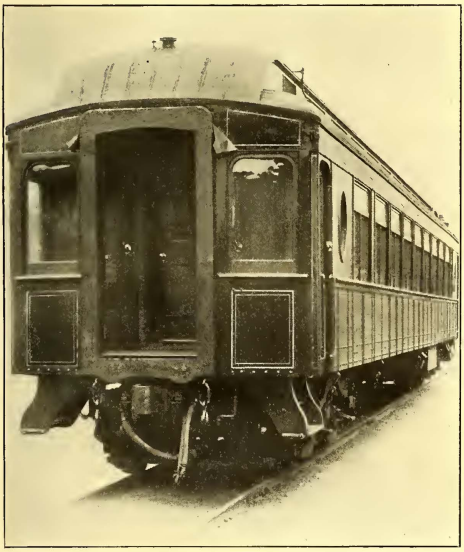


FIG. 4.—END VIEW OF SOUTHERN RAILWAY CAR

Of particular interest here, however, is the type of car built for the Philadelphia Rapid Transit Company and shown in Figs. 6, 7 and 8. These forty cars are for service on the Market street elevated and subway line, and the reproduction in Fig. 8 gives an idea of the pleasing external appearance of the car. The design is of steel throughout with non-combustible flooring composition, and it is to all intents shock and fire proof. The outside sheathing is of cold rolled steel and the underframe consists of deep fishbelly side sills, with cross-

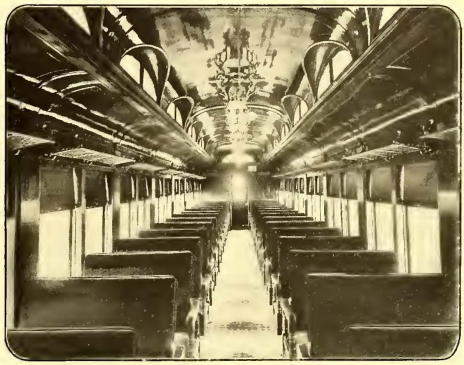


FIG. 5.—INTERIOR SOUTHERN RAILWAY CAR

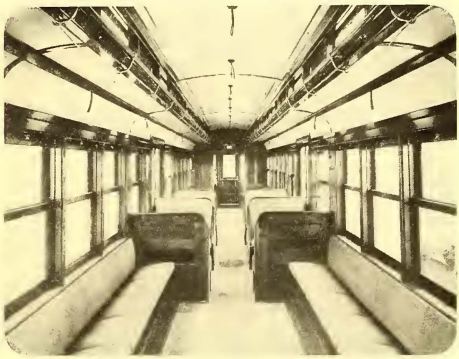


FIG. 6.—INTERIOR OF PHILADELPHIA SUBWAY CAR

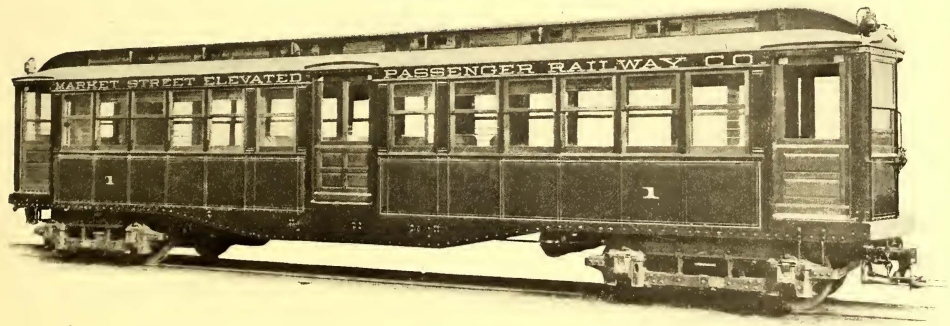


FIG. 8.—STEEL CAR FOR ELEVATED AND SUBWAY SERVICE IN PHILADELPHIA

bearers and connections in girder form. The general dimensions are as detailed below:

Length over platform (over all), 49 ft. 7¼ ins.
Length over door posts, 40 ft. 6¼ ins.

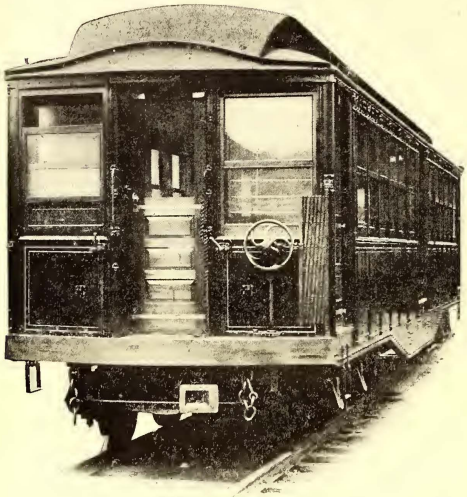


FIG. 7.—END OF STEEL CAR FOR PHILADELPHIA ELEVATED AND SUBWAY SYSTEM

Length inside of car (end lining), 39 ft. 6¼ ins.
Width of car outside of side sheets, 8 ft. 7 ins.
Width of car inside, 7 ft. 7¾ ins.
Height from rail to top of floor, 3 ft. 10 ins.
Height from floor to ceiling center, 8 ft. 6½ ins.
Height from rail to top of car, 12 ft. 7 ins.
Opening for vestibule side door (between door posts), 2 ft. 9 ins.
Width of end door opening, 3 ft. 2½ ins.
Width of center door opening (side), 3 ft. 4 ins.
Distance from center to center of trucks, 34 ft. 6 ins.
Width over eaves—upper deck, 5 ft, 6¾ ins.
Width over eaves—lower deck, 8 ft. 8⅝ ins.
Width of vestibule end door opening, 2 ft.

Several details of equipment and interior fittings follow:

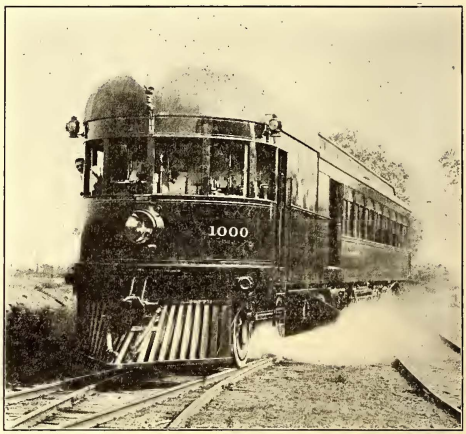
Automatic air brakes complete with automatic air couplers; also bevel-geared vertical hand brakes on each end of car. Twelve carlines per car composed of 1½-in. x 1½-in. steel. Van Dorn coupler and draw-bar. Pantasote curtains with Forsythe ring fixtures No. 48. Mahogany doors, lower half paneled, upper half with one light of ¼-in. plate glass. The side doors and those at the center are arranged for opening and closing by pneumatic devices from either end of the car. The vestibule side and center doors have elastic strikers. The electric lighting equipment consists of twenty-five single fixtures, one headlight and two markers on each end. There is a complete system of electric heating and apparatus for power for control. The lighting, heating and control apparatus were furnished by the purchaser and the last two items were installed by the railroad.

The underframe is covered with corrugated steel sheets and Monolithic flooring composition. The interior finish is of straight-grained mahogany. There are two motorman's cabs on each car, at diagonally opposite corners, right-hand side. The roof is constructed of tongue and groove poplar ½ in. thick and covered with 8-oz. cotton duck. There are two safety chains on each end, equipped with 4-in. diameter springs. Pantagraph safety gates are applied on platform corners opposite the motorman's cabs. Mason safety treads are applied at each end door. The seating arrangements consist of four longitudinal seats for nine persons each and eight cross seats in center of car for two persons each. Each car is fitted with twelve pairs standard automatic ventilators, and there are twenty-four side windows per car, eighteen of which have upper sash movable and lower sash stationary. The cars are painted Tuscan red with gold stripes.

A NEW STEAM MOTOR COACH

The Kobusch-Wagenhals Steam Motor Car Company, of St. Louis, has just completed a steam coach developed by W. G. Wagenhals, in partnership with George J. Kobusch, president of the St. Louis Car Company. The car is 82 ft. 6 ins. long; height from rail to top of stack, 15 ft. 2 ins.; width, 10 ft. over all; weight, 178,560 lbs., which is stated to be at least 40,000 lbs. heavier than previous cars of this type. The underframing is of steel and the body construction and fittings are of the standard steam coach type except the machinery and engineer's section, which is constructed of steel. There are fifty-two seats in the main compartment. Adjacent to the engine compartment, which is 12 ft. long, is a 10-ft. baggage room.

The power section contains a marine type water-tube boiler

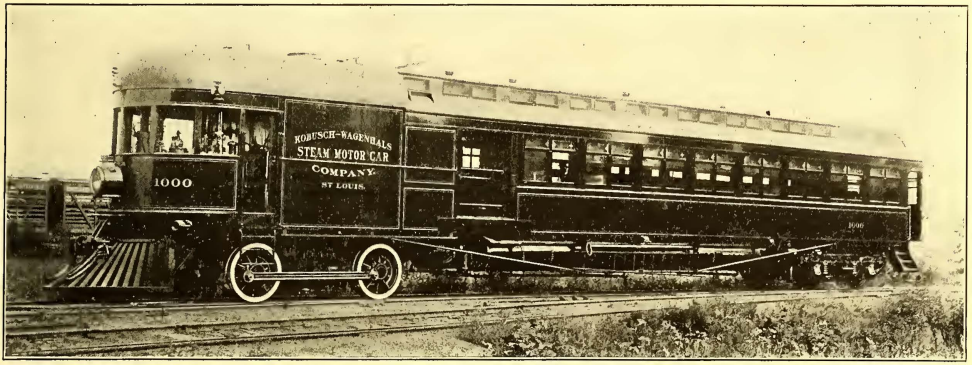


END VIEW OF STEAM MOTOR CAR

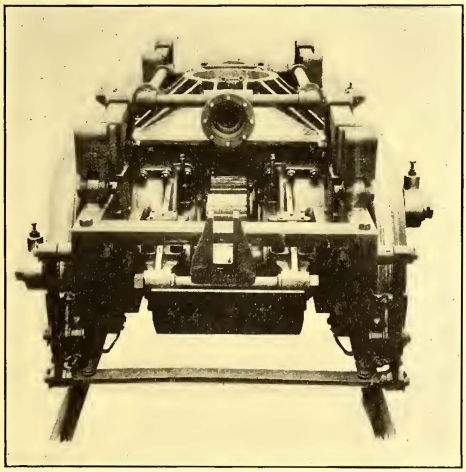
placed over the motor truck. This boiler is 77 ins. in width and breadth. It has 1215 sq. ft. of heating surface, 43.5 sq. ft. of grate area, and carries a working pressure of 250 lbs. per sq. in., though built for a cold-water test of 500 lbs. It is fired with crude oil through five burners. One thousand gallons of this oil are carried in a tank underneath the car body. In this tank the oil is heated by a portion of the exhaust steam and a pressure of air, obtained through a reducing valve from the main reservoir of the brake system, forces the oil up to the burners, where it is sprayed by either steam or air or both, as may be desired. Two thousand gallons of water are carried in two tanks also under the body of the car, and the feed water passes through heating coils at the top of the boiler before entering the boiler proper. In addition to the boiler and its attachments, the compartment contains a Westinghouse 9½-in. air pump and a complete E-T brake equipment. Steam is conveyed to the engines by a

flexible steam pipe consisting of ball joints and an expansion joint, which arrangement has been found to prevent steam leakage even at 300 lbs. pressure.

A novel departure of this car is the motor truck, which is designed along electric railway lines, the engine being hung on the axle in the same manner as electric motors. Side rods have been added to utilize all four wheels. The engine, which is rated at 275 hp, has piston valves and 11-in. x 12-in. cylinders. The frame of the cylinder end is hung on a single point spring suspension just back of the truck center casting. At the other end the engine frames are extended beyond the crank shaft so as to rest on and be supported by the axle of the forward wheels. This affords a three-point suspension



SIDE VIEW OF STEAM MOTOR CAR



END VIEW OF TRUCK

for the engines, while a still further extension of the engine frames enables the two to be rigidly connected by a heavy shouldered bolt. A pinion on the crank shaft meshes with a gear wheel on the axle, as in the gearing of electric motors. Both engines are enclosed in crank cases so as to be self-oiling as well as protected from dust, etc., and the gears are also encased. The oil cups of the other parts are located outside the truck frame and reach their particular bearings through small pipes. The exhaust is used to heat the coach and the fuel oil through it is directed out the stack when not required for these purposes.

The wheels are 42 ins. in diameter, and with the present pinion and gear a tractive effort of 8000 lbs. or a speed of 40 miles per hour is secured. The truck center casting and frames are of cast steel and the axle bearings are equipped with locomotive type boxes and cellars. The trailer truck is of the standard M. C. B. four-wheel type, with its center 53 ft. from that of the motor. It has a wheel base of 8 ft. and 36-in. diameter wheels.

The hauling capacities of this car at various speeds are as follows: At 5 miles per hour on level, 538 tons; at 5 miles per hour on 1 per cent grade, 299 tons; at 5 miles per hour on 2 per cent grade, 172 tons; at 5 miles per hour on 3 per cent grade, 120 tons, and at 41.6 miles per hour on a level, 205 tons. The above includes the weight of motor car.

The absence of vibration from the engine is a noticeable feature of this car. This is due to the separation of the motor truck from other than a center casting connection with the car. Only three or four simple disconnections are required to enable the truck to be run out from under the car for repair or exchange with another truck. Within a few days the car will be sent on a demonstration trip around the country, after which it will be put into regular service on the Missouri Pacific Railway.

The Lake Shore Electric Railway has just issued a unique folder showing a lithographic map in several colors of its own line and connecting lines in Northern Ohio. It contains a time table of the Lake Shore and of the electric connections at all points. It is a handsome piece of lithographic work.

An unofficial statement of the traffic over the lines of the Brooklyn Rapid Transit Company for the recent Mardi Gras week at Coney Island says the figures are unprecedented in the history of the company and probably in the transportation world. The celebration began Sept. 17, and is said to have resulted in an average daily increase in earnings for the month of $5,600 over those of a year ago, this in spite of unfavorable weather and the discontinuance of the parade on Saturday night. Figures for July, August and September show daily and monthly gains respectively for these months of $2,000 for July with a total of $62,000 as the increase for the month; $4,000 for August with a total of $124,000 for the month, and $5,600 for September, with a total for the month of $168,000.

EXHIBITORS AT COLUMBUS

The following is a list up to Oct. 8 of those manufacturing companies which have applied for and been assigned space in the Columbus Convention exhibit buildings. The diagram on the inset herewith shows the location of the different exhibits within the buildings. The number, 1, 2, 3, etc., refers to the number of the building. The letter, A, B or C, designates the section. Those having track space are given in the second list.

3 A Allis-Chalmers Company, Milwaukee, Wis.
6 A American Advertising Indicator Company, St. Joseph, Mo.
3 B American Brake-Shoe & Foundry Company, Mahway, N. J.
3 B American Instrument Company, Philadelphia, Pa.
1 B American Railway Supply Company, New York.
6 C American Water Softener Company, Philadelphia.
3 B Anderson, A. & J. M., Manufacturing Company, Boston, Mass.
4 B Atlas Railway Supply Company, Chicago, Ill.
4 C American Mason Safety Tread Company, Boston, Mass.
4 C American Steel & Wire Company, Chicago, Ill.
3 A Atha Steel Castings Company, Newark, N. J.
4 B Adams & Westlake Company, Chicago, Ill.
4 A Acme Automatic Street Indicator Company, Cleveland, Ohio.

3 B Bache & Company, Semon, New York.
2 D Baldwin Steel Company, Pittsburg, Pa.
6 B Baldwin & Rowland Switch & Signal Company, New Haven, Conn.
4 B Bayonet Trolley Harp Company, Springfield, Ohio.
4 C Berry Brothers, Ltd., Detroit, Mich.
6 C Bird, F. W., & Son, East Walpole, Mass.
3 A Blake Signal & Manufacturing Company, Boston, Mass.
3 B Brown, Harold P., New York City.
4 B Buckeye Engine Company, Salem, Ohio.
1 B Brady Brass Company, New York.
4 C Bowser, S. F., & Company, South Bend, Ind.
4 B Booth, L. M., Company.
6 C Buckeye Third-Rail Shield Company, Columbus, Ohio.
6 A Buhne Metal Company, New York.

2 C Cambria Steel Company, Philadelphia, Pa.
2 A Carnegie Steel Company, Pittsburg, Pa.
6 A Cary Automatic Coupler Company, Chicago.
6 B Carey, Philip, Manufacturing Company, Cincinnati, Ohio.
6 A Chicago Pneumatic Tool Company, Chicago, Ill.
6 B Chase Foundry & Manufacturing Company.
6 C Chase-Shawmut Company, Newburyport, Mass.
2 C Cleveland Frog & Crossing Company, Cleveland, Ohio.
6 B Climax Stock Guard Company, Chicago, Ill.
4 B Coleman, Emil, & Company, New York.
6 C Columbia Machine Works & Malleable Iron Company, Brooklyn, N. Y.
4 A Consolidated Car Fender Company, Providence, R. I.
4 C Consolidated Car Heating Company, New York.
4 A Cook's Railway Appliance Company, Kalamazoo, Mich.
6 B Crouse-Hinds Company, Syracuse, N. Y.
6 B Consolidated Engine Stop Company, New York.
6 C Cook, C. Lee, Manufacturing Company, Louisville, Ky.
1 C Creaghead Engineering Company, Cincinnati, Ohio.
1 B Curtain Supply Company, Chicago, Ill.

6 B Davis Pressed Steel Company.
4 A Dearborn Drug & Chemical Works, Chicago, Ill.
4 B D. & W. Fuse Company, Providence, R. I.
1 A Duff Manufacturing Company, Pittsburg, Pa.
3 B Dayton Manufacturing Company, Dayton, Ohio.
4 C Dixon, Jos., Crucible Company, Jersey City, N. J.
1 B Duplicate Transfer & Rebate Company, Philadelphia, Pa.
3 A Dossert & Company, New York.

1 C Edwards, O. M., Company, Syracuse, N. Y.
1 C Electric Storage Battery Company, Philadelphia, Pa.
3 B Earll, Chas. I., New York.
1 A Electric Service Supplies Company, Chicago, Ill.
3 B Eclipse Railway Supply Company, Cleveland, Ohio.
4 A Electrical Review, New York.
6 A Electric Railway Improvement Company, Cleveland, Ohio.
4 B Elliott Brothers Electric Company, Cleveland, Ohio.

6 A Fay, J. A., & Egan Company, Cincinnati, Ohio.
4 B Franklin Car Heating Company, Syracuse, N. Y.
4 B Franklin Electric Manufacturing Company, Hartford, Conn.
4 C Felt & Tarrant Manufacturing Company, Chicago, Ill.

4 A Galena Signal Oil Company, Franklin, Pa.
3 B Garton, W. R., Company, Chicago, Ill.
3 A General Electric Company, Schenectady, N. Y.
4 A Gold Car Heating & Lighting Company, New York.
1 A Goldschmidt Thermit Company, New York City.
1 B Globe Ticket Company, Philadelphia, Pa.
2 D Griffin Wheel Company, Chicago, Ill.
3 B General Systems Company, Dayton, Ohio.
6 A General Railway Supply Company, Pittsburg.
2 D Grip Nut Company, Chicago, Ill.

4 B Hale & Kilburn Manufacturing Company, Philadelphia, Pa.
4 B Harrison, F. P., Electric & Manufacturing Company, Inc., New York.
6 B Harrison Safety Boiler Works, Philadelphia, Pa.
4 B Hastings, George S., & Company, Cleveland, Ohio.
4 B Haywood Bros. & Wakefield Company, Wakefield, Mass.
6 B Heany Fireproof Wire Company, Chester, Pa.
1 B Helios Manufacturing Company, New York.
6 B Home Rubber Company.

2 D Indianapolis Switch & Frog Company, Indianapolis, Ind.
1 B International Register Company, Chicago, Ill.
1 C International Sprinkler Company, Philadelphia, Pa.
6 B Interurban Railway Journal, Indianapolis, Ind.
6 A International Fence & Fireproofing Company, Columbus, Ohio.

2 C Jones & Laughlin Steel Company, Pittsburg, Pa.
6 A Jenkins Automatic Fender Company, The, Toronto, Ont.
4 C Johns-Manville, H. W., Company, New York City.

1 C Kalamazoo Railway Supply Company, Kalamazoo, Mich.
3 B Keystone Brake-Shoe Company, New York.
3 B Kinnear Manufacturing Company, Columbus, Ohio.

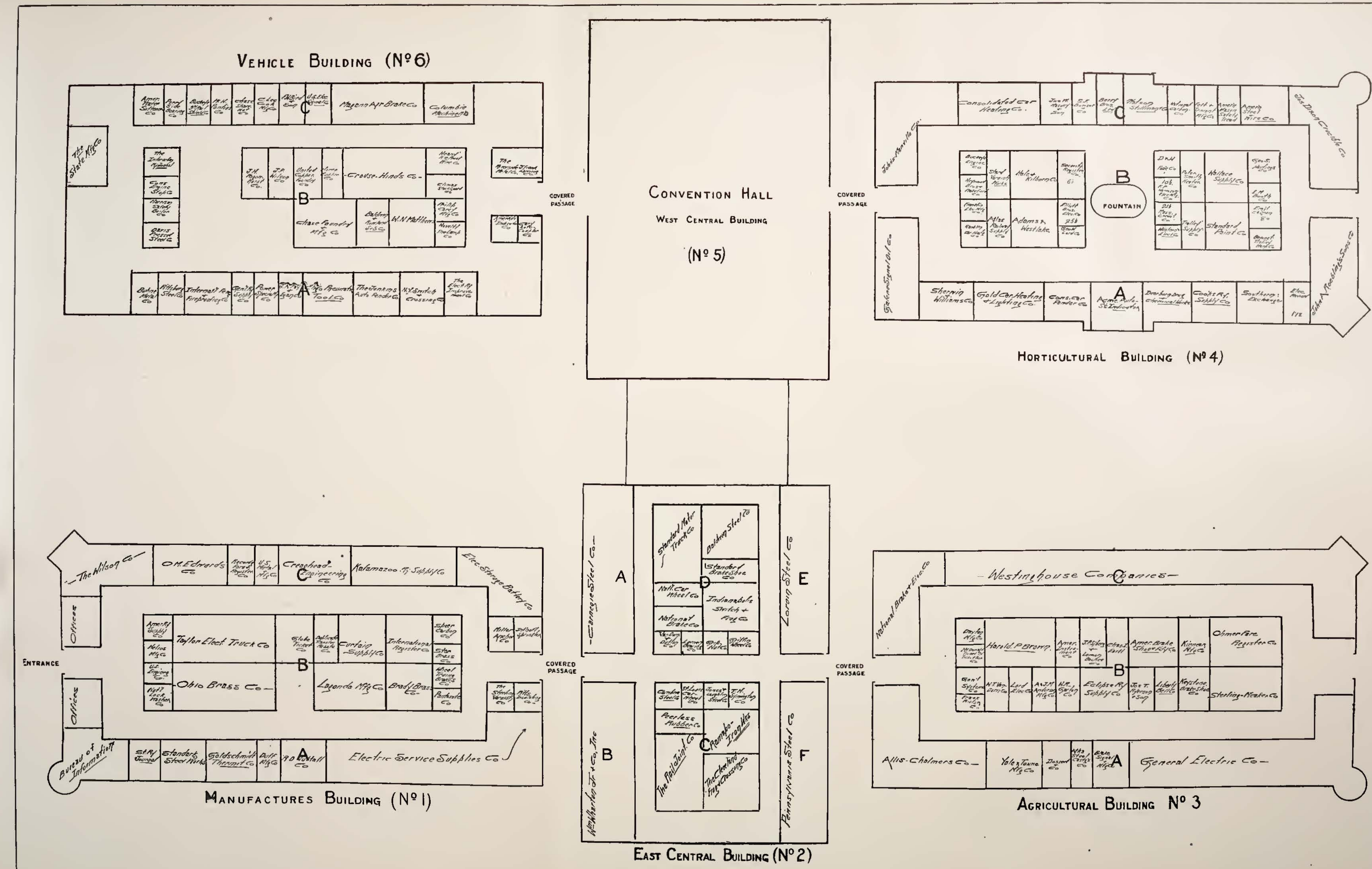
1 B Lagonda Manufacturing Company, Springfield, Ohio.
3 B Liberty Bell Company, Bristol, Conn.
6 C Lanning, G. Frank, & Company, Pittsburg, Pa.
2 E Lorain Steel Company, Philadelphia, Pa.
3 B Lord Electric Company, Boston, Mass.
4 B Lord Company, George W., Philadelphia, Pa.
2 D Lumen Bearing Company, Buffalo, N. Y.

6 C. Magann Air Brake Company, Ltd., Detroit, Mich., and Toronto, Can.
3 B MacDonald Ticket & Ticket Box Company, Cleveland, Ohio.
6 B Matthews, W. N., & Bro., St. Louis, Mo.
4 B Massachusetts Chemical Company, Walpole, Mass.
4 C Masury, John W. & Son, Brooklyn, N. Y.
1 C Miller Anchor Company, Norwalk, Ohio.
1 A McGraw Publishing Company, New York City.

2 D National Brake Company, Buffalo, N. Y.
3 C National Brake & Electric Company, Milwaukee, Wis.
4 C National Carbon Company, Cleveland, Ohio.
1 B National Lock Washer Company, Newark, N. J.
1 A Nuttall Company, R. D., Pittsburg, Pa.
2 D National Car Wheel Company, Pittsburg, Pa.
6 A New York Switch & Crossing Company, Hoboken, N .J.
6 B Novelty Lamp Manufacturing Company, Inc.

1 B Ohio Brass Company, Mansfield, Ohio.
3 B Ohmer Fare Register Company, Dayton, Ohio.

1 B Pantasote Company, New York City.
2 C Peerless Rubber Company, New York.
2 F Pennsylvania Steel Company, Philadelphia, Pa.
6 C Perry Side Bearing Company.
1 A Pittsburg Insulating Company, Pittsburg, Pa.
6 A Pittsburg Steel Company, Pittsburg, Pa.


VEHICLE BUILDING (No. 6)
Magenn Air Brake Co
Columbia Machine Co
The State Mfg Co
Crouse-Hinds Co
Chase Foundry & Mfg Co
W. N. Matthews
Accurate Tool Co
The Jenkins Auto Fender Co
N.Y. Switch & Crossing Co
CONVENTION HALL
WEST CENTRAL BUILDING
(No. 5)
COVERED PASSAGE
COVERED PASSAGE
Consolidated Car Heating Co.
Jos. Dixon Crucible Co
John A. Roebling's Sons Co
Galena Signal Oil Co
FOUNTAIN
Adams & Westlake
Standard Paint Co
Sherwin Williams Co
Gold Car Heating & Lighting Co
Cons. Car Fender Co
HORTICULTURAL BUILDING (No. 4)
The Wilson Co
O.M. Edwards Co
Creaghead Engineering Co
Kalamazoo Ry. Supply Co
Elec. Storage Battery Co
Offices
ENTRANCE
Taylor Elect. Truck Co
Ohio Brass Co
Curtain Supply Co
International Register Co
Lagonda Mfg Co
Brady Brass Co
Bureau of Information
Standard Steel Works
Goldschmidt Thermit Co
Electric Service Supplies Co
MANUFACTURES BUILDING (No. 1)
COVERED PASSAGE
Carnegie Steel Co
Standard Motor Truck Co
Baldwin Steel Co
Standard Brake Shoe Co
Nat'l Car Wheel Co
Indianapolis Switch & Frog Co
National Brake Co
Lorain Steel Co
Wm. Wharton Jr. & Co. Inc
Peerless Rubber Co
Ramapo-Iron Works
The Rail Joint Co
The Cleveland Frog & Crossing Co
Pennsylvania Steel Co
EAST CENTRAL BUILDING (No. 2)
COVERED PASSAGE
National Brake & Elec. Co
Westinghouse Companies
Harold P. Brown
Eclipse Ry. Supply Co
Ohmer Fare Register Co
Sterling-Meaker Co
Allis-Chalmers Co
Yale & Towne Mfg Co
General Electric Co
AGRICULTURAL BUILDING No. 3

6 A Power Specialty Company, New York.
6 C Pontius, W. H., Company, Columbus, Ohio.

2 C Rail Joint Company, New York City.
2 C Ramapo Iron Works, Hillburn, N. Y.
1 C Recording Fare Register Company, New Haven, Conn.
6 C Riverside Metal Company, Atlantic City, N. J.
3 B Ridlon Company, Frank, Boston, Mass.
4 A Roeblings, John A., Sons Company, Trenton, N. J.
3 B Ryerson, Jos. T., & Son, Chicago, Ill.

4 A Sherwin-Williams Company, Cleveland, Ohio.
4 A Southern Exchange Company, New York City.
1 B Speer Carbon Company, St. Marys, Pa.
4 B Standard Paint Company, New York City.
1 A Standard Steel Works, Philadelphia, Pa.
4 B Smith, Peter, Heater Company, Detroit, Mich.
4 B Security Register & Manufacturing Company, New York.
4 B Standard Varnish Works, New York.
1 B Star Brass Works, Kalamazoo, Mich.
1 A Sterling Varnish Company, Pittsburg, Pa.
2 C Symington Company, he T. H., Baltimore, Md.
2 C St. Louis Car Wheel Company, St. Louis, Mo.
3 B Sterling-Meaker Company, Newark, N. J.
1 A STREET RAILWAY JOURNAL, New York City.
3 B Sjoberg, J. P., & Company, New York.
2 D Standard Brake-Shoe Company, Aurora, Ill.
2 D Standard Motor Truck Company, Pittsburg, Pa.
6 C State Manufacturing Company.

1 B Taylor Electric Truck Company, Troy, N. Y.
4 B Trolley Supply Company, Canton, Ohio.

1 C United States Metal & Manufacturing Company, New York.
1 B United States Engineering Company, Philadelphia, Pa.
6 C U. S. Electric Signal Company, West Newton, Mass.
6 B United Copper Foundry Company, Boston, Mass.

3 B Van Dorn Company, W. T., Chicago, Ill.
2 D Van Dorn & Dutton Company, Cleveland, Ohio.

6 B Wagonhurst, J. H., Company.
4 B Wallace Supply Company, Chicago, Ill.
4 C Watson, Stillman Company, New York.
4 B Western Electric Company, Chicago, Ill.
3 C Westnghouse Companies, Pittsburg, Pa.
2 A Wharton, William, Jr., & Company, Philadelpha, Pa.
1 B Wheel Truing Brake-Shoe Company, Detroit, Mich.
1 C Wilson Company, The, Chicago, Ill.
6 B Wilson, J. P., Company.

3 A Yale & Towne Manuacturing Company, New York.

TRACK SPACE

The following companies will also have track space:

American Locomotive Company, Schenectady, N. Y.
Brill Company, J. G., Philadelphia, Pa.
Jewett Car Company, Newark, Ohio.
McGuire-Cummings Manufacturing Company, Chicago, Ill.
Niles Car & Manufacturing Company, Ohio.
Pedric Company, A. B.
Pressed Steel Car Company, Pittsburg, Pa.
St. Louis Car Company, St. Louis, Mo.

ENTERTAINMENTS AT THE COLUMBUS CONVENTION

The Manufacturers' Association, which has charge of the social side of the Columbus Convention, has made elaborate arrangements for the entertainment of the ladies during the day time and for that of all the attendants in the evening. A complete program of this portion of the convention is to be published and will be distributed at Columbus. The following, however, are the main features which have already been decided upon:

Tuesday Evening—Reception and ball at Memorial Hall.

Wednesday Evening—One theater party at the Southern Theater in the play "She Stoops to Conquer"; also another theater party at the Shubert Theater in the play "Fantana."

Thursday Afternoon—Reception to the ladies at the Arlington Country Club.

Thursday Evening—Annual banquet at the Southern Hotel.

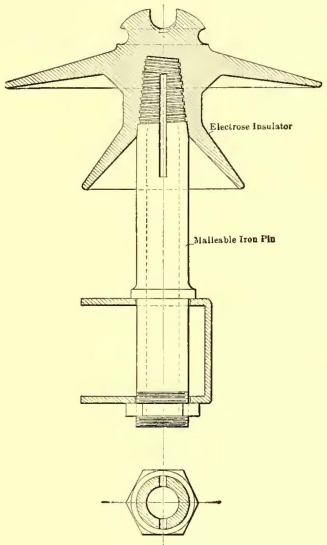
Friday Evening—Vaudeville entertainment at the Southern Theater.

In addition there will be interurban trolley parties, automobile rides, golfing and a number of other forms of amusement, most of which will be specially arranged for the ladies in attendance at the convention.

ELECTROSE HIGH-TENSION INSULATORS

At the recent annual convention of the Canadian Electrical Association, Harold W. Buck, chief electrical engineer of the Canadian Niagara Power Company, gave a description of the insulator used on the transmission line to Fort Erie, which line will supply current to Buffalo. The length of the line, which is of 37-strand aluminum of 500,000-circ.-mils section, is 15 miles, the voltage being 24,000.

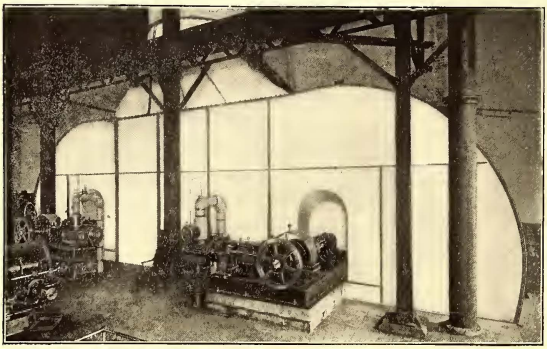
The material of the insulator which is shown in the accompanying cut is made by Electrose Manufacturing Company, Brooklyn, N. Y. "Electrose" is an insulating compound which has been largely used in telephone, telegraph and electric railway work, and is now being employed for high-tension insulation. Mr. Buck states that this material is a very good insulator, is very strong mechanically and is entirely free from cracks and other defects which are common in glass and porcelain. Similar insulators have been used on the Buffalo transmission lines of the Niagara Falls Power Company for the past three years, and they are the only insulators on those lines which have caused no trouble. Mr. Buck adds that it is impossible to shatter Electrose insulators by stone throwing, and they will frequently turn a rifle bullet without being damaged seriously.



HIGH-TENSION INSULATOR

THE STEAM GENERATING EQUIPMENT OF THE SPRING STREET STATION, COLUMBUS

A brief description is published in Section II. of this issue of the Spring Street station of the Columbus Railway & Light Company. This station is perhaps the most interesting of all the stations in Columbus, partly because it generates most of the railway current used, and partly because it is equipped with both natural and mechanical draft. An account of the steam generating equipment may therefore not be out of place. The station contains two 1000-kw, one 850-kw and two 500-kw direct-current generators driven by Green-Wheelock compound engines, also two 500-kw alternating current turbo-generators supplying current for lighting. Steam at 175 lbs. gage pressure is supplied by four Babcock & Wilcox boilers connected to a brick stack and six served by mechanical draft fans. Four more boilers, which are to be connected to the mechanical draft fans, are being installed.



INDUCED DRAFT AT SPRING STREET STATION, COLUMBUS

Each of the four boilers connected to the stack contains 168 tubes, 4 ins. in diameter and 18 ft. long. There are also two 42-in. drums, 23 ft. 5⅜ ins. long, so that the total heating surface of each boiler, assuming that half of the cylindrical surface of the drums is in contact with the hot gases, is 3424 sq. ft., equivalent to 311 hp at a rating of 11 sq. ft. per horse-power or 342 hp on a 10 sq. ft. per hp rating. These four boilers have Dutch ovens, two at present fired with gas and the other two hand-fired with coal. The brick stack drawing the gases from these furnaces is 203 ft. high, including a 50-ft. extension added a short time ago. Between the boilers and the stack is a Green economizer of 800 tubes, aggregating 2200 sq. ft. of heating surface, or a little more than 50 per cent of the boiler surface with which it is connected.

The mechanical draft part of this plant at present comprises 2100 boiler horse-power, although boilers now being put in will bring this up to 3500 hp, for which capacity the fans were designed. The furnaces of these boilers have travelling chain grates, and although the same coal is burned as in the Dutch ovens with natural draft, namely, coarse slack costing about $1.25 per ton, there is less smoke from the short funnel into which the fans discharge than from the tall stack. The fans were supplied by the Green Fuel Economizer Company, and are shown in the accompanying engraving. As they are located in the main engine room, the housings are covered with magnesia plaster to prevent radiation. The overhung wheels measure 18 ft. x 6 ft., and are driven by center-crank engines, the two water-cooled fan bearings for each wheel being supported on the engine foundations. At the rear of the housing is a sliding damper which shuts off either fan as desired, one standing as a "spare." Similarly, there is a two-way butterfly damper in the discharge passage, operated by a rope in reach of the engine-room floor. The draft is regulated by varying the cut-off of the engines while running by means of a hand wheel which shifts a block in a link of the valve gear. This method is considered more economical than regulation by throttling either the engine or the draft. Between the fans and the boiler are two Green fuel economizers, one of 600 tubes and one of 300 tubes, or 10,800 sq. ft. of economizer surface altogether, which is about 78 per cent of the boiler surface. Recording thermometers register the temperature of the water on entering and leaving the economizers and the average rise in temperature of the feed water with the present boiler capacity is about 90 per cent.

The main engines exhaust into a Wheeler surface condenser, the exhaust passing through a Cochrane oil separator on the way. Although the condensation is returned through open feed-water heaters, receiving the exhaust of the pumps and fan engines directly to the boilers, no traces of oil have appeared in the latter, which are cleaned every sixty to eighty days. The condenser circulating water is taken from the Scioto River, and after leaving the condensers discharges into an overflow tank from which the "make-up" for the boilers is drawn.

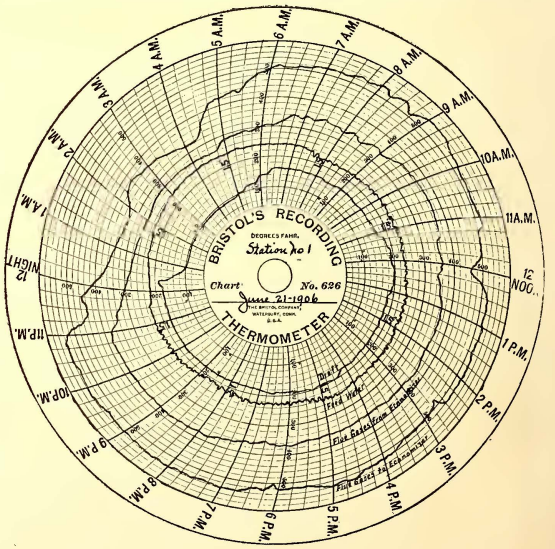


CHART SHOWING TEMPERATURES AND DRAFTS, COLUMBUS

A chart for June 21, 1906, from one of the Bristol recording thermometers, is shown above, the records from other charts being superimposed, so that the one diagram shows for

simultaneous moments, (1) the temperature of the flue gases entering the economizers, (2) the temperature of the gases leaving the economizers, (3) the temperature of the feed water leaving the economizer and entering the boiler, and (4) the intensity of the draft in inches of water. It will be noticed that the gases leaving the boilers are above 500 deg. practically all of the time except from midnight to 6 a. m., and that the economizer reduces this temperature by 150 deg. on the average. The mean of the feed-water thermometer readings is 227 deg., although the actual average temperature of the water cannot be stated in the absence of hourly readings of the water meter. As the average temperature of the feed water entering the economizer from the heaters is about 150 deg., this corresponds to an average rise of temperature of about 75 deg., which in turn indicates a fuel saving of 7 per cent. The average hourly evaporation from the boilers served by this fan is 63,000 lbs. of water. The above plant is in charge of F. R. Brosius, chief engineer, to whom this paper is indebted for the Bristol chart. There is a complete ash and coal handling equipment and the plant is a model in many respects.

INDURATED FIBER FOR INSULATING PURPOSES

Plans and description of the under-running third-rail system adopted by the New York Central Railroad Company for its electric zone were published in the STREET RAILWAY JOURNAL for Sept. 2, 1905. At that time the company was planning to protect all of its third rail with a wooden covering. During September, 1905, however, a portion of the New York Central experimental third-track system at Schenectady was covered with sections of indurated fiber made by the Indurated Fiber Company, of Lockport, N. Y., and the material has proved so satisfactory that a considerable portion of the New York Central tracks in its electric zone near New York is being equipped with this material. It is also being used on the under-running third-rail system which the West Shore Railroad is installing between Utica and Syracuse, and which will be put in operation about Dec. 1.

Indurated fiber has been in use for a long time for the manufacture of pails, jars and other household goods, and for such purposes has been found to be strictly water and weather proof, and will stand the elements for years. Its application to electrical work, however, is comparatively recent. Nevertheless it is an excellent insulator. When ⅛ in. thick the material, it is claimed, will stand 23,000 volts without puncturing or breaking down; when ¼ in. thick it will stand 35,000 volts, and when ⅜ in. thick, 46,000 volts. As used on the New York Central & West Shore the indurated fiber is molded in sections 43½ ins. long, so that it takes three sections to cover the third rail, as the latter is held in insulators 12 ins. in length supported in brackets every 10½ ft. The joints in the indurated fiber covering are made by a 2-in. lap joint of the same material, as shown in Fig. 2, and a wider covering, illustrated in Fig. 3, is used at points where the third rail is bonded. One great advantage possessed by this material for this class of work is that it is much cheaper than the wood covering, principally for the reason that it can be installed much more easily, as it has simply to be slipped over the rail. The elasticity of the material will then hold the covering in place.

FIG. 1.—UNDER-RUNNING THIRD-RAIL COVERING

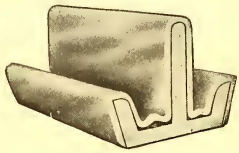


FIG. 5.—NEW YORK CITY CONDUIT RAIL COVERING

Two other applications of this material to electric railway work are also illustrated. Fig. 4 shows the section of a protecting covering used on the Manhattan Elevated and Subway systems in New York. The subway third rail, it will be remembered, has a timber protection which prevents accidental contact from above, but as originally laid the third rail was not protected on the side. The indurated fiber protector is molded to fit the base of the rail between the ties and is carried up on the inside of the rail in the way shown. Its elasticity permits it to be slipped over the base of the rail, after which it holds itself in position.

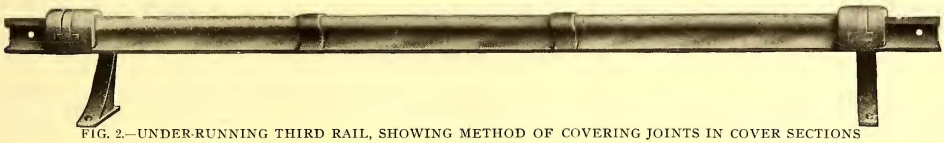


FIG. 2.—UNDER-RUNNING THIRD RAIL, SHOWING METHOD OF COVERING JOINTS IN COVER SECTIONS

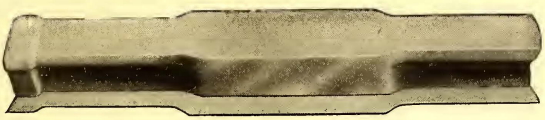


FIG. 3.—COVER FOR A BONDED JOINT

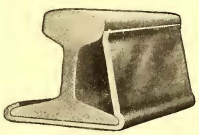


FIG. 4.—SUBWAY AND ELEVATED PROTECTOR

Another application of this material to railway work has been made by the New York City Railway Company on its Thirty-Third Street Crosstown line, between First and Second Avenues. On Oct. 6, 1905, 90 ft. of the conduit conductor rail was covered with the special form of indurated fiber molding shown in Fig. 5, which surrounds the rail with the exception of the flat surface on which the shoe of the plow slides. The installation of the conductor in this case was made not so much to protect the rail against accidental contact as against corrosion and ammonia salts from the street. For this purpose it has answered excellently.

Indurated fiber is also being manufactured as a covering for wire of any size, especially when in exposed places. For this purpose the elasticity and insulating and weather-proof properties of the material commend it. It is also being employed for battery jars, transformer jars and covers, and for oil switch jars. The Western Union Telegraph Company is also employing it for its resonators.

PNEUMATIC DOOR OPENER

J. E. Osmer, master mechanic of the Northwestern Elevated Railroad Company of Chicago, has invented a pneumatic door opener, which will be put on a number of new elevated cars in Chicago.

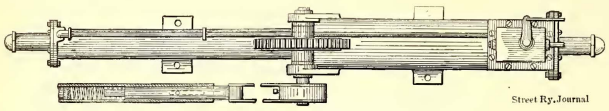


FIG. 2.—PLAN OF OPENER

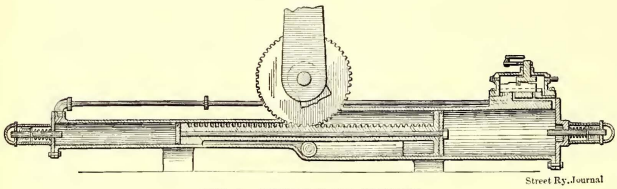


FIG. 3.—SECTION OF OPENER

Fig. 1 shows the apparatus complete as it will be installed under a seat in one end of a car to operate a corner door which slides back into the side of the car. Figs. 2 and 3 are drawings showing the details of construction. Referring to the sectional view, Fig. 3, it will be noted that there is a small high-pressure cylinder at the left end and a low-pressure cylinder at the right. Between the high and low pressure piston heads is a rack which engages a pinion. On the same shaft as this pinion is the lever which operates the door. The slide valve which controls the operation of the device is located on top of the low-pressure cylinder at the right. To close the door, the air is admitted through a port in this slide valve to the high-pressure cylinder at the left. This forces the high-pressure piston from left to right to the limit of its travel. This holds the door closed, air pressure being kept on the piston until it is desired to open the door. To open the door, a movement of the slide valve cuts off the air supply from the air control line or reservoir from which it is obtained and allows the air in the high-pressure cylinder to exhaust into the low-pressure cylinder. The pressure in the two cylinders, therefore, equalizes, and the area of the low-pressure piston being greater than that of the high-pressure, the low-pressure piston will be forced from right to left and the door will be opened. The beginning of the latter movement to open the door is, of course, accomplished with a high-air pressure but a little below the control-line pressure. At the end of the stroke the air has expanded down to a pressure which will give about 16 lbs. at the end of the door-operating lever. Several sizes are made, but the following is an example of the one giving a 40-in. door movement. The small piston is 1.5 in. in diameter and 1.76 in. in area. With 70-lb. pressure in the control line from which the air supply is obtained, this will give a piston force of 123 lbs. The pinion diameter is 5 ins. and the lever arm is 20 ins. long, so that 15.4 lbs. is available at the end of the lever to move the door and hold it closed. The large low-pressure piston has an area of 7.04 sq. ins., or four times that of the small cylinder. Therefore when air is admitted to the low-pressure cylinder from the high, a force of 123 lbs. in the small cylinder is balanced against 492 in the large, with a resultant force of 369 lbs. to open the door. The stroke of the piston is 11 ins. At the end of each stroke there is a spring cushion. The piston head strikes a pin at the end of the stroke. This pin is cushioned by a spring. The exact end of the stroke can be adjusted by means of a plug and set nut on the end of the cylinder. The amount of air required for two movements, that is for closing and opening the door, is 24.64 cu. in. To prevent a person's hand from being injured by catching in the door when it is shut there is a spring in the connecting rod between the lever and the door which permits the door being opened 2½ ins. with a reasonable pressure. One very strong feature of this device is that there are no stuffing boxes, the only moving joints being the piston heads and slide valves. As now made there are no keys or set screws to work loose. Reducing valves are not needed with this device. The shaft on which the pinion and lever are placed is 1-in. square steel with bearings turned down upon it. Although designed primarily for use on corner entrance cars which have the door sliding back in the side of the car, it can, of course, be adapted to cars with platform gates or doors.

Figs. 5 and 6 show the pneumatic door opener as applied to a folding door, Fig. 5 showing the door closed and Fig. 6 the door open. When the door is closed the lever forms a toggle joint which makes it impossible to force the door open until the joint is moved off center either by compressed air or by hand. The particular device shown in Figs. 5 and 6 is not the one which will ultimately be used on folding doors, as it is too long to fit in the corner of the vestibule. The small machine will be only 18 ins. long. Also one 13 ins. total length, 4¾ piston travel, 1¼ ins. diameter small cylinder, 1¾ ins. large cylinder, the same to be used as a door check and opening and closing device.

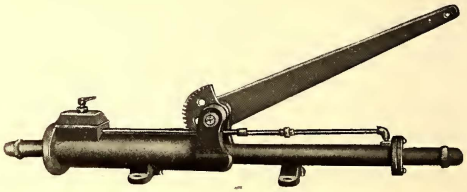


FIG. 4.—OPENER COMPLETE

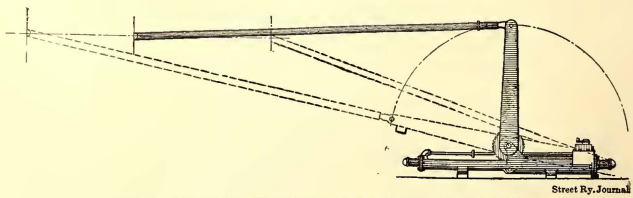


FIG. 1.—DIAGRAM SHOWING OPERATION OF OPENER

Fig. 4 is from a photograph of the device ready to put on a car. To take it off the car the only thing necessary is to unscrew the legs from the floor and disconnect the lever.

Summed up, the principal advantages of the devices are a

saving of air over previous pneumatic door-operating devices, and the absence of stuffing boxes, set screws and a multiplicity of small parts likely to get out of order.

A SECTIONAL DUMPING GRATE

Freedom from frequent repairs and time-saving in cleaning are two of the features claimed for the dumping grate designed by the Gibson Iron Works Company, of Jersey City. These claims appear to have a substantial basis, as will be evident from the construction of the grate as well as the fact that it has been adapted by such large power users as the Brooklyn Heights Railroad Company, of New York, the New York Edison Company, Pennsylvania Railroad, and others.

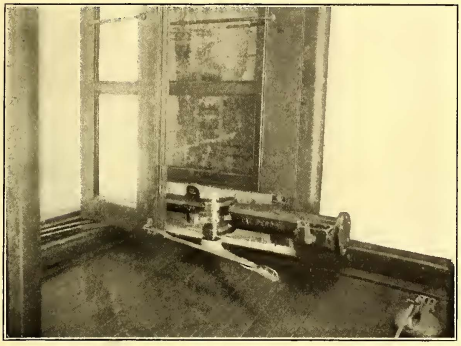


FIG. 5.—OPENER ON FOLDING DOOR

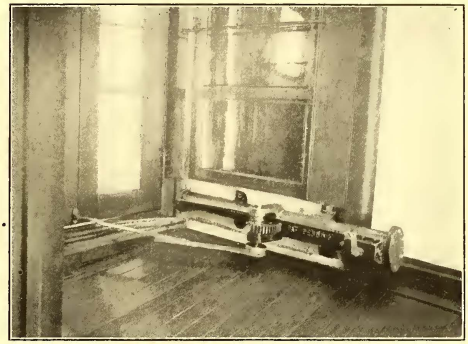


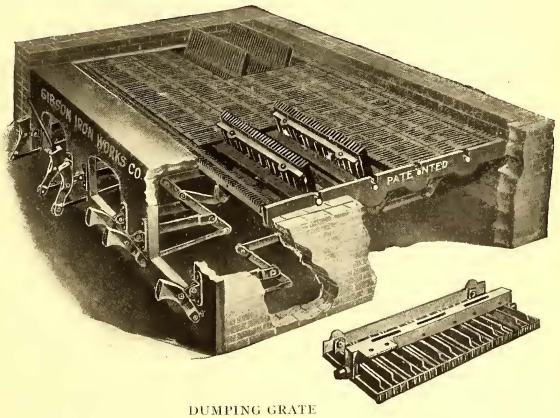
FIG. 6.—OPENER ON FOLDING DOOR

The construction and assembling of the grate is performed in small units, each bar consisting of a number of straight-running ribs with a center tongue which depends from the middle of the body of the grate and fits into the pocket of the rocker shaft, thus making the grate strongest at the point of greatest strain. The company has not followed other grate designers by cutting up into the backbone of the grate in order to fit over the rocker shaft; instead, it has reinforced its grate at the place of maximum strain by casting a tongue onto the cross-wall of the grate, which joins the webs together, increases the strength of the grate sections and distributes the metal evenly in the same, thus combining strength and durability. The body of the grate sits in a frame, and the rocker shafts which support the grate sections rest in the sides of the frame. In the rockers is cast a pocket which extends from one end to the other and which receives the tongues of the grate sections. A section complete consists of eight to ten bars, securely pinned through the rocker, thereby allowing the expansion to take place in several small units and avoiding all warping and jamming in the furnace.

The accompanying cut illustrates the dumping arrangement under the grate, whereby two of the forward sections are dumped to the center and two rear sections are dumped likewise, showing the latitude allowed by the use of this grate, by which any single section can be dumped at will, or the whole fire may be dumped if the occasion requires it. In case a bar needs repairing it is an easy matter to knock out the pin, take out the damaged bar and insert a new one without much difficulty.

When the fire needs cleaning, the live fire is pushed from the front to the rear part of the furnace and the clinkers and ashes dumped into the ash pit; the grates are then leveled, the live fire brought forward, and the rear section dumped in the same manner. After the fire is leveled and fresh coal added there is a clean, bright fire secured so quickly that the operation may be repeated as often as the condition of the fire requires, since there is practically no loss of steam or fuel in the operation. It is possible to clean and coal one part of the grate without disturbing the balance of the fire.

The operation of cleaning the fire is positive and complete, and the clinker is not mixed through the fire as is the case with other grates. A fireman can clean a fire in one-fourth the time required for stationary grates, thus saving furnace walls and boilers from much damage by contraction and expansion, as less cold air is admitted in cleaning the fires. The simple operation of this grate will commend itself to almost all, and especially to those whose boiler rooms are too short to properly clean a fire.



DUMPING GRATE

The contract for the Sixth Avenue subway extension of the Hudson Tunnel Company, of New York, has been awarded.

NEW EQUIPMENT FOR LAKE CHARLES STREET RAILWAY COMPANY

It was in the summer of 1905 that the old horse line at Lake Charles, about 2 miles in length, was electrified. The management adopted the best track and overhead construction, using creosoted ties and span poles 60 ft., 60-lb. rails with American continuous joints, and 00 trolley wire with double galvanized span wire. On Feb. 3 of this year, after having completed three lines with a total trackage of 8 miles, the company began operating five Brill full convertible cars, two

A VIEW ON RYAN STREET, THE PRINCIPAL BUSINESS AVENUE OF LAKE CHARLES, LA.

on the Goosport line, the patrons of which are mostly connected with the large lumber mills and manufacturing interests which border this line; one on the Hodges Street line, which passes through the residential portion of the city, and two on the Shell Beach line with a terminus at Shell Beach, where is located a fine pier, the destination of a great many of the passengers who patronize the Shell Beach line. On the pier every form of amusement is provided, and the waters of the lake afford excellent bathing, boating and fishing. A stage is now being constructed in connection with the dancing hall on the pier, and it is the purpose of the management to provide theatricals during the winter months, and it is expected that this new enterprise will stimulate winter travel in a marked degree.

The company recently added to its rolling stock three Brill type grooveless-post semi-convertible cars built by the American Car Company, of St. Louis. The new cars measure 20 ft. 8 ins. over the end panels and 30 ft. 1 in. over the vestibules; width over the sills, 7 ft. 9½ ins., and over the posts at the belt, 8 ft. 2 ins.; height from the floor to the ceiling, 8 ft. 4⅜ ins.; height from the track to the platform step, 1 ft. 2 7-16 ins.; the side sills measure 3⅜ ins. x 5 ins.; the end sills, 3½ ins. x 8⅝ ins.; sill plates inside, 3½-in. x 6-in. x ⅜-in. angle-iron; length of the seats, 35 ins.; width of the aisle, 24 ins. The car bodies are mounted on the No. 21-E single trucks with a wheel base of 7 ft.

In speaking of its new semi-convertible cars, the Lake Charles Railway Company states that it has had ample opportunity to test the extra large carrying capacity of this type of car, having carried as many as 143 passengers on one car at a time. Such a load would be impossible with an ordinary drop-sash car with its restricted aisle space. The illustration shows Ryan Street, the principal thoroughfare of Lake Charles, on which will be seen one of the full convertible cars in operation.

The Springfield, Troy & Piqua Traction Company is now operating six limited cars daily between Springfield and Troy. At Troy the cars connect with the limited cars on the Dayton-Toledo interline service. This makes possible direct service between Springfield and Toledo of about six hours.

Ohio interurban lines show a gain of about 16½ per cent in the taxation assessment for 1906 as compared with 1905. The returns made to the State Board of Equalization for railroads show an appraisement for interurban lines of about $11,650,000. Last year the total appraisement was about $10,000,000. A number of hearings was granted by the State board on an application for reductions for some of the smaller roads, and in several cases reductions were made.

A NEW SWITCH STAND FOR INTERURBAN RAILWAYS

The three switch stands of different heights shown in the accompanying cut have been designed by the Ramapo Iron Works, of Hillburn, N. Y., for service on interurban railways. These stands are known as automatic return stands No. 11, No. 12 and No. 13. No. 11 being the high stand, No. 13 the low stand, and No. 12 the medium height stand for general use. These stands are said to be as nearly ideal in their simplicity and reliability as is possible to have any mechanical appliance. Fig. 2 is a sectional view showing the automatic mechanism, which is the same in the three stands. The maker of these switches has introduced a number of safety features into their construction, as will be described in this article.

The spindle to which the target and lamp tip are secured is one solid piece extending through the stand base to the eye bolt to which the moving rod connecting the switch is attached, giving a perfectly rigid connection between the switch points and targets and lamps. As the throw on spring switches is usually made as small as practical, 3 ins. to 3½ ins., a slight movement of the switch points gives a decided angle to the target or lamp, showing a definite indication of danger to the approaching car if points are held partly open by an obstruction.

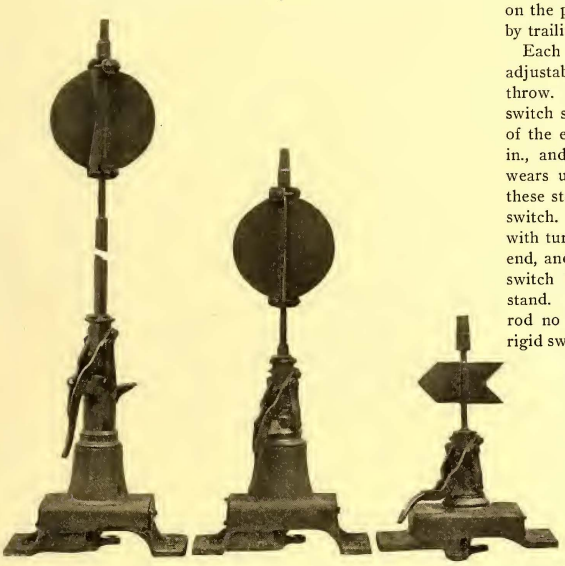


FIG. 1.—SHOWING THREE TYPES OF SWITCH STANDS

The lever handle for throwing the switch stand as shown in Fig. 1 is attached rigidly to the spindle, and consequently to the switch points. To throw the switch the operator in lifting the lever handle raises a square block from a square hole in the top of the stand, and cannot lower the handle again until a quarter turn has been made, that is, a complete throw of the switch. If there was any obstruction in the switch preventing the points closing tight against the stock rail the operator could not make the quarter turn or lower or lock the lever handle, and consequently would look for the obstruction. When the stand is thrown and locked it is a sure indication that the switch has been completely thrown and locked.

The safety block as shown in Fig. 2 is held in position by a roller in an equalizing bar; the latter being held by two springs. The roller eliminates friction and the safety block is so shaped as to give the same effective pull on the switch throughout an entire automatic movement, returning the switch points to their original position.

The safety block is attached rigidly to the spindle by a square block fitting in the top of it below the lever handle; but when the lever handle is raised the square block is raised and the spindle is then free for operation of the stand by hand. The springs on the spring bolts can be tightened or loosened by putting on or taking off washers back of the nut and cotter, to give greater or less effective strain on the switch points according to their length, weight of rail section, etc. This insures the switch points always being held snugly against the stock rail, and does not throw increased strain on the points when they are thrown wide open automatically by trailing car.

Each stand is furnished with an adjustable throw and an adjustable moving rod, and they will fit switches of any throw. The connection of the switch moving rod to the switch stand spindle is through a large eye-bolt; a half turn of the eye-bolt will affect the throw of the stand about 1-16 in., and any desired throw can be obtained. As a switch wears under service the throw slightly increases, but with these stands the throw can always be readily adjusted to the switch. The adjustable moving rod consists of a round rod with turn-buckle jaw on one end and a rigid jaw on the other end, and this adjustment will permit of all lost motion in the switch being readily taken up without moving the switch stand. With the adjustable throw and adjustable moving rod no further adjustment in the switch is necessary, and rigid switch tie-bars are desirable.

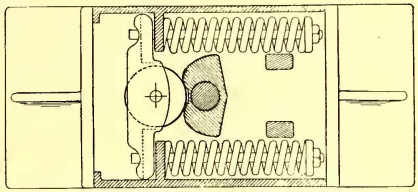


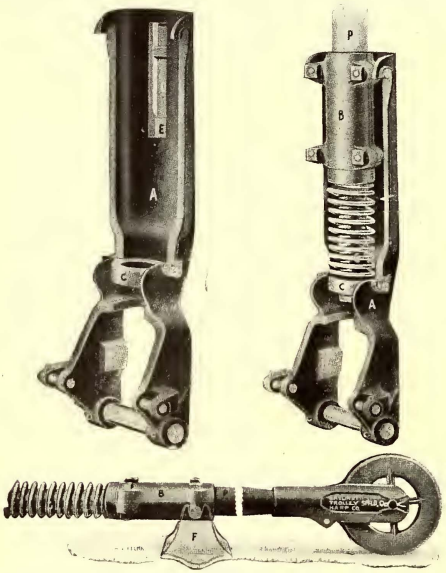
FIG. 2.—DETAILS OF SAFETY-BLOCK MECHANISM

Several features of these stands have been well proven by many years' use in the old-style Ramapo safety stands designed for steam railroads. The new style Ramapo switch stand for steam railroads is the same as styles Nos. 11, 12 and 13 referred to in this article, with the exception of the safety block, which is made to snap switch points entirely over to the opposite track by car trailing instead of returning them to their original position. For steam railroads it is not thought desirable to have each pair of wheels of a long train operate the switch and stand automatically, but to have the first pair of wheels snap the switch points over to a correct position, the target and handle being locked in new position. This is accomplished entirely automatically without the aid of an operator.

A lively interest in these switch stands has already been manifested, and the maker believes that their general use throughout the United States and Canada is assured. Thousands have already been distributed throughout the United States, Canada, Mexico, the Philippine Islands, etc.

A DETACHABLE TROLLEY POLE

An invention for which important claims are made has recently been added to the time-saving devices of the Bayonet Trolley Harp Company, of Springfield, Ohio. It is known as a detachable trolley pole clamp and arm. The device is very simply constructed, consisting of two principal parts, an arm and pole clamp or base. The lower part of the arm *A* is designed to fit any style of base, but has a trough-like extension, defined by marginal flanges, and at the upper and lower end of this extension, and forming part of the flanges, are sets of hook-like projections oppositely directed toward each other. The lower set of projections receive the trunnions of an abutment collar, *C*. The upper set receives the



DETAILS OF CONSTRUCTION OF DETACHABLE TROLLEY POLE

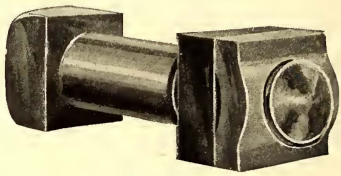
studs and projections on either side of the clamp *B*. This clamp is also provided with an extension or tail piece which is designed to pass through the opening in the abutment collar *C*, and forms a guide and support for the lock spring *G*, which is coiled thereon and secured thereto by means of a spiral groove in another collar at the union of the tail piece and clamp proper. When the pole clamp *B* is in working position the lock spring *G* rests against the abutment collar *C* and holds the clamp studs into engagement with the upper set of hook-like projections with a pressure of over 100 lbs. On the under side of the clamp is a locking projection which extends through the slot in the arm and engages the spring safety latch *D*. This safety latch is not a necessity, but a precaution in case of backing the trolley. The pole is removed by holding back the latch *D* and pressing the pole down and forward steadily until the clamp studs disengage the upper set of hook-like projections, when the tail-piece of the clamp is withdrawn from the abutment collar *C*. On reversing the operation the pole is on again. No tools whatever are required to remove or replace the pole.

Not the least important part of this device is the means of lining up the pole, which is done in the car house. The trunnion rack or frame, *F*, is placed on any plane of sufficient length to accommodate the pole fitted with harp and wheel. The clamp *B* is placed in the rack with the studs in their bearings, then the pole with the wheel flanges resting on the other end of the plane is laid in the clamp and fastened with four bolts as in the ordinary way. It has been fully demonstrated that this method of lining up the wheel and pole insures a more perfect alignment than it is possible to get on top of the car.

As this alignment can be done in the car house in five minutes' time and the poles exchanged on top of the car in only one minute, every railroad man who has ever taken note of the time lost in renewing broken poles will realize the value of this contrivance from a time-saving standpoint. The manufacturers expect to give daily demonstrations at the Columbus convention of this device.

A NEW GRIP NUT

The most important of a car inspector's duties is to see that all nuts on the car body, trucks, and motors are kept tight. Several styles of lock nuts have been devised to prevent nuts coming loose, but in many cases their cost or the lack of simplicity has prevented their general adoption. The "grip nut" made by the Grip Nut Company, of Chicago, Ill., is claimed to overcome both of these objections. This nut, which is made of special steel by automatic machinery, is intended to be used as a second nut. At first glance it has much the appearance of an ordinary nut, and the reason for its peculiar holding power becomes evident only when the threads are examined. These are cut in such a manner that the bolt is gripped tightly whether or not the nut is screwed up against its mate.



NEW GRIP NUT

The "grip nut" has been in use in connection with rail joints on steam road rails for several years. At crossings which are subjected to heavy traffic and where previous to the application of the "grip nut" it was necessary to tighten the nut every day or two, the nut has demonstrated its ability to hold under the most adverse conditions. The nut is applied like the ordinary type and requires no special thread, hole or slot or other change in a standard bolt. It is made in all sizes from ⅜ in. to 1¾ ins. and with special threads.

The enforcement at Savannah, Ga., of the State law relative to the separation of the races on street cars, as well as railway trains, has had the same effect in that city that it had in other Southern cities when first attempted—a boycott by the colored people of the trolley cars. Since the day that the enforcement of the law was commenced the number of colored passengers riding, even on the suburban lines, has been less than 10 per cent of the number of passengers formerly carried. Successfully to carry out the boycott independent hack lines, carrying colored passengers to any part of the city for 10 cents, have been established, and this has been carried to such an extent that at least two members of the Council have threatened to introduce an ordinance making the maximum charge for carrying passengers in the city 10 cents.

A WEDGE BRAKE SHOE ADAPTED FOR STANDARDIZATION

When deciding upon a brake-shoe for a given service it is desirable to have, besides a body metal giving the best braking coefficient, a construction that will permit the braking metal to be worn down to the limit without the danger caused by broken pieces falling out of the head. To secure these results, the Keystone Brake Shoe Company, of New York, N. Y., has brought out a novel wedge-type brake-shoe capable of

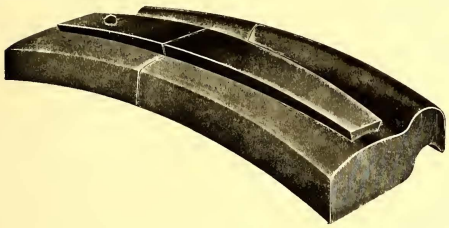


FIG. 1.—TAPERING KEYSTONE TENON ON A CONVEX SURFACE

using any kind of braking metal and easily adaptable to any type of car truck or wheel.

Despite the numerous improvements in brake-shoes, it is still true that the scrap, though largely reduced, has not been eliminated. A large number of shoes are held only by a

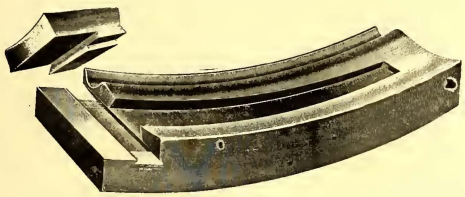


FIG. 2.—ONE-PIECE SHOE

middle lug, the proportion being 13 ins. of braking metal to 1½ ins. of lug. This means that hardly more than 11 per cent of the shoe is secured unless the brake-shoe is bolted top and bottom to the brake-shoe head or keyed to prevent the broken parts from falling. This dangerous condition is remedied in the Keystone shoe by having a tapered keystone tenon on a convex back for nearly the entire length of the shoe as shown in Fig. 1. It will be noted from the cut that the keystone tenon is wider and thicker near the middle than at the

FIG. 3.—A TWO-PART SHOE FOR ASSEMBLING

ends. As this tenon is about 12 ins. long it holds the braking metal for about 93 per cent of its entire length, thus increasing the factor of safety over the single-lug construction by 800 per cent. It is evident, therefore, that a shoe thus secured can break any number of times without having the pieces fall out. The tenon becomes a tight wedging fit in service, so that rattling is impossible.

The face of the wedge brake-shoe has a tapering keystone mortise on a concave surface, as shown in Fig. 2, for retaining the metal until it is entirely worn out. The convex construction for the back and the concave for the face of the shoe gives such strength to the sides that they are much more liable to wear away than to break. As the shoe is divided in two parts (Fig. 3) it is flexible enough to conform to the tread of the wheel. When the shoe is worn so thin that it is time to remove it from the head, the old shoe may be applied to the face of a new one where it will form a lap joint as shown in Fig. 4.

The constructional feature which enables this shoe to be readily adapted for different forms of brake-shoe heads is obtained by an intermediate brake-shoe head. This is made

FIG. 4.—WORN SHOE IN NEW SHOE, SHOWING LAP JOINT

of malleable semi-steel and is divided near the middle. Its weight varies from 4 lbs. to 7 lbs. according to the design of the back, and requires a space of one-quarter to three-quarters of an inch between the shoe and usual head. This intermediate head gives a flexible, removable steel back that does not scrap, besides enabling railways to adopt one standard shoe

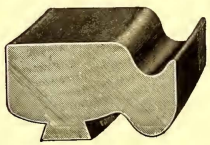


FIG. 5.—SECTION OF PLANED FACE ON FIRST APPLICATION

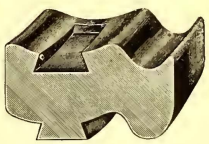


FIG. 6.—SECTION OF MORTISED FACE FOR CONTINUOUS APPLICATION

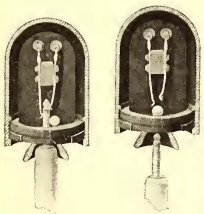
without discarding their present heads. Of course, with new equipment, the standard Keystone brake-shoe can be employed.

NEW JACK BOX FOR INTERURBAN RAILWAYS

The telephone is recognized as the most efficient instrument for the despatching of trains—steam as well as electric. But up to the present time it has been an expensive proposition to equip a line with a telephone system, because of the fact that booths had to be constructed at great expense at frequent intervals. A 'phone had to be installed and kept under lock and key, each conductor having a key, which necessitated his getting off the car and consuming valuable time in unlocking and locking the booth, with the chance of forgetting the last operation. The booths were not infrequently destroyed by grass fires or overturned by wind storms. They were always subject to frequent repairs because of the action of the elements, rodents, woodpeckers, etc.

Very recently, however, Geo. H. Metheany, a practical telephone man from the interurban railway district of Ohio, invented the Lima jack box, which enables the train crew to obtain instant connection with a despatcher without the delay of lock and key and without leaving the car. Fig. 1 shows the jack box ready for instant use within convenient reach of the car; Fig. 2, the ease of "plugging in" for con-

nection to portable 'phone, and Fig. 3 the parts of the Lima jack box grouped in the order they are assembled. The way the spring jack holder is completely insulated from the outside casting deserves particular notice. The spring jacks are made especially heavy and are mounted on a fibre-block. The connections pass through mica bushings and are soldered to the weather-proof wire on the back of the spring jack holder. As a still further precaution the jack plug is equipped with a fuse which will blow if a high voltage were to get through, thus protecting the conductor and the telephone from accident. The plugs have long handles and are so constructed as to leave no metal parts exposed or uninsulated in the jack box. There is absolutely no chance of a short circuit or ground. The lock washer shown at the bottom of Fig. 3 securely holds the spring jack holder in the casing and cannot be removed without special tools. This prevents the possibility of irresponsible persons tampering with the inside of the box.



FIGS. 4 AND 5.—JACK BOX PLUG IN AND OUT

Figs. 4 and 5 show a cross-section of the jack box and the way the parts look when assembled. Fig. 4 shows the plug engaged and ready for conversation, and the manner of displacing the metal ball. Fig. 5 shows the plug being withdrawn and how the ball drops back into the opening and closes it perfectly against the entrance of dust, moisture, and insects. The cone-shaped mouth of the plug opening guides the plug instantly to its position. This mouth, in conjunction with the outer cast-iron shell of the receptacle, forms a double petticoat which effectually sheds off the rain, sleet and snow.

This jack box has been in constant use on the lines of the Ft. Wayne, Van Wert & Lima Railway Company for over a year and a half. The company has one installed every half mile, so that the crews do not have to go more than a quarter of a mile at any time to obtain instant communication with the despatcher's office. They are also installed over the lines of the Muncie & Portland Traction Company and others.

The patents and rights of manufacture of the Lima jack box and plug have recently been purchased by W. N. Matthews & Bro., of St. Louis, who are prepared to furnish them to other electric railway companies. They will have a working exhibit of the Lima jack box in section B, space 18 and 19, building 6 at the Street Railway Convention at Columbus.

THE FRANKLIN WATER-TUBE BOILER

Water tube boilers have been manufactured for so many years that it seems impossible to introduce in their design any very radical features. The Franklin Boiler Works Company, of Troy, N. Y., does not assume to do this, but rests its claims for public confidence on the good results already given by its boiler as a steam generator in many classes of service. Its electric railway customers include among the interurban railways the Scioto Valley Traction Company, of Columbus, Ohio, and among city companies the Utah Light & Railway Company, the Public Service Corporation of New Jersey and others.

The boiler is constructed of wrought steel throughout and consists of one or more drums having openings in the bottom near the front and rear heads, covered by water-legs riveted to the shell. These water-legs are connected by tubes parallel to and under the drums, which tubes are expanded into the tube plates of the water-legs. The water-legs are made of wrought steel plates which are flanged to fit the drums and riveted together with butt straps, thus permitting unrestricted areas for the water to circulate through them and into and out of the drums. The boiler proper is tested at the factory and shipped complete in one section, which eliminates assembling, completing and testing at destination, and greatly facilitates erection and setting.

When set the boiler is slightly inclined, the water filling the tubes, water-legs and half of the drums, the remaining half of the drums being steam space. When heat is applied the water circulates up the inclined tubes, then vertically through the front water-leg into the drum, whence it passes down through the rear water-leg and into the tubes again, the steam being disengaged in the drum. The areas being

FIG. 1.—JACK BOX READY FOR USE

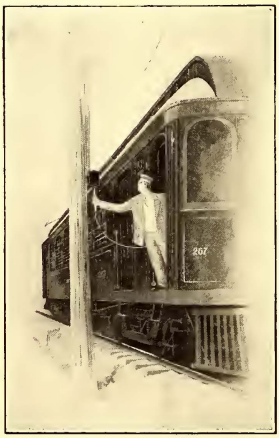


FIG. 2.—PLUGGING IN FOR PORTABLE 'PHONE

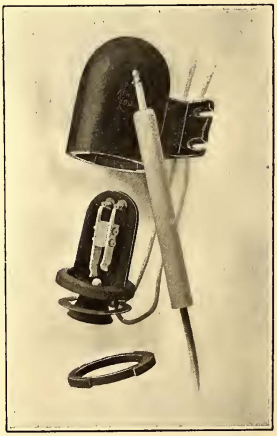
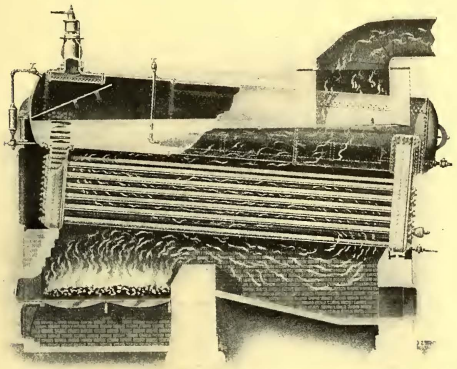


FIG. 3.—PARTS OF JACK BOX

unrestricted at all points, the water is continually traveling in this circuit over all of the heating surface and absorbs the maximum amount of heat.

Fire brick tiles rest on the bottom row of tubes, extending from the front water-leg to within a few feet of the rear water-leg, forming the top of the furnace and combustion chamber. Similar rows of tiles, resting on the top row of tubes, extend from the rear water-leg to within a few feet of the front water-leg. Rows of side tiles rest on the walls of the setting and tile-bars riveted to each side of the drum and extend from the front water-leg to the cross wall which forms the front of the uptake chamber. The gases pass under the bottom tiles to the rear over the bridge wall into the combustion chamber, whence they pass upward and forward among the tubes under the second row of tiles to the front, where they leave the tubes and pass back under the drums and side tiles to the uptake chamber. The bottom tiles being white hot, radiate high temperature in the furnace and combustion chamber, insuring complete combustion of the gases before they come in contact with the rest of the



CROSS-SECTION OF WATER-TUBE BOILER

tubes. The gases in traveling three times the length of the boiler impart the maximum amount of heat to the water, and the greater part of the soot is deposited in the combustion chamber, from which it is removed through the rear cleaning door.

Each water-leg has hollow stay-bolts so arranged that a steam blower can be inserted through them to blow away any soot which may collect on the tubes and tiles in the combustion chamber. This can be done while the boiler is in operation without admitting cold air into the setting. In the outside plate of each water-leg hand holes are placed directly opposite the ends of each tube, and are fitted with plates and gaskets so constructed that the internal pressure keeps them tight. For a thorough cleaning of the inside of the tubes, it is only necessary to remove the front hand-hole plates to admit the scraper, which pushes the scale into the rear water-leg, from which it can be taken by removing a few of the hand-hole plates in the bottom row. Inspection can be made in a similar manner by inserting a torch in the rear water-leg through the opening in the drum, which is amply large for the purpose. No cleaning is done from the sides, so any number of these boilers can be set in one battery without wasting space for cleaning aisles.

The steam nozzle is near the front end of the inclined drum where it is at the greatest distance from the water, and a steam separating device, consisting of a perforated dry pan and deflection plate, is placed between the nozzle and the water, which insures dry steam even when the boiler is heavily overloaded.

A mud drum of thin steel is placed inside the drum below the water line. Into this the feed water enters and there deposits incoming impurities. These are blown off at intervals through blow-off pipe extending through rear head. This mud drum being submerged in water at high temperature, the feed water is heated before leaving it and does not come in contact with the shell while at a low temperature.

The front end of the boiler is supported on cross beams resting on and bolted to steel columns which extend to the foundation. A lug is riveted to the front head and bears on a roller set in a roller chair placed on the cross-beam. The rear end of the boiler is supported on the rear foundation wall, which is carried up for the purpose. On this wall are set plates and rollers on which rests the back water-leg. This method of supporting the boiler, independent of the setting, provides for any change in the inclination of the boiler and for expansion and contraction.

The upright columns and cross-beams form the framework of the front. Small cross-channels are bolted to the upright columns and support the upper half of the front. The lower half consists of wrought steel plate panels to which are bolted the frames for the fire and ash doors. This construction provides for the removal of all or any part of the lower half of the front without disturbing the supports or the upper half, and also provides for the installation of stokers without other change.

NIGHT REBONDING AT OAKLAND, CAL., WITH THE PLASTIC PLUG RAIL BOND

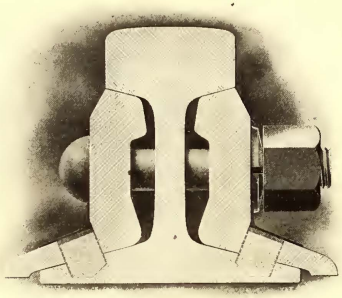
Nearly every electric railway finds after a few years of operation that its traffic greatly exceeds the original estimates. The number of cars operated has been increased; more dynamos and engines have been installed and more overhead feeders put up, but the expense of tearing up the pavement around the joint plates, removing and replacing same, frequently prevents proper rebonding. It was a problem of this kind that confronted the Oakland Traction Consolidated Railway at Oakland, Cal., after the earthquake last spring. San Francisco's terrible disaster had caused a large increase in the population of Oakland and surrounding towns, and trains running at 40 miles per hour were so frequent on the company's Key Route that it was impossible to do any track work during the day. The problem was still further complicated by the fact that heavy guard rails on each side of the service rails prevented the easy removal of the joint plates and made it practically impossible to hammer them back into place if they were removed. The management finally decided to apply the Harold P. Brown "plastic plug" rail bond, which among other advantages avoids any necessity of removing the angle plates, as in paved streets the exposure of only a few inches of rail joint is required in order to put the bond into place.

On the Oakland work, two large air-brake compressors with their motors and reservoirs were mounted upon a car and operated four different sets of air drills. With this apparatus the gang of nine men were able to bond 150 joints per night. Careful tests have shown that these bonds, when applied to both angle-plates per joint, have practically the same conductivity as the unbroken rail.

The Eckles & Smith Company, of San Francisco and Portland, supplied the Chicago pneumatic drills used for this work, done under the supervision of J. Q. Brown, the assistant manager and engineer of the road. After installing

these bonds and giving them a thorough test under severe conditions, further orders have been placed for other portions of the road, as the bonds have given entire satisfaction.

The bond itself is extremely simple. Between the first and the second bolt holes from the end of each rail a hole from ⅝ in. to ⅞ in. in diameter is bored diagonally downward through the flange of the angle-plate, into, but not through, the base of the rail. The hole is nearly at right angles to the



RAIL SECTION, SHOWING APPLICATION OF PLASTIC PLUG BOND

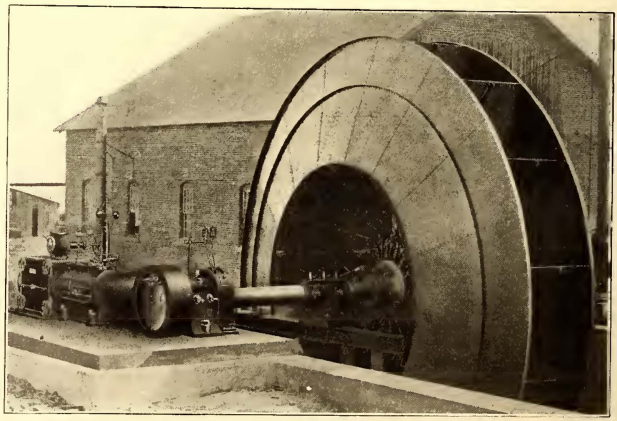
plate flange and as near the vertical web as possible, as shown in the illustration. In doing a small amount of work, an ordinary ratchet drill and a J-shaped clamp passing under the base of the rail are the only tools necessary. When desired, a portable electric drill can be supplied, with which from 100 to 200 joints per day can be bonded by one mechanic and two helpers. The hole is usually drilled to within ⅛ in. from the bottom of the rail base. The drill chips are removed with a permanent magnet, and the proper depth of the hole determined by a template or by a collar fastened to the drill stock. If desired, the plates may be drilled to a slightly smaller size before being distributed along the road for new work; this more than doubles the number of joints which can be bonded in a day. After the hole is drilled it is amalgamated by filling with water and rubbing with the end of a rod of solid alloy. This instantly coats the steel with a layer of bright amalgam, which will not rust, nor will it permit the steel below it to rust.

On bonds of large diameter, a spiral of flat amalgamated copper wire is placed into the hole to seal completely the crack hidden between the meeting surfaces of the rail and angle-plate. This is not necessary with small sizes. The hole is then partly filled with the new process plastic alloy, which adheres closely to the amalgamated surfaces of the steel and forms a conducting path of very low resistance between the rail and the angle-plate. Unlike the old type of plastic alloy, this material will not leak away even though a crack should be left between the rail base and the angle-plate. The bond hole is closed by an amalgamated metal disc which is locked in place by a hammer blow on a blunt chisel, making a burr in the angle-plate just above the top edge of the disc. To further insure the seal, a piece of flexible waterproof insulating material is fastened to the angle-plate over the hole with a waterproof cement. After the bond is applied, the rail and angle-plate may move on each other ¼ of an inch or more in any direction without breaking the contact through the plastic alloy. Even if the plastic alloy above the level of the to pof the hole in the rail base should escape, there is still enough retained in the hole to maintain a direct contact, and this cannot be jarred out, since it is absolutely inelastic and adheres tightly to the steel and to the amalgamated copper spiral. The current passes from one rail through the plastic plug to the angle plate, then through the second plug to the next rail. A bond formed by a pair of ¾-in. plugs into each angle-plate on a 70-lb. T-rail joint of A. S. C. E. section has practically the same conductivity as that of the unbroken rail. This bond is especially designed for rebonding work where the joint-plates, bolts and nuts have firmly rusted into place. The bond is also very effective in new work, but to secure durability on new work the manufacturers recommend that lock washers should be used under all of the track nuts.

LARGE STEEL VENTILATING FANS

The Allis-Chalmers Company, for some years past, has made a specialty of large ventilating fans with diameters varying from 12 ft. to 35 ft. These are of the double-intake, center-draft type. They are built up of sheet steel and angles, the blades being rigidly fastened to sheet-steel arms, which are in turn clamped between two cast-iron centers, so shaped as to present the least possible resistance to the air as it enters the fan; the blades are also well braced to insure their running true. The sides of these fans are enclosed, from the periphery of the intake to the periphery of the outside or top blades, by steel plates reinforced by angle rings on the outside and by angles on the sides of the blades on the inside.

This construction insures a strong, rigid fan for heavy



VENTILATING FAN, DRIVEN BY DIRECT-CONNECTED ENGINE

duty, and also prevents all loss of air due to clearance between the fan and the side of housing, and also reduces the friction for the same reason. The fan is usually mounted upon a hammered iron shaft secured to it by heavy keys. Then large set collars in halves are placed one upon either

side against the fan centers and clamped in recesses turned into the shaft; these prevent the fan from working upon the shaft. A bronze bushed water-jacketed bearing is placed upon either side of the fan, and these bearings, braced by suitable columns, are supported on long sole plates, the ends of which rest on the foundation and are securely bolted to it.

These fans may be arranged for direct connection to the motive power or provided with pulleys for belting, depending upon the conditions of service, but in either case the apparatus is made exceptionally compact and combines maximum efficiency and durability with minimum bulk and weight. When the fans are required to be placed in damp and dirty passages, the direct-connected unit has many advantages, for the use of belting under such conditions is far from desirable. The limited space available in such cases is also another argument in favor of this arrangement. The fans may be driven either by small "Reliance" Corliss engines or by motors, preferably induction motors, where alternating current can be supplied.

THE UEHLING GAS-COMPOSIMETER

It is well known to all steam engineers that prime movers, turbine as well as reciprocating, in their highest development have reached a state of perfection that only very small additions to steam economy may be hoped for in this direction. On the other hand, there is still room for large gains in economy in the boiler room in generating the steam required. From 20 per cent to 40 per cent of the heat developed by the coal is still lost up the chimney, due to in-

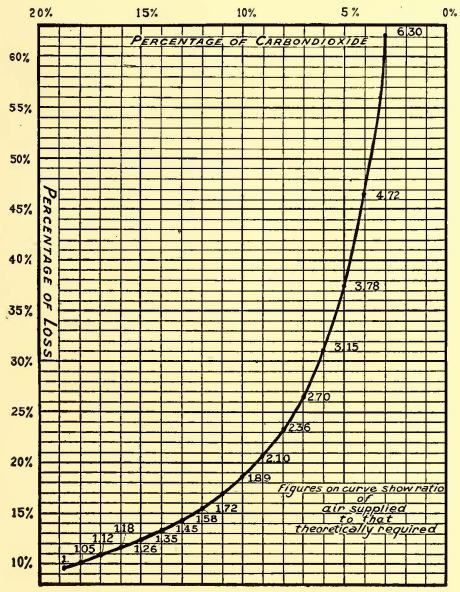


FIG. 1.—SHOWING RELATION BETWEEN THE LOSS OF HEAT AND PER CENT OF CARBON DIOXIDE IN THE CHIMNEY GASES

judicious or careless firing. This loss can be reduced to a minimum only by having a positive control over the fireman and by giving him the means of knowing the condition of his fire at all times, thus enabling him to supply the coal and regulate the air in such a manner that maximum efficiency results.

The best index of efficiency for the furnace of a steam boiler is the percentage of carbon dioxide (CO_2) in the products of combustion. It is of easy calculation to deter-

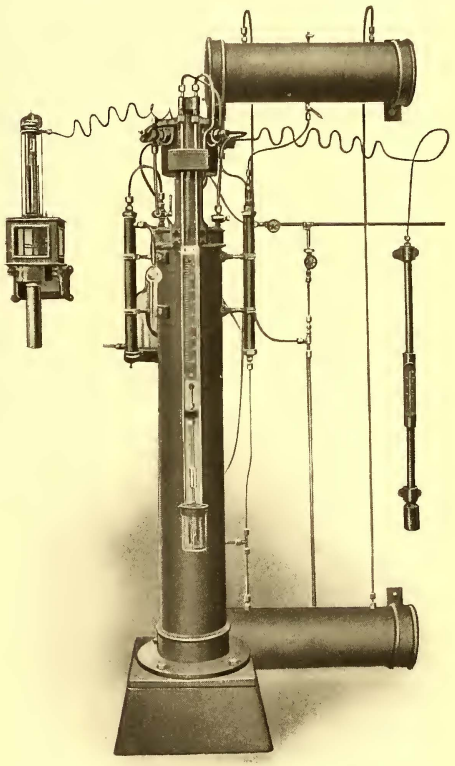


FIG. 2.—SINGLE TYPE OF GAS COMPOSIMETER

mine how the loss up the chimney increases as the CO_2 in the products of combustion decreases. Fig. 1 graphically illustrates the relation between the loss of heat, i. e., waste of fuel, and the per cent of CO_2 in the chimney gas. The logical conclusion is, therefore, that if the CO_2 contained in the products of combustion can be continuously observed the fire can be so regulated that maximum efficiency results. Several instruments have been devised to indicate continuously the CO_2, others to record the same, but none of these, it is claimed, accomplishes the two important results secured by the Uehling gas-composimeter, namely, that the fireman shall at all times be able to see what he is doing in the way of efficient firing, and the superintendent have a continuous record of what he did—and thus have a check on his work. The Uehling gas-composimeter indicates the CO_2 at the boiler front or other conspicuous place for the fireman's guidance, and at the same time makes a continuous record of it in the office of the superintendent or other convenient place. This instrument is made by the Uehling Instrument Company, of Passaic, N. J., and can be furnished in single, double or multiple form, adapted to serve one or more boilers up to eight

in one system, indicating and recording the CO_2 for each boiler.

Fig. 2 illustrates the instrument in single form. Fig. 3 shows two records, of which the upper one is an example of bad firing and the lower of average good firing. The latter shows an economy of more than 12 per cent in fuel over the former. Neither the fireman nor the proprietor were aware of how badly they were doing until the fact was revealed by the gas-composimeter.

This company also makes a combined pyrometer and gas-composimeter. Fig. 4 shows two records made by this instrument. The temperature was taken near the bridge wall

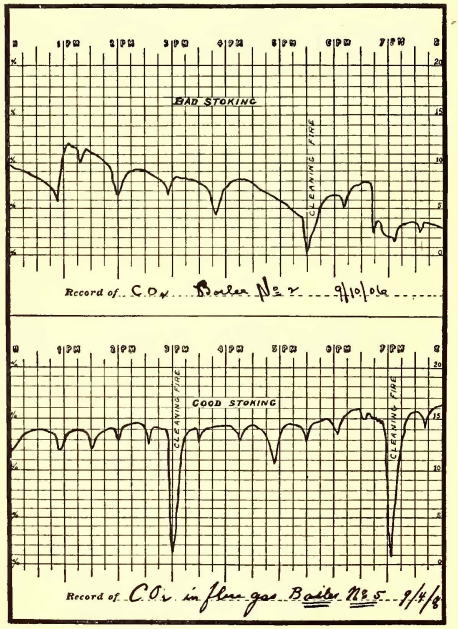


FIG. 3.—GRAPHIC COMPARISON OF THE RESULTS OF GOOD AND BAD FIRING

of the boiler furnace, the CO_2 of which was simultaneously recorded. A comparison of these records shows the temperature of the furnace is also a measure of efficiency, but that the per cent of CO_2 is more sensitive to excess of air and hence waste of heat than the temperature. It also shows that after cleaning the fire it was possible by careful regulation to attain close on to the theoretical per cent of CO_2 in the products of combustion. Since the loss of heat is directly proportionate to the stack temperature, a continuous record of the latter is of greatest value and always advisable to have.

The Indiana, Columbus & Eastern, acting with the Indianapolis & Eastern, is soon to resume the operation of fast limited service from Dayton to Indianapolis. The schedule will call for 108 miles in four hours, which is considerably faster than the schedule of the Interstate Limited, which formerly ran over this route, but which was abandoned some time ago when the Schoepf interests were unable for the time being to buy the Dayton & Western, which operated the cars.

INDESTRUCTIBLE FIBER FURNISHINGS FOR NEW YORK CENTRAL ELECTRIC CARS

One of the most interesting facts in connection with the rolling stock for the New York Central's electrified division at New York City is the use of a new indestructible fiber instead of wood for the headlinings and roofs of the 180 cars ordered jointly from the American Car & Foundry Company and the St. Louis Car Company. In view of this important order it may be of interest to describe the qualities of this fiber.

This material, known as "Durite," is made by the Indestructible Fibre Company, of New York, from a specially treated wood pulp on paper-making machinery. When finished it has a very hard, smooth, wood-like surface, and is so compact and non-absorbent that it is very easily finished and decorated. Another variety is waterproof, which will be

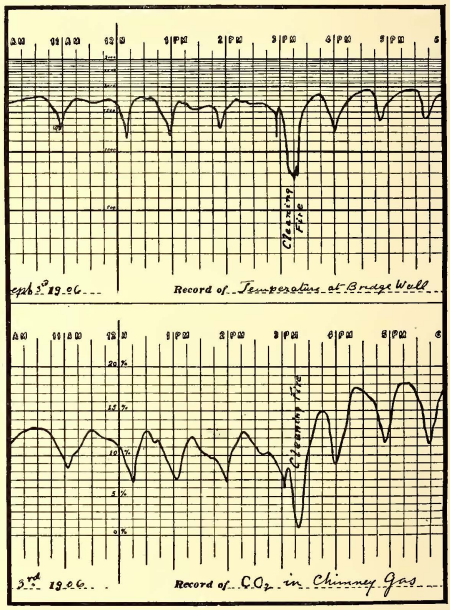


FIG. 4.—SIMULTANEOUS RECORDS MADE BY A COMBINED PYROMETER AND GAS COMPOSIMETER

especially adapted to trolley equipment. This fiber can be made in any desired thickness and bent into various shapes; will hold nails and screws; does not splinter; takes less coats of paint and varnish than wood. Unlike the latter, however, veneered fiber panelings will not crack, warp or peel, as they do not absorb moisture as readily and are less affected by changes in temperature.

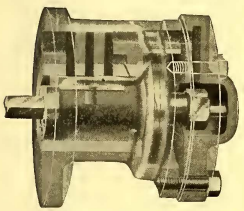
From the qualities mentioned it is apparent that this material has a wide field of usefulness. In car construction alone it is being employed for ceilings, panels, headlinings, roofs (with canvas protection), seats, seat backs, etc. In the form of tiling it makes an excellent covering for the walls of power stations, waiting rooms and the like.

The Northern Ohio Traction & Light Company has won an important decision before the Supreme Court in the matter of grade crossing assessment in Akron.

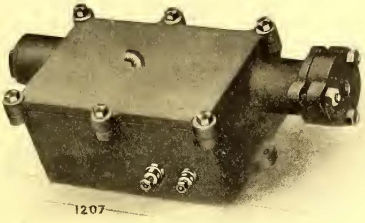
EMERGENCY VALVE AND THE NEW TYPE OF GOVERNOR FOR AIR BRAKES

The peculiar advantage of the straight air brake system is its simplicity and the fact that the brakes may be released gradually. The system, however, is deficient in that it puts the control of the brakes in the hands of the motorman alone; and, moreover, when two or three cars are run in a single train, if the train should break apart, the brakes are not set automatically as with the automatic air brake system. The National Brake & Electric Company has put into service an emergency valve which eliminates the deficiencies of the straight air brake system by giving to it the automatic feature in case of separation of the cars of a train and by putting the control of the brakes in the hands of the conductor as well as in the hands of the motorman.

The valve which is attached direct to the head of the brake cylinder has connections with the main reservoir, the auxiliary reservoir, the train pipe line, and an emergency pipe line as well as with the brake cylinder. The emergency pipe line is continuous throughout the length of the train, and takes the place of the customary equalizing pipe line used to balance the pressures in the reservoirs on the separate cars.



EMERGENCY VALVE FOR STRAIGHT AIR BRAKE



OIL-PNEUMATIC GOVERNOR

In ordinary operation, the system is essentially a straight air brake system. Air from the main reservoir on the forward car is admitted through the ordinary type of straight air brake engineers' valve, the train pipe line and the emergency valve to the brake cylinder

A phantom view of the emergency valve is shown in one of the illustrations. It consists of a slide valve and piston moving in an air chamber. The auxiliary reservoir is connected with the slide valve chamber and the main reservoir with the piston chamber. Of the three ports controlled by the slide valve, the one to the left leads to the brake cylinder, the middle one is connected to the train pipe line, and the port on the right has a connection with the emergency line.

The valve is shown in the normal position, that is, for straight air operation. Pressures in the auxiliary and main reservoirs and in the emergency pipe line are equalized through the small port shown to the right of the slide valve, and the piston and valve are held in the position shown by a spring which exerts a pressure equivalent to a pressure of about 15 lbs. per sq. in. on the back of the piston. With the valve in this position, air from the train pipe line enters the central one of the three ports controlled by the slide valve, passes through a connecting port in the valve and enters the brake cylinder through the port to the left. If the train should separate or the conductor should pull his emergency valve, air escapes from the emergency line and the pressure behind the piston is reduced. This causes the piston and valve to be forced to the right by the auxiliary reservoir pressure in the slide valve chamber. When this occurs (1) the port to the brake cylinder is uncovered and opened to the slide valve chamber, and as this chamber is connected to the auxiliary reservoir, the pressures in the brakes are set by the equalization of pressure in the auxiliary reservoir and the brake cylinder; (2) the train pipe line is connected direct to the emergency pipe line through the slide valve and the emergency pipe line is given an additional opening to the atmosphere; (3) the small port to the left of the valve seat is covered by the valve and air is prevented from passing to the emergency line from the auxiliary reservoir; (4) the connection between the main reservoir and the emergency line is cut off by the seating of the piston so that no air can pass into the emergency line from the main reservoir.

To release the brakes after they have been set by a reduction of pressure in the emergency pipe line, the openings of the emergency line to the atmosphere are first closed and the engineer's valve is thrown to the emergency position. Air then passes from the main reservoir through the engineer's valve and train pipe lines into the emergency pipe line, which is connected to the train pipe line through the port in the slide valve. The increase of pressure in the piston chamber which is connected with the emergency pipe line and the pressure of the spring previously mentioned causes the piston and valve to move in the normal position. When this occurs the engineer's valve may be thrown to release position and the brake cylinder will be vented to the atmosphere through the train pipe line. At the same time connections are restored between the emergency pipe line and the auxiliary and main reservoirs and the pressures in these are equalized.

In addition to adding the advantages of the automatic air brake system to straight air brakes, the application of the emergency valve has several other desirable features. Unless the straight air train pipe is closed the brakes cannot be released until the train is brought to a full stop, as sufficient pressure cannot be obtained in the emergency line to reverse the piston. The emergency pipe line serves to balance the pressure between the reservoirs of each car, as the reservoirs are all connected to the emergency pipe line through the emergency valves. Should the pressure in any of the main reservoirs drop suddenly, due to breakage of pipes, the brakes will be set. As the emergency valve acts only in cases of emergency, there will be very little wear on the parts and the expense of maintenance will consequently be a minimum.

The type-N pump governor is another new feature of the brake equipment of the National Brake & Electric Company. The governor is extremely simple in design, has few working parts, and occupies very little space. The essential features of the device are a cylinder 1¼ ins. in diameter which is connected direct to the main reservoir; a piston working in the cylinder is acted upon on one side by the pressure of the air in the main reservoir and on the other by the tension and compression of springs. Movement of the piston throws a toggle joint over its center and causes a hammer to strike a switch-arm which makes or breaks the circuit to the air pump.

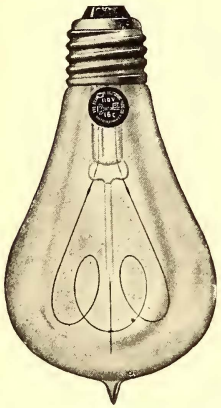
The working parts are all contained in a box 8 ins. long, 5½ ins. wide and 4 ins. high. The box is filled with oil, which not only keeps the working parts lubricated but also serves to extinguish the arc caused by the breaking of the circuit. A tightly fitting cover prevents leakage of oil. When filled with oil the governor weighs but 12 lbs.

The device is rightfully named a pneumatic governor, as the only electrical features about it are the two terminals and the switch-arm which makes the connection between

the terminals. The pressure at which the governor cuts in and out is regulated by changing the position of two adjustable nuts on the piston rod. The governor has been in practical operation on cars for more than a year.

AN INCANDESCENT LAMP FOR RAILWAY USE

The Franklin Electric Manufacturing Company, of Hartford, Conn., has recently put on the market a new lamp designed especially for street railway and other work where there is much vibration. In this lamp the filament is anchored at its lowest point and is supported directly from the stem. As will be noted from the accompanying illustration, this is accomplished by a small glass column extending from the stem past the upper portions of the filament coil. The filament is securely fastened to an anchor wire welded in said glass column, and the greatest possible rigidity of filament support is thus obtained.



NEW ANCHORED FILAMENT LAMP

Through this improved method of construction the street railway type sustains vibration equally at all parts of the filament, and not at one point as in the case of ordinary incandescent lamps. All possibility of the filament drooping or touching the bulb is removed. It is impossible for the filament coils of the Franklin street railway lamp to short-circuit and destroy the lamp.

Especially selected materials are used throughout, and the lamp is constructed to resist the hard usage which is unavoidable in certain lines of service. The lamp will be exhibited at the Columbus Convention with a vibrating machine designed especially to reproduce the conditions under which lamps operate in railway service.

A PNEUMATIC DOOR OPENER

Pneumatic door openers in passenger elevator service it has been proven effect a saving of from 25 to 35 per cent in the average duration of the stops at floors. Definite figures as to the time saved by the use of these devices in elevated and interurban railway service where stops are frequent are not available, but it is reasonable to presume that the time saved is considerable. The accompanying reproduction from a photograph shows the Burdette-Rowntree pneumatic door opener as applied to an elevated car. These openers are in use on cars of the Metropolitan West Side Elevated Railroad, Chicago; the Boston Elevated System, the Old Colony Street Railroad, of Boston, and several other systems. The pneumatic door opener consists primarily of an air cylinder the piston rod of which carries a rack having teeth which mesh with the teeth of a pinion placed above it. The pinion carries a lever of a length equal to about half that of the door opening. A long arm attached to the lever at one end and at the other to the door to be operated opens and closes the door.

To open the door the guard or motorman operates a small valve similar to an air brake valve. Air from the air-brake reservoir is then admitted to the crank end of the cylinder and the movement of the piston causes the door to be opened. To close the door the air-valve handle is thrown in an opposite direction. The air in the cylinder is discharged into the atmosphere and at the same time air is admitted to the head end of the cylnder. The door is closed and latched, and

PNEUMATIC DOOR OPENER

moreover is held closed and is kept from rattling by the air pressure which remains in the cylinder. The fact that the crank is at the etreme end of its travel causes the final movement of the door in either opening or closing to be made very slowly, and slamming of the door or the danger of injuring passengers is thereby avoided.

The cylinder and operating device is usually placed behind the seats of the car, but in some instances they are installed immediately above the door opening.

TENTH ANNIVERSARY OF METROPOLITAN STREET RAILWAY ASSOCIATION

The tenth anniversary of the Metropolitan Street Railway Association, composed of employees of the Metropolitan Street Railway Company, of New York, was celebrated at Carnegie Hall Saturday evening, Oct. 6, the employees of the company and their families all being present. A vaudeville program of ten numbers was arranged for the entertainment of those present, and in addition Marshall P. Wilder again volunteered his service and gave a short talk. Music was furnished by the Metropolitan Street Railway fife, drum and bugle corps, composed entirely of employees of the company. As president of the association, President Vreeland, of the company, addressed those present in part as follows:

Friends and Families:—This is the only opportunity in the year that I have of speaking to the families of the members—the men I see every first Saturday night of the month during eight months of the year, although I always regard this annual meeting of men and their families as completing the large family group. I view this gathering together of the men's families as indicating the deep interest they take in the association. No one knows what the benefits morally and physically are better than the wives, mothers and sisters of members of the association. You all know of the close touch and relationship that it brings between the officers of the company and the men. A railroad operated by men who believe in, and rely upon, the management, caring for their interests and welfare, is always a harmonious organization. Loyalty of employees to the management and loyalty of the management to the men, is always the key-note of harmony and success.

The work of the association has grown wonderfully during the past year. During the year ending September 19, 1906, $35,265 has been paid out for sick benefits and death claims. The treasury of the association is in a prosperous condition as is shown by the

printed statement of the treasurer, which will be found in every seat. The indications are that during the coming year the membership will be largely increased, and next year I hope to see the association not only largely increased in membership, but largely increased in prosperity and scope than it is at the present time.

The benefits of the association are restricted by certain provisions of the constitution and by-laws, and to some extent by the limitation of funds of the association for entering into the broader field. A friend of mine, and of yours, having this in mind and anxious to help the situation in relieving sickness and distress when such exists outside the functions of the association, has placed a large sum of money in my hands for distribution, to be used in procuring surgical instruments and appliances and special treatment, etc. Most all of the cases where such benefits are dispensed would not be known were it not for the association and its physicians.

The welfare of the employees of the New York City Railway Company and the association is constantly the care of the officers of the road. This fact will be noted in connection with the recent voluntary increase in the wages of the operating employees of the road. No request was made by the men for this increase; none of them knew that it was being considered, and were pleasantly surprised when the announcement of the increase was posted upon the bulletin boards at the various depots. This is one of the best assurances that we can give our men of the interest we take in their well-being. The wages now paid by the New York City Railroad Company are the highest paid to operating men upon any surface railroad in the United States.

During the thirteen or more years that I have been connected with the management of the surface railroads in New York City, we have had no labor disturbances. Whenever the men had any misunderstanding or grievances of any kind they came to me, knowing that I would treat their differences as justly and as impartially as a court of arbitration. In this way, which is the only way, the faith of the men has remained unshaken in my promises and agreements.

It is my earnest wish and desire that the men employed on the lines of the New York City Railway Company and the members of the association continue to maintain the happy harmonious family relationship that has existed for so many years; that each forthcoming year, I may see the faces, old and familiar to me, each more loyal and earnest in his endeavor to make the railroad on which he is employed a model one for efficiency, courtesy and general attractiveness to the public, and that each and every man feel safe in the assurance that his welfare and that of his family is in the fair, just and kind hands of officers whose records are unblemished and whose promises have always been fulfilled.

I hope that next year we may meet under the same happy conditions as to-night.

I wish you all health and happiness during the year, and hope that you may enjoy the evening's performance.

Briefly the condition of the association may be summarized as follows:

	1906	1905	Increase	Total to Date
Cash on hand	$2,474.39	$7,904.04	$1,815.50	$34,822.99
Investments	34,822.99	27,577.84		
Dues and initiation fees	31,918.00	30,866.00	1,052.00	224,387.99
Entertainments, interest, etc.	11,632.71	10,344.10	1,288.61	70,617.06
Sick benefits and death claims paid	35,265.00	31,695.00	3,570.00	207,604.68
	Membership,	4824.		

THE PENINSULAR RAILWAY UNDER CONSTRUCTION

The Peninsular Railway Company, controlled by people prominently identified with the Southern Pacific Company, is building a double-track electric railway, 50 miles long, connecting Los Gatos and San Carlos. The road will run along the lower slopes of the foot hills of the Santa Clara Valley, opening up a beautiful suburban district. Ten thousand tons of steel rails have arrived at San Jose and Los Gatos, and the actual work of construction will be pushed as fast as possible. The right of way has been acquired and is all on private property. It is planned to build three new towns along the line. One of these will be located at the junction of the branch railroad, which runs to Meridian and thence to San Jose, and will be about 9 miles distant from San Jose. Another will be opposite Mountain View Station of the Southern Pacific line. The Peninsular Railway recently acquired the electric line running from San Jose to Los Gatos, and to Saratoga Springs, completing a triangle about 28 miles long. The line known as the San Jose & Los Gatos Railway Company was sold by O. H. Hale, of San Jose, and others, because it had become involved in financial troubles.

THE DETROIT FRANCHISE QUESTION

At a session of the Council franchise committee Thursday evening, Sept. 27, Mayor Codd submitted the two amendments which he secured from the Detroit United Railway earlier in the day. One provides for the coterminus expiration of all franchises on car lines that are within the city limits in 1924. The other provides that the city has a right to purchase at that time all such lines. The first amendment results in an extension of three franchises that expire respectively in 1917, 1919 and 1920 till 1924 and for the termination on the same date of the Fairview franchise, which extends to 1935, such expiration and extension, of course, to be conditional upon annexation to the city of territory containing these lines. To the amendment, which applies to the municipal purchase clause, is added the condition that the city must assume the obligations undertaken by the Detroit United Railway relative to tracks in territory that is later made a part of Detroit. For instance, the Fairview franchise provides that residents of that village shall enjoy a single fare within the village limits. In the event of Detroit ownership of a part of the village line and Detroit United Railway ownership of the balance within Fairview, then villagers would have to pay car fare to two street railway systems, namely, the Detroit United Railway and the Detroit municipally owned system if the latter should come into existence. But this amendment protects Fairview and other suburban residents by requiring the city of Detroit to assume the obligations.

At the meeting of the Common Council Tuesday, Oct. 2, the franchise, as amended by the committee on franchises, with one amendment passed by the Council, was adopted and laid on the table, and the election commission was instructed by resolution to place on the official ballot:

"Do you favor a settlement of the street railway controversy under the terms embodied in the franchise submitted by the Mayor?" The question will appear twice, with a square and the word "yes" opposite one insertion and a square and the word "no" opposite the other.

The report of the committee on franchises was adopted practically in its entirety. The only exception was the amendment offered by Alderman Gutman, making the time within which transfers shall be accepted 15 minutes instead of 10. The committee explained, through Alderman Grindley, that it was understood that the present franchises give only 10 minutes, but a reading of the old Detroit Railway franchise disclosed that 15 minutes is allowed.

Aside from the transfer time amendment, the original franchise as submitted by the Mayor stands amended as follows:

1. The Common Council reserves the right to make such new regulations for the interest, safety, welfare or accommodation of the public as may be deemed necessary.
2. All franchises on lines included in the city in 1924 shall expire in that year, no matter by whom granted.
3. The company must make extensions when ordered by the Council after property owners residing along the route petition for them.
4. The company must use air brakes.
5. The old cars on the present 3-cent lines must be replaced by modern ones within two years, and not at the company's pleasure.
6. The Council reserves the right to regulate the speed of cars.
7. The city's members of the board of arbitration on the purchase of the lines shall not be three Aldermen, but three persons appointed by the Council on the nomination of the Mayor.
8. Extensions of certain routes shall not be delayed until grade separation is achieved, but must be made within a year after the Railroad Crossing Board gives leave to cross at grade.
9. Iron poles shall be used in all parts of the city, not alone within the 2-mile circle.
10. The ten-for-a-quarter tickets to be named "industrial tickets."
11. City not to purchase the "good will" of the company in the event of the purchase of the system in 1924.
12. Immediate repeal of franchise if rate of fares is arbitrarily increased.
13. If the city purchases annexed suburban lines in 1924, the city must take over the conditions and obligations of the township or village grants.

(In addition to the above, several amendments were made to the routes which were proposed by the railway company. New routes were laid out and certain portions of present routes were discontinued.)

Important concessions asked for, but not obtained, by committee:

A publicity clause.

Uniform rate of eight tickets for a quarter.

Transfers on transfers.

A higher rate of taxation.

Uniform rate of fare after annexation of suburban lines.

THE PLANT OF THE HOPE WEBBING COMPANY

The plant of the Hope Webbing Company, located on the outskirts of the city of Providence, R. I., illustrates in an interesting manner how an industrial establishment expands under the influence of steadily increasing business. About fifteen years ago the first building of the company on the present site was erected; to-day about 1150 employees are at work on the premises, and about 800 looms are in operation. The company manufactures narrow woven fabric of cotton, worsted, silk, etc., devoting a large share of its attention to tapes and webbing, varying in width from ⅛ in. to 6 ins. A considerable portion of the tape output is devoted to electrical insulation purposes.

The factory buildings are of substantial mill construction with brick walls, concrete foundations being used in the newer portions. There are five principal structures. Of these, three are one-story weave sheds 453 ft. long each, and from 77 ft. to 85 ft. in width; one is a preparing mill built in five stories 223 ft. x 84 ft., while the fifth is about 320 ft. long, 60 ft. wide and three stories in height, used for offices, the shipping and finishing departments. The latest structure to be completed is one of the weave sheds mentioned, including an 85-ft. addition to the northern end of the office building. The latter building extends perpendicularly across the ends of the three weave sheds, and parallels Main Street, which is one of the direct routes between Providence and Pawtucket. The plant is located at the intersection of Main Street and Warren Avenue, which is about 3 miles from the retail business district of Providence. Provision for further expansion exists on the south and west and the latter portion of the company's property adjoins the main line of the New Haven system passing between Boston and New York.

Raw cotton, silk, jute and worsted yarns enter the plant via the preparing mill building, a large storage capacity being provided on shelves in the basement of the latter structure. About 150 looms are devoted to the manufacture of electric tape. Of the total number of looms in the mill, half are double-shuttle looms, made by the Crompton & Knowles interests in Worcester, Mass., according to patents owned by the Hope Webbing Company. Looms of this type have twice the output of an ordinary loom, and this is one of the most valuable assets of the company. The product leaves the factory at the opposite side from which its entrance occurs. The weave sheds are all provided with central monitors and the entire establishment is liberally equipped with windows to facilitate careful work under the best of daylight conditions. Tar and gravel roofs are employed and all the machinery except that in the original weave shed is group-driven by electric motors. Of these, about twenty-five are in service, the makes being General Electric, Westinghouse, Sprague and Holtzer-Cabot machines.

The power plant is a steam-driven installation and the boiler room is a 39-ft. x 21-ft. structure, located between the original weave shed and the preparing mill. There are four Corliss upright boilers, two being rated at 150 hp each and two at 125 hp each. The operating steam pressure is 110 lbs. The prime mover of the plant consists of a 14-in. x 36-in. Corliss engine of the non-condensing type, speed 94 r. p. m.; an 18-in. x 48-in. Corliss engine, speed 83 r. p. m. and a 9-in. x 12-in. Russell engine, speed 280 r. p. m. All the engines are of the horizontal type. The first two drive line shafts, from which are belted a 9-E 46-kw 116-volt direct-current generator, speed 975 r. p. m., and a 150-kw 600 r. p. m. 9-E 240-volt three-phase alternator. The Russell engine is direct-connected to a General Electric 45-kw 115-volt direct-current generator. All these units are controlled from a seven-panel marble switchboard set up near the belted generators. A Tirrell voltage regulator is included in the switchboard equipment, and a service connection is available from the circuits of the Narragansett Electric Light Company. The lamps and motors in the mill are divided between the 235-volt a. c. circuits and the 115-volt d. c. wiring. There are two feed-pumps; one, a Gould triple power-driven pump of 1640 gallons per minute capacity, and the other an 8-in. x 5-in. x 12-in. Warren steam pump, capacity 3000 gallons per hour.

The mills are heated by the Sturtevant hot-air system; six sets of fans and coils being in service. All but one of the heaters employs exhaust steam. The sixth heater uses live steam through a reducing valve, on account of its distance from the boiler room. The Rhode Island sprinkler system is installed, and city water at 108 lbs. pressure is available at the mills. A special fire-alarm box is located at the main office entrance.

The product undergoes a rigid inspection, both by machine methods and by observation before shipment. In case a flaw in a tape appears, the roll-dinding machine comes to a full stop automatically. Gaps in webbing are sewed instead of pinned together, and the company is prepared to supply tape correct in thickness to within .005 in. A new sleeving department has just been opened for coverings of armature and commutator connecting wires.

The officers of the company are: President, Fenner H. Peckham; vice-president, Joseph Belfield; treasurer, Charles Sisson; secretary and assistant treasurer, Willis H. White; superintendent, Oscar A. Steere.

LARGE INSTALLATION OF GAS ENGINE-DRIVEN UNITS FOR WISCONSIN COMPANY

Contracts have recently been placed by the Milwaukee Northern Railway Company for the electrical equipment of its line to be built out of Milwaukee to Port Washington as the present northern terminus. Grading for this portion of the line is now practically completed, and it is expected that cars will be in operation over this section by June, 1907. The Comstock-Haigh-Walker Company, of Detroit, is acting as engineer and contractor for the company.

The equipment ordered comprises three horizontal twin tandem Allis-Chalmers gas engines, each with a rated capacity of 1500 hp, direct connected to three 1000-kw, three-phase, 25-cycle Allis-Chalmers alternators, together with gas driven exciter sets and complete equipments for eight sub-stations.

The main power house is to be at Port Washington, and sites for sub-stations have been provided at Burleigh, Cedarburg, Georgia Avenue, Marblehead, Brown Deer, Cedar Grove, West Bend and Campbellsport. As soon as the grading and construction work between Milwaukee and Port Washington are completed, work will be begun on the extensions from Port Washington to Sheboygan and from Cedarburg to Fond du Lac.

The route from Port Washington to Milwaukee is over private right of way for practically the entire distance and in almost a straight line. Between Port Washington and Grafton there is a single curve only of 2 degs. There will be no grade crossings. At the points where the new right of way intersects the Chicago, Milwaukee & St. Paul and Northwestern Railroads, in four different places, the new company has made preparation to trestle over or tunnel under. Trestles will be built over the St. Paul tracks at Grafton and in the town of Mequon, and tunnels under the Northwestern will be built at Port Washington and in the city of Milwaukee.

The power equipment, furnished by the Allis-Chalmers Company, of Milwaukee, will be of standard Allis-Chalmers design, both for gas engines and alternators. The electrical features of the equipment may be briefly described as follows: Three-phase alternating current will be generated in the power house, at 405 volts and 3000 alternations, by the three direct-connected alternators, each of 1000 kw normal capacity, driven at 107 r. p. m. by twin tandem gas engines. The power house is designed for a future installation of an additional 1000-kw unit to complete the plant. The current generated will be delivered to a six-panel switchboard having three generator panels, one exciter panel and two transformer panels.

From the switchboard the current will be carried to the step-up transformers and also to the rotary transformer switchboard. There will be seven oil-filled water-cooled step-up transformers of 500 kw each, arranged in two banks of three each, with one transformer as a reserve. These transformers will raise the voltage from 405 to a maximum of 22,000, with intermediate taps to allow the voltage to be varied if desired. The current will be carried from each bank of transformers to the high-tension bus through three oil switches, of 40 amps. capacity each, in each circuit, and in addition to plug switches at each transformer to allow for speedily cutting out any transformer in case of breakdown. From the high-tension bus three transmission lines will be led away, each with automatic oil circuit breakers of 40 amps. capacity in circuit. The station apparatus will be protected from lightning by means of an equipment of low equivalent lightning arresters and oil-immersed choke coils connected to the high-tension bus.

There will also be installed in the main power house two compound-wound rotary converters of 300 kw normal capacity, at 650 volts direct current, connected to a six-panel switchboard, having two alternating-current rotary panels, two direct-current rotary panels and two direct-current feeder panels with two feeder circuits, which will contain all the necessary switches, circuit breakers, instruments, etc., for handling and regulating the current and apparatus.

Of the eight sub-stations, two will have two 400-kw each, compound wound, 650-volt rotary converters and six 125-kw, 22,000/405-volt step-down oil-filled, self-cooled transformers. The remaining six sub-stations will each have two 300-kw compound wound, 650-volt rotary converters and six 100-kw, 22,000/405 step-down oil-filled, self-cooled transformers.

Each sub-station will be protected against lightning by means of three 22,000-volt, low-equivalent lightning arresters and three 22,000-volt oil immersed choke coils, and will have an eight-panel switchboard, having two alternating-current rotary panels, two alternating-current starting panels, two direct-current rotary panels and two feeder panels, except in the Cedarburg sub-station, where there wil be three feeder panels.

All sub-stations will have 22,000-volt, 20-amp. automatic oil circuit breakers on outgoing transmission lines, and on the transformer circuits, except at Cedarburg, which will have 40-amp. breakers on outgoing transmission lines. The Cedarburg substation will also have 22,000-volt, 40-amp. oil switches on the incoming transmission lines and three 22,000-volt, 20-amp. automatic oil circuit breakers on the high-tension equalizing bus. The low-tension cables are to be triple braided, weatherproof wire, supported on insulators, the insulated covering being relied upon only for protection from accidental contact and as a spacer. All high-tension wires will be bare, mounted on proper insulators.

EXPLOSION IN PHILADELPHIA SUBWAY

Eight men were killed and nearly two-score of persons were injured Oct. 5 by the explosion of illuminating gas in the Market Street subway at Sixth Street. The street caved in, halting traffic, but damage to neighboring buildings was confined to broken windows. That section of the subway in which the accident happened is being built by the Millard Construction Company for the Philadelphia Rapid Transit Company. The exact cause of the explosion has not yet been determined. On Oct. 4 workmen in the excavation discerned the odor of gas, and the United Gas Improvement Company, whose conduits run through the tunnel, was notified. A man was sent by the company Oct. 5 to find the leak and repair it, and it was while he was making his investigation at 6:35 o'clock that the explosion occurred.

EXTENSIONS IN A SUPPLY BUSINESS

The Watts & Uthoff Supply Company, of St. Louis, has recently enlarged its quarters, having leased the entire double three-story building and basement at 310 and 312 Market Street, which will make more prompt shipments possible. The company reports a very large increase in business during the present year, showing a net gain of over 50 per cent for the corresponding months in the years of 1906 and 1905. This concern started in business in 1902, but has progressed rapidly and now claims to be the largest exclusive electric railway supply house west of the Mississippi River. It has just arranged to open branch offices in Kansas City, Denver and Dallas, and expects to carry stock in each city as soon as proper arrangements can be effected.

This company is the general western agent for the Ohio Brass Company, handling that company's well known line of overhead material, rail-bonds, etc., and in addition makes a specialty of all kinds of car-equipment material, so that it is in a position to furnish everything, as the managers aptly say, "from trolley to track."

THE NEW WORKS OF THE D. & W. FUSE COMPANY

The D. & W. Fuse Company, of Providence, R. I., has recently become re-established in a new factory on Hathaway Street in that city, off Elmwood Avenue. This well known electric specialty concern was organized in 1897 to manufacture enclosed fuses for electric lighting and power service. At that time the enclosed fuse was unknown as a commercial article, either in this country or abroad, and the total floor space occupied by the company in its first shop was but 320 sq. ft. Two men were sufficient for the work at the beginning. The new plant has a total floor area of 80,000 sq. ft. and employs about 300 men. Besides enclosed fuses and cut-outs, the company manufactures the new product known as Deltabeston wire, which has come to the front within the past year in connection with railway motors and other work, where specially treated asbestos-insulated wire has been successfully applied.

The new property has a land frontage of about 1080 ft. on the shore line tracks of the New York, New Haven & Hartford Railroad, the average width of the lot being 350 ft. The total area of the premises is 7.8 acres. There are four principal factory buildings, including the office. The two main shops are built parallel to the railroad, and a special side track facilitates shipment by rail to or from the plant. All the shop buildings are two-storied, with basement, and brick walls with heavy mill construction was used throughout. The builders were Messrs. Hartwell, Williams & Kingston, of Providence.

The main factory building is 284 ft. long by 50 ft. wide, and it is divided into three sections by means of hollow fire walls running from the basement to the roof. It is devoted to the manufacture of fuses, cut-outs and fuse boxes. The second large shop is 203 ft. long by 47 ft. wide and is devoted to the manufacture of wire insulation. The boiler house, engine room, brass foundry and enamel shop occupy a separate building 98 ft. x 50 ft. in dimensions at the north end of the plant, power being electrically transmitted to the shops. The main line shafting in each department is driven by a separate motor, so that any portion or the entire factory can be operated and controlled from the engine room. The enamel shop is 40 ft. x 58 ft., the engine room 40 ft. x 25 ft., and the boiler room 40 ft. x 25 ft.

The boiler room contains two 100-hp Babcock & Wilcox water-tube boilers, each having fifty-four 4-in. tubes 16 ft. long. The working steam pressure is 135 lbs., and the boiler-feed is handled either by a Deane single-cylinder feed-pump or a Gorting injector. Coal is dumped from the railroad into an area just outside the boiler room, whence it is wheeled to the furnaces in hand barrows. All fuel is weighed before being fired. In the engine room are two generators. One is a 20-kw Crocker-Wheeler 110-volt direct-current machine direct-connected to a Westinghouse vertical compound engine, which also drives by belting a 50-kw 500-volt power d. c. generator of the Crocker-Wheeler make. The 20-kw machine's speed is 300 r. p. m., while the belted unit makes 1000 r. p. m. The engine size is 10 ins. x 18 ins. x 10 ins. The switchboard in the engine room is provided with a double-throw lighting switch so that the current of the Narragansett Electric Light Company can be utilized in case of a breakdown. A brick stack surmounts the power house, and the power and steam supply for the factory is carried in pipe tunnels from point to point.

The fire protection is particularly well organized in the new plant. A hand hose wagon is kept in a small house on the premises ready for instant service; city water is available at yard hydrants, and there is also a special city fire alarm box on the premises. A 20-000-gallon sprinkler tank is installed in the yard on a tower which brings the bottom of the tank 50 ft. above the yard and 17 ft. above the highest sprinkler head of the interior fire protection system. All the lighting of the factory is electric.

The motors are all 500-volt d. c. Crocker-Wheeler machines, and there are two Rhode Island Elevator & Machine Company electric elevators in each mill. About a dozen motors are in service, the largest size being 25-hp. All the tools are group driven. The company also operates an electro-plating plant, equipped by Hanson & Van Winkle, of New York. The principal electro-plating generator has a capacity of 4 kw, giving from 666 amps. at 6 volts to 333 amps. at 12 volts.

The offices of the company are installed in a commodious building 50 ft. x 40 ft. at the south end of the plant. The first floor contains the main office and a handsomely appointed directors' room. On the second floor are private offices, a drafting room and a laboratory for experimental work, where both electrical and chemical tests can be made. The laboratory is equipped with a large variety of chemical reagents, alternating and direct current, special thermometers, regulating rheostats and transformers. Instrumental tests are made regularly upon the different lines of fuses, and the data secured enables exceedingly accurate prediction to be made as to the behavior of the product in regular and emergency service. The company has made fuses of 4 amps. capacity for 20,000-volt circuits, and of 800 amps capacity for 250-volt lines. The smallest fuse thus far turned out regularly is for 0.1 amp. The company makes no open fuses whatever. Deltabeston wire is now being used for armature coils and arc light magnets, besides its older feed-coil service. The D. & W. fuse is rated at the load the fuse will carry continuously and will blow at about 15 per cent excess of its rating.

EXTENSION TO JOINT WORKS

The enlargement of the steam rolling mill of The Rail Joint Company, at the city of Troy, N. Y., known as the Albany Iron & Steel Works, has been completed. The rolling mill building is 400 ft. long, independent of the machine shops and other buildings. The electric conveying crane, which has a run over 600 ft. in length, carries steel billets from the yard and constantly feeds the furnaces so as to supply two 21-in. trains that are in operation day and night rolling rail joints for T and girder rail sections. The Troy mill has a capacity to roll over 125 different sections of rail joints, and there are over 350 men employed in its operation. A railroad siding or switch, of the New York Central & Hudson River Railroad Company now runs around the property, bringing raw material, coal, and steel billets into the yard, and taking out the finished products.

While The Rail Joint Company owns the works at Troy, N. Y., it has nine other distributing points where its patented machinery and devices are used to produce the rail joints under contract with other mills for the convenience of their customers, thus the company makes deliveries from Buffalo and New York City, N. Y.; Newark, N. J.; New Castle, Del.; Steelton and Pittsburg, Pa.; Chicago and Joliet, Ill., and Milwaukee, Wis. The company maintains fourteen branch selling agencies.

THE NEW FACTORY OF THE MACALLEN COMPANY

One of the best examples of recent factory construction in Boston may be seen in the plant of the Macallen Company, located at Division and Foundry Streets, South Boston. The old establishment of this house was located on Congress Street on the east side of Fort Point Channel, and the growth of the company's business recently demanded a move to more commodious quarters. The company is the manufacturer of a great variety of insulating material, including railway line equipment, gas fittings, arc lamp insulators, joints for air-brake apparatus, fixture joints, canopy insulators, steam insulators, etc.

The new factory is of mill construction with brick walls and concrete foundations, six full stories in height. It is 188 ft, 10 ins. long by 158 ft. 10 ins. wide, and occupies about one-third of the land owned by the company at the new site. About 300 men are employed, and each of the six floors has 16,000 sq. ft. area, exclusive of toilet rooms, columns and elevator wells. The ground area occupied is 17,400 sq. ft. Very little steel work was used in the construction of the building, with the exception of some special work in the boiler-house roof and blacksmith shop. The company operates a complete modern brass foundry in the new factory, and its forge shop is fitted with "American" gas annealing furnaces.

A large number of new and more powerful tools were added to the installation in the new factory, including two toggle presses, a 750-ton folding press, a new 300-hp engine, new boilers and a 48-in. swing lathe; also a 1000-ton accumulator for heavy press work. Every room in the factory has an admirable supply of natural light from either the north or south sides. The machinery is all driven by belt and line shafting, operated by a 300-hp, 20-in. by 42-in., horizontal single-cylinder, Harris-Corliss four-valve engine, which is supplied with steam by a battery of two 200-hp Robb-Mumford horizontal return tubular boilers, operating at 90 lbs. steam pressure. Coal is hauled to the plant by wagons and dumped directly into the boiler room after being weighed on a set of platform scales just outside the building. The factory has no basement. There are two Deane feed-pumps, of the horizontal duplex type, with 6-in. x 6-in. x 6-in. cylinders.

Ample testing facilities are provided for the inspection of the various products and electrical tests of insulation are made by means of a 110/220-volt, ½-hp belted alternator, which is wired to a transformer located beneath the testing table. Solid mica insulating joints are tested to 4000 volts, and railway line material to 5000 volts. The tests are easily made by an operator who swings an insulated handle on a spindle carrying one terminal of the circuit radially over the product, which is packed immediately after passing the insulation test. A high-potential testing set capable of giving 50,000 volts will soon be installed. The new factory has at least double the production power of the old one, and the possibility of extension to three times the present area, insures room for the future business of the company for some time to come. The architect was M. D. Safford, of Boston, and the builder, C. A. Dodge & Company, Boston. The officers are: President, Thomas Allen; treasurer, Louis McCarthy; secretary, Gardner W. Prouty.

PERSONAL MENTION

DR. CARL GOLDSCHMIDT, of the Goldschmidt Thermit Company, Essen, Germany, is on a short visit to this country.

MR. FRANK COOLEY has been appointed superintendent of employment and inspection of the various companies comprising the Brooklyn Rapid Transit system.

PROF. H. E. CLIFFORD, of the Massachusetts Institute of Technology, who has temporarily been directing the affairs of the electrical engineering department, will now be relieved from this executive work, through the recent appointment of Prof. Jackson to the electrical engineering department, and is planning to devote considerable time to consulting engineering.

MR. H. A. DUNCAN, electrical engineer in charge of the electric lighting department for the Interborough Rapid Transit Company, has resigned to go with the Citizen's Railway & Light Company, of Ft. Worth, Tex. This company has recently been formed by the consolidation of several railway and lighting properties by a syndicate headed by Mr. Warren Bicknell, of Cleveland.

MR. EDWIN M. HAMLIN has resigned from the Lord Electric Company, of Boston, which on Nov. 1 will establish headquarters in New York. Mr. Hamlin is cognizant of the special advantages of this change in location by the company, but in spite of his appreciation of New York as a center of industry and opportunity, business interests of his in Boston demand that he reside in the latter city for the present at least.

MR. C. W. RICKER, formerly engineer of power houses, substations and electrical distribution for the Interborough Rapid Transit Company, of New York, has become associated with the Cleveland Construction Company, of Cleveland, as electrical engineer, in charge of the electrical end of the work on several lines which this company is now building in the Central West. Mr. Ricker will have his headquarters in the Schofield Building, Cleveland, Ohio.

MR. J. H. KINNEY, who recently retired as general manager of the Steubenville Traction & Light Company, Steubenville, Ohio, was tendered a dinner at Stanton Park by his former associates recently, at which he was presented with a fine diamond stick-pin as a token of their esteem. Mr. Kinney goes to Salt Lake City to become superintendent of the Utah Gas, Light & Coke Company, a position under General Manager J. C. Ross, who was formerly general manager of the Steubenville Company.

MR. C. N. DUFFY, for several years auditor of the Chicago City Railway Company, has been made comptroller of the Milwaukee Electric Railway & Light Company. Since the retirement of Mr. Mackay and the death of Mr. Wheatcroft the duties of treasurer and auditor have been performed by Mr. Frank Boehm, former bookkeeper, and now assistant secretary and treasurer, and by Mr. George M. Kalweit, as acting comptroller and auditor. The position of comptroller has now been separated from the other departments and that place will be filled by Mr. Duffy.

MR. FRANK H. BOWEN, division superintendent of the Public Service Corporation, of Elizabeth, N. J., has accepted a position as division superintendent of the Pawtucket Street Railway system of the Rhode Island Company. Mr. Bowen fills the position made vacant by the resignation of Mr. Raymond R. Smith, who went to Evansville, Ind., last July. Mr. Bowen was born in Pawtucket, and was educated in the public schools of that city. He started in the railroad business in Worcester, Mass., fifteen years ago last February, as a conductor. He was promoted to the car house, where he was in charge, later going to Elizabeth, N. J., as an inspector and working his way up until he became division superintendent.

MR. C. F. BAKER has been engaged by Mr. L. B. Stillwell as superintendent of power and construction in connection with the engineering and operating contract which Mr. Stillwell has recently executed with the United Railways & Electric Company, of Baltimore. Mr. Baker is well known to the engineering fraternity and the railroad world. He has filled the office of President of the American Railway Mechanical and Electrical Association; and has taken a prominent part in the councils of that body, of the New England Railroad Club, and of the New England Street Railway Club. For many years Mr. Baker was with the West End Street Railway Company, of Boston, and the Boston Elevated Railway Company, in charge of the construction and operation of their power plants and rolling stock. He is regarded as one of the ablest and most experienced, practical men in this line of work.

Plate I

PART OF THE MAIN BUILDINGS AT THE FAIR GROUNDS, COLUMBUS

THE SKYLINE ALONG HIGH STREET, COLUMBUS, LOOKING FROM THE CAPITOL

CORNER HIGH AND GAY STREETS, COLUMBUS

VIEW OF COLUMBUS, LOOKING EAST FROM BROAD AND HIGH STREETS, SHOWING RESIDENTIAL AND INDUSTRIAL SECTIONS

LOOKING NORTH ON HIGH STREET, COLUMBUS, SHOWING SHOPPING DISTRICT

VIEW AT CORNER OF HIGH AND BROAD STREETS, COLUMBUS

THE INTERURBAN UNION STATION IN COLUMBUS AT NIGHT

INTERURBAN UNION STATION ON WEST GAY STREET, COLUMBUS

THE NEW CARNEGIE LIBRARY, EAST BROAD STREET, COLUMBUS

COLUMBUS POSTOFFICE

COLUMBUS COUNTRY CLUB

THE COURT HOUSE, COLUMBUS

HARRISON BUILDING, COLUMBUS, ONE OF THE CITY'S SKYSCRAPERS

INSTITUTION FOR THE FEEBLE MINDED, COLUMBUS

BROAD STREET, COLUMBUS, LOOKING EAST—BROAD STREET PRESENTS A 7-MILE STRETCH OF ASPHALTED BOULEVARD

ENTRANCE TO UNION STATION, COLUMBUS

FRANKLIN COUNTY MEMORIAL HALL, COLUMBUS

THE EMPIRE, ONE OF THE ATTRACTIVE COLUMBUS THEATERS

COLUMBUS CITY CLUB

BIRD'S-EYE VIEW OF THE STATE CAPITOL AT COLUMBUS

ADMINISTRATION BUILDING, OHIO STATE UNIVERSITY, AT COLUMBUS

THE "ARMORY" OR GYMNASIUM, OHIO STATE UNIVERSITY

SCIOTO RIVER AND BIRD'S-EYE VIEW OF COLUMBUS, LOOKI NG SOUTH, WIRELESS TELEGRAPH STATION SHOWN AT LEFT

COLUMBUS SAVINGS & TRUST BUILDING

OFFICES OF THE COLUMBUS RAILWAY & LIGHT COMPANY ON HIGH STREET